AI SMART GLASSES RESEARCH

How a Tiny Chip Could Power Up Smart Glasses Like Meta Ray-Bans Next Year

Meta's Ray-Bans arrived in 2023. The chips that power their successors, and other future smart glasses, are on their way. Scott Stein/CNET© Provided by CNET

I've been wearing Meta Ray-Ban smart glasses a lot over the past year. I use them to easily record POV video of my experiences at theme parks like Epic Universe, using tech like the Nintendo Switch 2 and everywhere else. They're great, but the battery runs out fast, and the cameras could be better.

That might be changing soon. Qualcomm just announced its newest chip for smart glasses, which will roll out in products starting next year. It promises more power efficiency, support for better cameras and even AI that'll work offline on glasses without a cloud connection.

The new AR1 Plus Gen 1 chip is an upgrade from chips on smaller smart glasses like Meta Ray-Bans. It's not meant for higher-end AR glasses that project 3D images, but it could very well show up on the types of display-enabled glasses that Google recently showed off at its developer conference and on Meta's next generation of Ray-Bans.

I spoke to Qualcomm's head of XR, Ziad Asghar, about the news and what it'll mean for glasses you could be buying soon.

A smaller chip allows a bigger battery

The Meta Ray-Bans I wear these days already look like real glasses, just slightly chunky ones. Asghar emphasizes that the new chip is 20% smaller. That's going to help future smart glasses look even more like regular glasses, with thinner frames, for example.

"If I've got to make it fit on the side of the glass," Asghar told me about the chip, "I need to get that dimension really small."

A tinier chip also leaves more room to pack in battery capacity. The power efficiency of the new chip will actually be around 5% better despite its smaller size. That doesn't sound like much, but Asghar also sees a future shift to more off-glasses processing on phones that will also help battery life. At the moment, devices like Meta Ray-Bans use cloud processing for AI.

Room for more AI, even offline

"What's truly different now is AI," Asghar says about the current state of smart glasses. "I keep saying this, but I truly believe it, that it's going to help XR use cases probably more than any other space."

One of the new tricks Qualcomm's new chip can do is on-device AI running small language models, letting it do more offline things with voice commands. Qualcomm's showing off some of these demos at the Augmented World Expo conference in Long Beach, California, I'm attending, so I'll share thoughts on how it works soon.

Meta Ray-Bans can use voice commands to take photos and while offline, but the bag of voice tricks for future glasses could be even more expanded. Think fitness, music playback and more.

"This device has a character as a standalone device as well. This is not just always linked or tethered to another device or tethered to the cloud. And I think that will open up quite a lot of scenarios," says Asghar.

Better cameras for low light, motion

Meta Ray-Bans take better photos and videos than you might expect, but the video quality is wide-angle and still sometimes jittery when I'm moving. Asghar says the new chips will improve camera and image stabilization.

"Let's say you're sitting in a restaurant at night, in dim light, and I have a menu in front of me that I want to translate. That's what we're working on, how to improve the low-light capability." Asghar also says camera stabilization will be better for videos and photos.

I ask about whether zoom features could come to glasses like these, which would likely require in-glasses displays, something these chips support. Asghar points to digital cropping as an option, and even possibly eye-tracking-based zoom control in the future.

Playing better with wearable rings, external pucks

Smart glasses are headed toward a deeper relationship with our phones and other wearables, and Qualcomm's already a player in all those spaces: it's also one of the key partners with Google's Android XR. Asghar sees watches as being a part of a wearable halo of gear that'll all work with glasses soon enough, but he sees even more potential in smaller wearables like rings today.

"You could essentially use a ring, and you could use it very discreetly," he says. Your hand could be down, and nobody knows," Asghar says. Qualcomm's demos at AWE show off a Bluetooth smart ring for gesture controls with glasses, hinting at decisions that could be coming soon from other partners.

Upcoming glasses could use their own processing pucks. Xreal is adopting a puck for its first experimental Android XR device, Project Aura, and Meta's already demo done for its concept Orion glasses. Part of the appeal of that puck is that it could allow glasses to more easily work around the limits of phones and their OSes (basically, Android and iOS) right now.

"The great thing about glasses is it gives our cloud players the path to be able to bring their AI and LLMs and agents to consumers," Asghar says. "Not every cloud player has smartphone assets."

Pucks could be a sign that while Android XR has now been announced as a future bridge to AR and VR devices, Google's still going to need some time to figure out how the phone-to-glasses link actually works. Apple, meanwhile, hasn't enabled any integrated smart glasses support for iOS at all, at least beyond individual apps like Meta's that are walled off from Siri and deeper phone access.

Battery life remains an issue

I can't get through more than half a day of Ray-Bans use at best before I need a recharge. Asghar admits that glasses have a battery life problem at the moment but says some solutions could pop up. This new chip may not boost battery life that much, but more on-phone processing or connected pucks might help.

"Today, the battery mostly resides on just one side. And we know that people are looking at basically doubling up the battery, having a dual-cell battery on both of the glasses legs to increase the capacity," he says. "Or maybe they can come up with an interesting design that allows a replaceable battery."

What about things that aren't even glasses?

AI leader OpenAI bought Jony Ive's hardware company, which is working on some sort of AI device that might be pendant-based instead of sitting on your face, or could sit on a desk. It's entirely possible that more camera-based AI wearables like the failed Humane AI Pin will be coming too. Asghar acknowledges that Qualcomm's processors could end up in devices other than glasses.

"This is the great part, right?" he told me. "People are gonna really experiment with form factors. You don't get this opportunity very often. The smartphone is pretty settled. This [XR] space is not settled. An AI agent device can be smart glasses. It can also be something on your body."

But Asghar knows whatever comes has to raise the bar better than AI device failures of the past. "There have been pretty significant failures. People do have very high expectations from products like this. They need to run, and they need to run very well." And hopefully last longer than a few hours on a charge.

Apple's 2027 smart glasses might copy what Meta already offers now

Ray-Ban | Meta Smart Glasses

Alongside rumors about a more affordable MacBook, analyst Ming-Chi Kuo is sharing more details about Apple's upcoming smart glasses. This wearable has been rumored for a few years now, and it seems the company is aiming to release it in 2027.

Since true AR glasses have long been a focus for Apple and Tim Cook, Kuo's latest report might disappoint users hoping for a more futuristic take on wearables.

According to the analyst, Apple won't include any display functionality in the glasses. That means users won't be able to view real-time information through the device. Some of the more futuristic ideas, like reading a notification by glancing at an inner screen, getting directions, or interacting with digital elements in the real world, won't be part of this product.

With that in mind, Apple's 2027 smart glasses might look a lot like what Meta already offers with Ray-Ban and, soon, with Oakley. The analyst highlights some of the top features expected in these glasses:

- **Audio Playback:** Apple Glasses users will be able to listen to their favorite tunes on Apple Music and other streaming services directly from the glasses.
- **Photo and video recording:** Users will be able to take photos, record videos, and more. For now, the specs of the cameras remain unclear.
- **AI environmental sensing:** While Kuo doesn't provide many details about this feature, Apple may be aiming to enhance Apple Intelligence capabilities by 2027. These AR glasses could become a useful AI companion with visual intelligence and other advanced functions.

In addition, Ming-Chi Kuo says Apple is actively testing "multiple material options for frames and temples" using "3D printing technology for production."

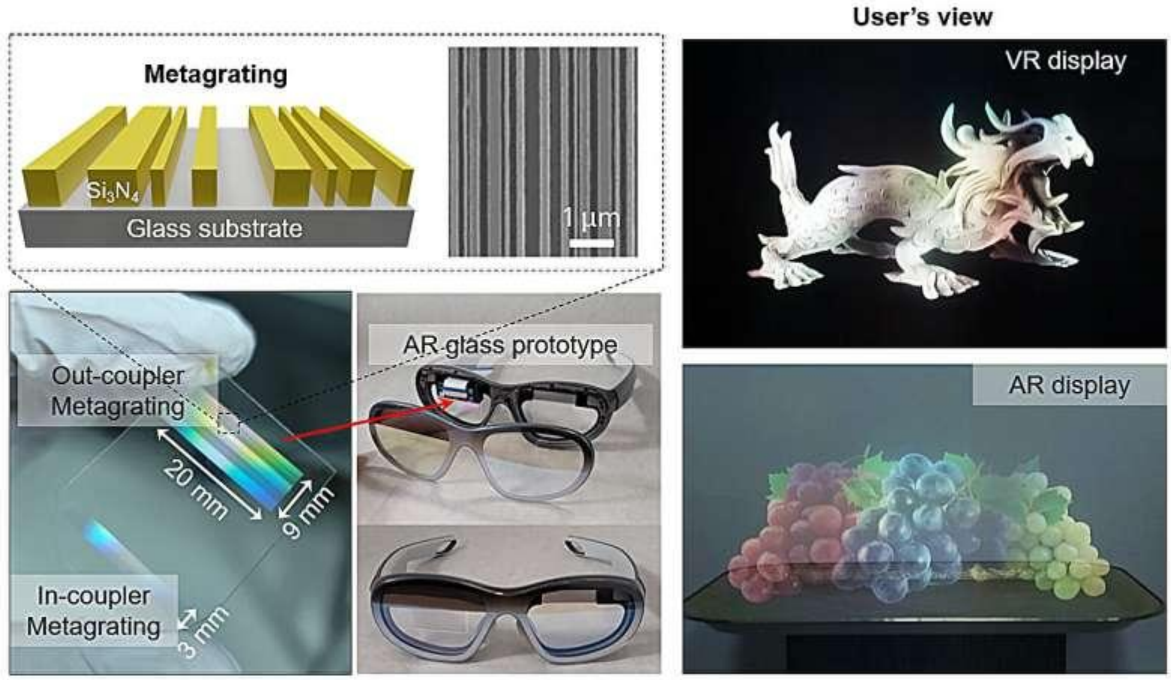
While Apple's long-awaited smart glasses are expected to make an impact, current rumors suggest the company isn't going much beyond what competitors already offer. By 2027, Meta could introduce more advanced smart glasses while Apple might still be catching up with today's tech.

It also seems the company has been falling behind competitors over the past few years. With underwhelming Apple Intelligence capabilities and low sales for the Apple Vision Pro, Apple could lose momentum if its AR glasses don't significantly improve on what's already out there.

MAY 8, 2025

One glass, full color: Sub-millimeter waveguide shrinks augmented-reality glasses

by Pohang University of Science and Technology



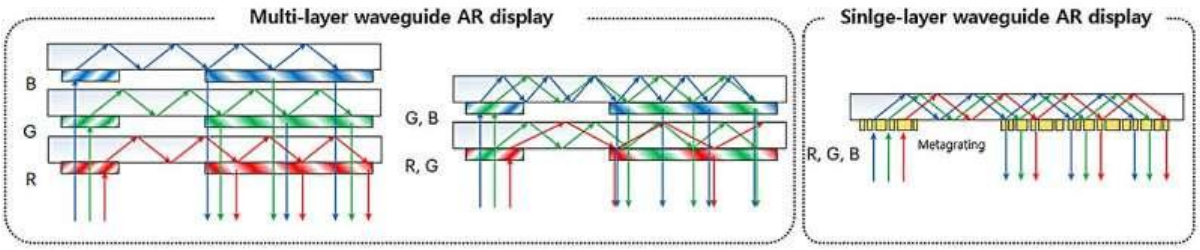
AR Glass Prototype and Experimental Results Based on Metagrating. Credit: POSTECH

Augmented-reality (AR) technology is rapidly finding its way into everyday life, from education and health care to gaming and entertainment. However, the core AR device remains bulky and heavy, making prolonged wear uncomfortable. A breakthrough from POSTECH now promises to change that.

The study is published in the journal *Nature Nanotechnology*.

One of the main hurdles to the commercialization of AR glasses has been the waveguide. In AR optics, the lens itself also serves as a "highway of light," guiding virtual images directly to the user's eye. Due to chromatic dispersion, conventional designs have required separate waveguide layers for red, green, and blue light—three to six stacked glass sheets—inevitably increasing both weight and thickness.

Professor Junsuk Rho and colleagues at POSTECH have eliminated the need for multiple layers by developing an achromatic metagrating that handles all colors in a single glass layer. The key is an array of nanoscale silicon-nitride (Si_3N_4) pillars whose geometry was finely tuned by a stochastic topology-optimization algorithm to steer light with maximum efficiency.



Architecture of AR waveguide display. Credit: POSTECH

In experiments, the researchers produced vivid full-color images using a 500-µm-thick single-layer waveguide—about one-hundredth the diameter of a human hair. They also secured a comfortable 9-mm eyebox, ensuring images remain sharp even if the viewer's eye shifts slightly.

The new design erases color blur while outperforming multilayer optics in brightness and color uniformity. Once commercialized, this technology could make AR glasses as thin and light as ordinary eyewear, reducing wearer fatigue and trimming manufacturing costs thanks to a simpler process. The era of truly everyday AR is a step closer.

"This work marks a key milestone for next-generation AR displays," said Prof. Rho. "Coupled with scalable, large-area fabrication, it brings commercialization within reach."

The study, authored by Junsuk Rho (corresponding author, POSTECH), Seokwoo Kim, Joohoon Kim, and Seokil Moon, was carried out by POSTECH's Departments of Mechanical, Chemical and Electrical Engineering and the Graduate School of Interdisciplinary Bioscience & Bioengineering, in collaboration with the Visual Team at Samsung Research.

More information: Seokil Moon et al, Single-layer waveguide displays using achromatic metagratings for full-colour augmented reality, *Nature Nanotechnology* (2025). DOI: 10.1038/s41565-025-01887-3

Journal information: Nature Nanotechnology

Provided by Pohang University of Science and Technology

'Super-vision' contact lenses let wearers see in the dark — even with their eyes closed

published May 22, 2025

Researchers have developed new contact lenses that enable vision in the near-infrared range, and they could restore color perception to people with color blindness.

A study participant places one of the night vision lenses in their eye. (Image credit: Yuqian Ma, Yunuo Chen, Hang Zhao)

Scientists have created night-vision contact lenses that they claim can grant people "super-vision."

The lenses — which use nanoparticles to absorb low-frequency light before emitting it in the visible spectrum — enable wearers to see infrared wavelengths that are otherwise invisible to the human eye.

And unlike traditional night-vision goggles, these lenses don't require a power source. The researchers described the new lenses May 22 in the journal Cell Press.

"Our research opens up the potential for non-invasive wearable devices to give people super-vision," senior author Tian Xue, a neuroscientist at the University of Science and Technology of China, said in a statement. "There are many potential applications right away for this material. For example, flickering infrared light could be used to transmit information in security, rescue, encryption or anti-counterfeiting settings."
First used in night combat during World War II, traditional night-vision goggles use an electronic image-intensifier tube to turn visible light or near-infrared photons into

electrons. These electrons are then channeled onto a luminescent screen, causing it to glow green.

But these goggles typically need an energy source, which makes them bulky. Infrared goggles are also unable to precisely distinguish light across the infrared range, especially those at longer wavelengths.

To create the new lenses, the scientists embedded nanoparticles inside flexible, nontoxic polymers typically used in soft contact lenses. The nanoparticles — which consist of sodium gadolinium fluoride embedded with luminescent ytterbium, erbium and gold — absorb near-infrared photons in the 800- to 1,600-nanometer wavelength range before emitting them as visible light, wavelengths from around 380 to 750 nanometers

The researchers first tested their new lenses in mice. Mice sporting the new lenses favored dark boxes over those illuminated by infrared light, while those without the lenses showed no preference. (Mice are crepuscular animals that usually stick to dark environments to evade predators.) Additionally, the pupils of lens-wearing mice constricted in the presence of infrared light sources, with brain scans showing that their visual processing centers were firing.

Next, the team tried the lenses in humans. The people could perceive flickering infrared light and pick up on its direction. This infrared vision was enhanced when the participants closed their eyes, the researchers said.

"It's totally clear cut: without the contact lenses, the subject cannot see anything, but when they put them on, they can clearly see the flickering of the infrared light," Xue said. "We also found that when the subject closes their eyes, they're even better able to receive this flickering information, because near-infrared light penetrates the eyelid more effectively than visible light, so there is less interference from visible light."

The scientists replaced the nanoparticles embedded in the lenses with modified versions that mapped specific parts of the near-infrared spectrum to blue, green and red. The researchers suggested that this tweak could be used to aid people with color blindness.

"By converting red visible light into something like green visible light, this technology could make the invisible visible for color blind people," Xue said.

Despite these promising advances, more work is needed before the lenses see the light of day. Currently, they only pick up light projected from LED sources, which are incredibly bright, so the scientists will need to boost the lenses' sensitivity to pick up light of lower intensities.

The lenses' proximity to the retinas also may prevent them from detecting finer details, so the researchers have developed a wearable glass system for viewing objects at higher resolutions.

'Night vision lenses' could give you power to see in the dark using simple eye glasses published June 28, 2025

Super-slim night-vision tech could be within reach thanks to a new material breakthrough that can capture infrared and visible light at the same time.

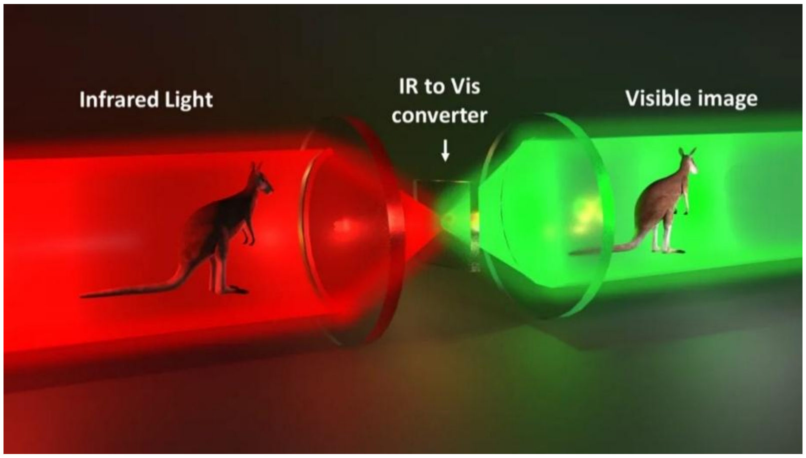
This breakthrough has opened the path to smaller, slimmer and more efficient night-vision systems for a variety of applications including the advent of night-vision filters that could be worn over eyeglasses to help people see at night. (Image credit: Pixsooz via Getty Images)

One day we could have everyday eyewear with night vision, thanks to an ultra-thin material that can capture infrared and visible light at the same time.

In a new study published May 23 in Advanced Materials, researchers in Australia have found that by using "metasurface-based up-conversion technology", you can create a night vision effect without the need for bulky light-processing and cryogenic cooling components.

"These results promise significant opportunities for the surveillance, autonomous navigation, and biological imaging industries, amongst others," chief investigator Dragomir Neshev from the Australian Research Council's Centre of Excellence for Transformative Meta-Optical Systems (TMOS) said in a statement. "Decreasing the size, weight and power requirements of night vision technology is an example of how meta-optics, and the work TMOS is doing, is crucial to Industry 4.0 and the future extreme miniaturisation of technology."

Traditional night-vision goggles work by visible light or infrared photons passing through a lens into an electronic image-intensifier tube consisting of a photocathode and a microchannel plate. The photocathode turns the photons into electrons, and these electrons then hit the microchannel plate, which has millions of holes that amplify their number. The electrons then interact with a phosphor-coated screen and exhibit a green glow, illuminating the scene that the wearer is viewing.



As the infrared photons only pass through a single resonant metasurface and are then mixed with a pump beam — a source of light used to amplify energy levels — night vision can be provided without the need to convert photons to electrons. (Image credit: Laura Valencia Molina, Australian National University)

The researchers explained that this current setup poses challenges due to its large size for a head-mounted device, thermal noise and the inability to augment infrared and visible imaging.

However, by using an "ultra-compact, high-quality-factor lithium niobate resonant metasurface" — a very thin photonic device that can modulate the behavior of electromagnetic waves — the researchers boosted the energy of the infrared photons, increasing their frequency so as to bring their wavelengths within the visual spectrum.

Let there be visible light

As the infrared photons only pass through a single resonant metasurface and are then mixed with a pump beam — a source of light used to amplify energy levels — night vision can be provided without the need to convert photons to electrons. This then bypasses the need for multiple heavy optical and cooling components to reduce thermal noise; the up-conversion from IR to visible light via the metasurface takes place at room temperature. Furthermore, this up-conversion can capture both visible and nonvisible light in one image, which standard night-vision systems cannot as they must display images from each spectrum side-by-side. This leads to non-identical images. As such, the researchers found their approach offers direct imaging and edge detection via infrared simultaneously in a single view, enhancing the overall quality of a night-vision image.

This breakthrough has opened the path to smaller, slimmer and more efficient night-vision systems for a variety of applications, the scientists said. We could even see the advent of night-vision glasses or filters that could be worn over eyeglasses to help people see at night. Uses could range from helping keep track of a dog during an evening walk to making driving at night safer.

Meta just stuck its AI somewhere you didn't expect it — a pair of Ray-Ban smart glasses

published May 11, 2024

Ray-Ban smart glasses will now use Meta AI virtual assistant software so that wearers can speak with their smart glasses and ask questions about what they're looking at.

Multimodal AI could super charge smart glasses. (Image credit: Meta / Ray-Ban)

Smart glasses have arguably failed to take off, but the addition of artificial intelligence (AI) could be the key to developing a truly transformational wearable technology.
In the US and Canada, Ray-Ban Meta smart glasses have received a rollout of multimodal AI technology with software called the "Meta AI virtual assistant." With multimodal AI — which means generative AI that can process queries that involve more than one medium (for example, both audio and imagery) — the device can better respond to queries based on what a wearer is looking at.

"Say you're traveling and trying to read a menu in French. Your smart glasses can use their built-in camera and Meta AI to translate the text for you, giving you the info you need without having to pull out your phone or stare at a screen," Meta representatives explained April 23 in a statement.

The device first takes a photo of what a wearer is looking at, then the AI taps into cloud-based processing to serve up an answer to a query, delivered by speech, such as "what type of plant am I looking at?"

(Image credit: Meta / Ray-Ban)

Meta first explored integrating multimodal AI into the Ray-Ban Meta smart glasses in a limited release in December 2023.
Testing the AI functionality in this device, a reporter from The Verge found that it mostly responded correctly when asked to identify the model of a car. It could also describe a type of cat, for example, and its features in an image snapped via the camera. But the AI ran into trouble in accurately identifying the species of plants belonging to one reporter and struggled to correctly identify a groundhog in their neighbor's backyard.

(Image credit: Meta / Ray-Ban)

Multimodal machinations

AI-powered virtual assistants are nothing new, with the likes of the Google Assistant, Amazon Alexa and Apple's Siri all providing smart answers to queries in natural language. But the crux of the Meta AI in the Ray-Ban smart glasses is its multimodal functionality.

The ability to fuse and process data from multiple sensor modules — for example, cameras and microphones — means a multimodal AI can generate more accurate and sophisticated outcomes versus unimodal AI systems. Google's Gemini multimodal AI model , for example,can process a photo of some cookies and respond with the recipe.
Trained on identifying patterns in different types of data inputs through multiple neutral networks — collections of machine learning algorithms arranged to mimic the human brain — multimodal AIs can process input data from text, images, audio and more.

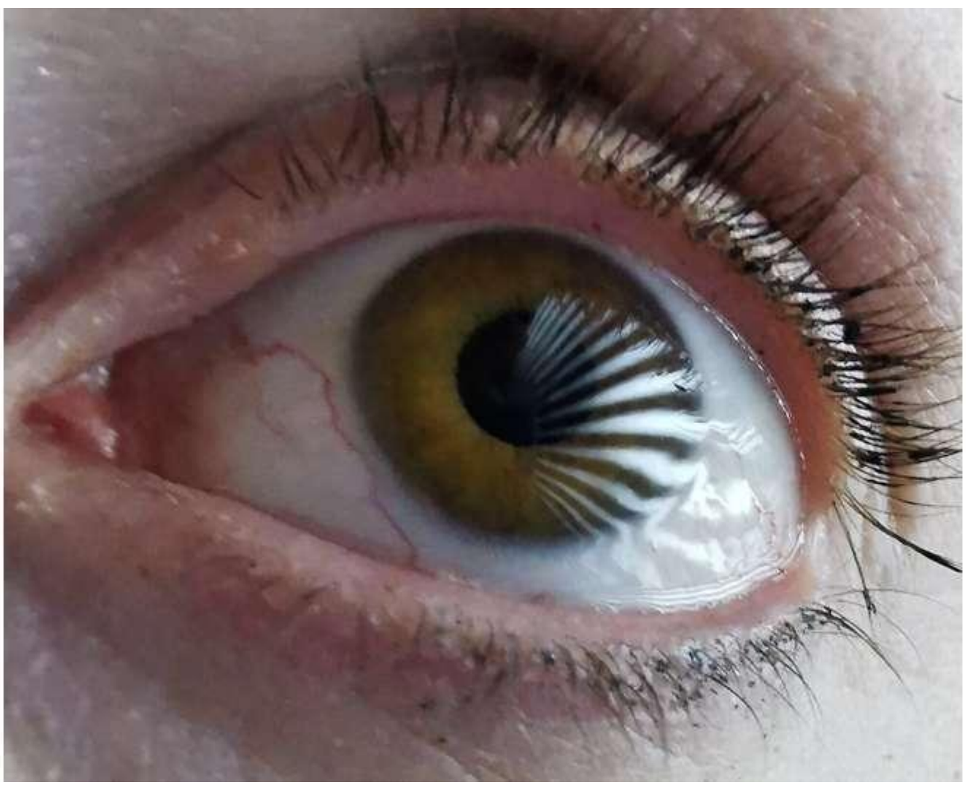
In smart glasses, it means an AI can make sense of the world the wearer is viewing by combining sensors on the glasses with these neural networks. As a result, the system can answer more sophisticated queries and offer smarter contextual information.

But in the case of the Ray-Ban Meta device, the AI has some distance to go before it meets the AI-processing capabilities found in the latest smartphones; these benefit from more powerful chipsets and onboard sensor fusion – where data is taken from multiple sensors and processed together, for example to offer scene recognition in camera apps allowing for lighting and color balance to be intelligently adjusted, or combining data from thermometers and optical sensors in smartwatches to offer better feedback on one's workout.

APRIL 1, 2025

'Superhuman vision': Powerful 3D imaging technology paves way for next-generation eye-tracking

by University of Arizona



A pattern of distorted lines is visible as a reflection in this close-up view of a human eye. By observing the deformation of illumination patterns reflected off the eye's surface,

researchers in Willomitzer's group can capture gaze direction information from tens of thousands of surface points instead of the dozen or so used by conventional eye-tracking methods. Credit: Florian Willomitzer
Eye tracking plays a critical role in the latest virtual and augmented reality headsets and is an important technology in the entertainment industry, scientific research, medical and behavioral sciences, automotive driving assistance and industrial engineering. Tracking the movements of the human eye with high accuracy, however, is a daunting challenge.

Researchers at the University of Arizona Wyant College of Optical Sciences have now demonstrated an innovative approach that could revolutionize eye-tracking applications.

Their study, published in *Nature Communications*, finds that integrating a powerful 3D imaging technique known as deflectometry with advanced computation has the potential to significantly improve state-of-the-art eye tracking technology.

"Current eye-tracking methods can only capture directional information of the eyeball from a few sparse surface points, about a dozen at most," said Florian Willomitzer, associate professor of optical sciences and principal investigator of the study.

"With our deflectometry-based method, we can use the information from more than 40,000 surface points, theoretically even millions, all extracted from only one single, instantaneous camera image."

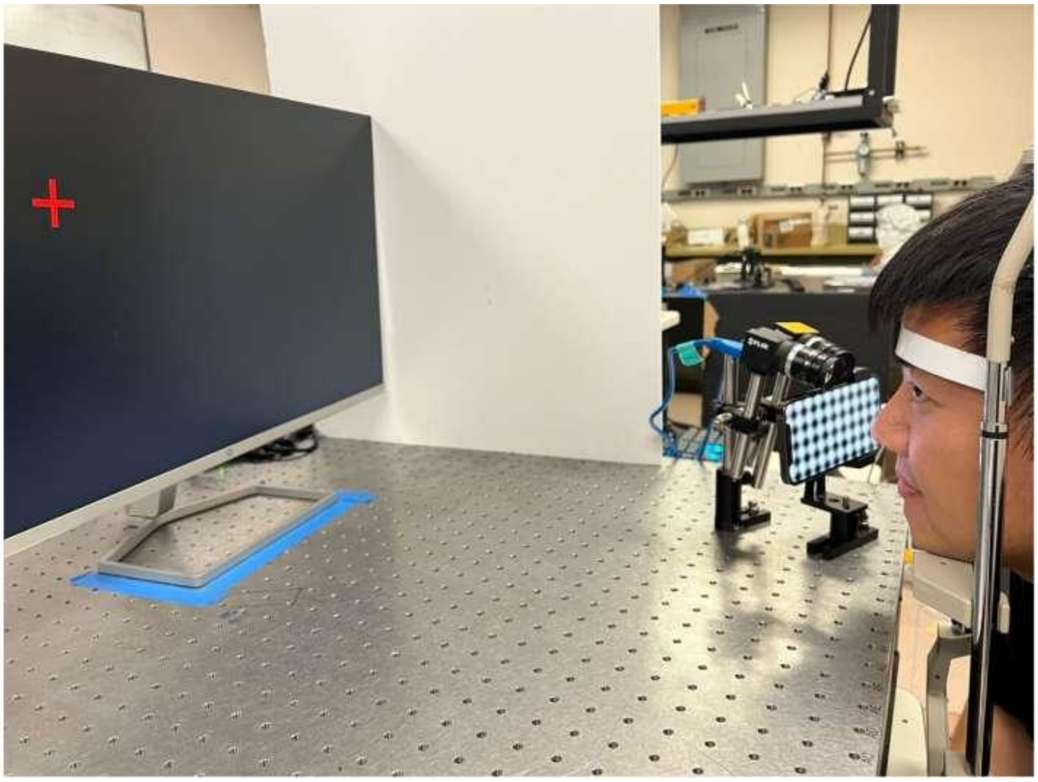
"More data points provide more information that can be potentially used to significantly increase the accuracy of the gaze direction estimation," said Jiazhang Wang, postdoctoral researcher in Willomitzer's lab and the study's first author.

"This is critical, for instance, to enable next-generation applications in virtual reality. We have shown that our method can easily increase the number of acquired data points by a factor of more than 3,000, compared to conventional approaches."

Deflectometry is a 3D imaging technique that allows for the measurement of reflective surfaces with very high accuracy. Common applications of deflectometry include scanning large telescope mirrors or other high-performance optics for the slightest imperfections or deviations from their prescribed shape.

Leveraging the power of deflectometry for applications outside the inspection of industrial surfaces is a major research focus of Willomitzer's research group in the U of A Computational 3D Imaging and Measurement Lab. The team pairs deflectometry with advanced computational methods typically used in computer vision research.

The resulting research track, which Willomitzer calls "computational deflectometry," includes techniques for the analysis of paintings and artworks, tablet-based 3D imaging methods to measure the shape of skin lesions, and eye tracking.



Jiazhang Wang, postdoctoral researcher in Willomitzer's lab and the study's first author, demonstrates the experimental setup: A stereo camera records reflections of a light grid reflected off the eye, as the study subject observes a point (red cross) moving on a screen. Credit: Florian Willomitzer

"The unique combination of precise measurement techniques and advanced computation allows machines to 'see the unseen,' giving them 'superhuman vision' beyond the limits of what humans can perceive," Willomitzer said.

In this study, the team conducted experiments with human participants and a realistic, artificial eye model. The team measured the study subjects' viewing direction and was able to track their gaze direction with accuracies between 0.46 and 0.97 degrees. When tested on the artificial eye model, the error was around just 0.1 degrees.

Instead of depending on a few infrared point light sources to acquire information from eye surface reflections, the new method uses a screen displaying known structured light patterns as the illumination source. Each of the more than 1 million pixels on the screen can thereby act as an individual point light source.

By analyzing the deformation of the displayed patterns as they reflect off the eye surface, the researchers can obtain accurate and dense 3D surface data from both the cornea, which overlays the pupil, and the white area around the pupil, known as the sclera, Wang explained.

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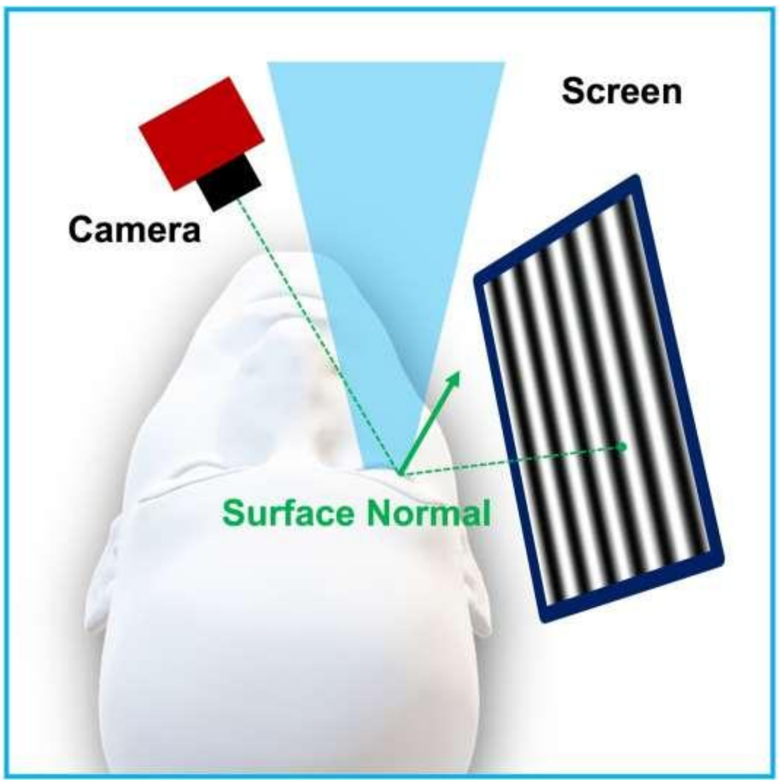
"Our computational reconstruction then uses this surface data together with known geometrical constraints about the eye's optical axis to accurately predict the gaze direction," he said.

In a previous study, the team has already explored how the technology could seamlessly integrate with virtual reality and augmented reality systems by potentially using a fixed embedded pattern in the headset frame or the visual content of the headset itself—be it still images or video—as the pattern that is reflected from the eye surface.

This can significantly reduce system complexity, the researchers say. Moreover, future versions of this technology could use infrared light instead of visible light, allowing the system to operate without distracting users with visible patterns.



How the technique works: A camera records patterns of light as they reflect off the surface of the eye. An algorithm uses a so-called surface normal vector – the direction that is perpendicular to the eye surface – to measure the eye shape, which can then be used to estimate gaze direction. "FoV" stands for "field of view." Credit: Florian Willomitzer and Jiazhang Wang
"To obtain as much direction information as possible from the eye's cornea and sclera without any ambiguities, we use stereo-deflectometry paired with novel surface optimization algorithms," Wang said. "The technique determines the gaze without making strong assumptions about the shape or surface of the eye, as some other methods do, because these parameters can vary from user to user."

In a desirable "side effect," the new technology creates a dense and accurate surface reconstruction of the eye, which could potentially be used for on-the-fly diagnosis and correction of specific eye disorders in the future, the researchers added.

Aiming for the next technology leap

While this is the first time deflectometry has been used for eye tracking—to the researchers' knowledge—Wang said, "It is encouraging that our early implementation has already demonstrated accuracy comparable to or better than commercial eye-tracking systems in real human eye experiments."

With a pending patent and plans for commercialization through Tech Launch Arizona, the research paves the way for a new era of robust and accurate eye-tracking. The researchers believe that with further engineering refinements and algorithmic optimizations, they can push the limits of eye tracking beyond what has been previously achieved using techniques fit for real-world application settings.

Next, the team plans to embed other 3D reconstruction methods into the system and take advantage of artificial intelligence to further improve the technique.

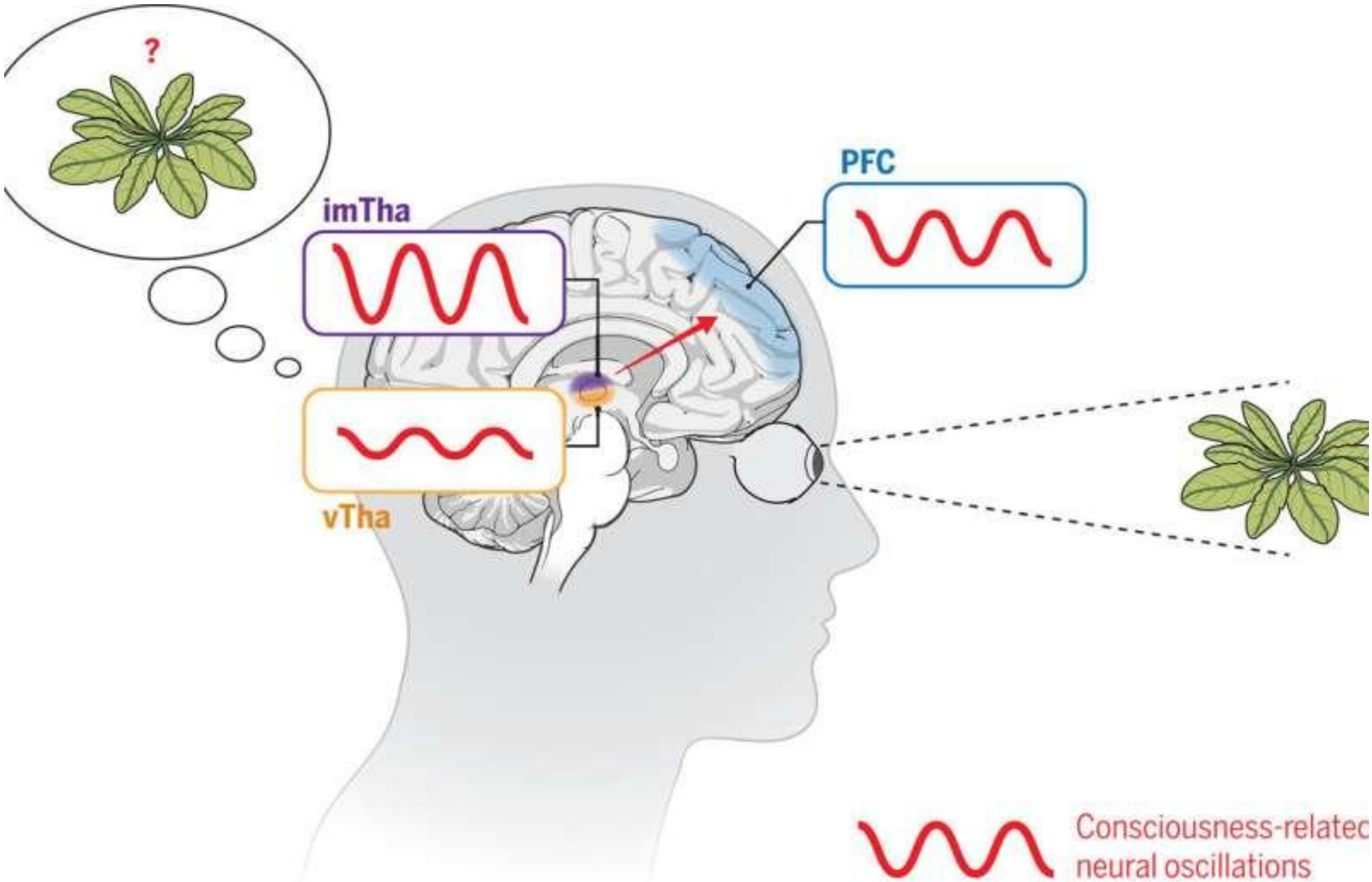
"Our goal is to close in on the 0.1-degree accuracy levels obtained with the model eye experiments," Willomitzer said. "We hope that our new method will enable a new wave of next-generation eye tracking technology, including other applications such as neuroscience research and psychology."

Co-authors on the paper include Oliver Cossairt, adjunct associate professor of electrical and computer engineering at Northwestern University, where Willomitzer and Wang started the project, and Tianfu Wang and Bingjie Xu, both former students at Northwestern.

More information: Accurate Eye Tracking from Dense 3D Surface Reconstructions using Single-Shot Deflectometry, *Nature Communications* (2025). DOI: 10.1038/s41467-025-56801-1
Journal information: Nature Communications

Thalamic nuclei observed driving conscious perception

by Justin Jackson , Medical Xpress



The intralaminar and medial thalamic nuclei (imTha) play a gate role in human conscious perception. Credit: *Science* (2025). DOI: 10.1126/science.adr3675

Beijing Normal University-led researchers have identified specific high-order thalamic nuclei that drive human conscious perception by activating the prefrontal cortex. Their findings enhance understanding of how the brain forms conscious experience, offering new empirical support for theories that assign a central role to thalamic structures rather than cortical areas alone.

Consciousness has been described as existing in two distinct forms: the general state of being awake or asleep, and the specific contents of subjective awareness. Most studies investigating the neural basis of perception have focused on the cerebral cortex.

Subcortical structures, including high-order thalamic nuclei, remain comparatively unexplored, ill-accounting for how rapidly shifting sensory information becomes part of conscious experience.

Previous work has often considered thalamus function only as a relay for sensory input, rather than as a direct participant in generating conscious perception. Yet anatomical studies have shown widespread thalamic connections to brain regions linked to awareness. Several theoretical frameworks propose that thalamocortical loops may carry out essential integration functions for perception.

Functional imaging methods lack the spatial and temporal precision to observe subsecond neural events in deep brain regions. Whether there are contributions from distinct thalamic nuclei interactions with the cortex during conscious perception has therefore remained hidden from observation.

In the study, "Human high-order thalamic nuclei gate conscious perception through the thalamofrontal loop," published in *Science*, researchers performed direct recordings from both thalamic and cortical areas in human subjects as a way to examine the timing and structure of these interactions in real time.

Stereoelectroencephalography (sEEG) recordings were taken from five adult patients undergoing evaluation for deep brain stimulation as part of treatment for drug-resistant headaches. Each patient had electrodes surgically implanted across multiple thalamic nuclei and regions of the prefrontal cortex. In total, 194 recording sites were located in nine distinct thalamic nuclei, and 213 in the prefrontal cortex.

A visual awareness task was used to distinguish neural signals related to conscious perception from those associated with other cognitive functions.

Subjects viewed brief presentations of faint black-and-white grating patterns, appearing for 50 milliseconds at peripheral locations and varying in contrast, to test conscious awareness via directional eye movements. The visual method was selected over physical or audible versions to reduce interference from motor planning or verbal reporting tasks.

Consciousness-related neural activity emerged earlier and with greater intensity in intralaminar and medial thalamic nuclei than in ventral thalamic nuclei or the prefrontal cortex. Recordings revealed that activity in these high-order nuclei preceded corresponding signals in cortical areas by several dozen milliseconds. This timing pattern was observed consistently across participants and trial types.

A total of 108 thalamic recording sites showed statistically significant differences between conscious and unconscious visual trials.

The majority of early responses, defined as divergence onset times within 350 milliseconds of stimulus presentation, originated in the central medial, mediodorsal medial, and parafascicular nuclei. These same nuclei showed higher event-related potential amplitudes and greater increases in low-frequency spectral power during conscious perception than the ventral anterior, ventral lateral, and ventral posterolateral groups.

Phase synchrony measurements revealed that consciousness-related low-frequency oscillations, particularly in the theta band (2 to 8 Hz), originated in intralaminar and medial nuclei. Oscillations propagated outward in a temporal sequence: first appearing within the thalamus, then in connections between thalamus and prefrontal cortex, and last within the cortex.

Consciousness-related phase-amplitude coupling, a type of brain signal coordination where slower brain rhythms influence the strength of faster ones, was stronger during conscious perception and emerged first in thalamic regions.

Signals from intralaminar and medial nuclei showed coupling between low-frequency phases and high-frequency amplitudes in the lateral prefrontal cortex, a pattern not present in unconscious trials. This cross-frequency interaction also originated in the thalamus and appeared earlier and more strongly than similar activity within the cortex.

Neural activity in the thalamofrontal loop more accurately distinguished between conscious and unconscious trials than between any other task elements, including stimulus contrast, rule cues, or eye movement direction. Performance differences were significant even in near-threshold conditions where stimulus properties remained constant.

Researchers conclude that intralaminar and medial thalamic nuclei serve as origin points for the neural activity underlying human conscious perception. These high-order structures not only activate earlier than prefrontal cortex areas but also appear to initiate functional coupling that coordinates cortical activity. Thalamic signals more reliably predict subjective awareness than other cognitive features of the task, including sensory intensity or behavioral output.

These findings add direct human evidence to support theories proposing thalamic nuclei as a gateway for conscious perception. Results challenge models that assign primary responsibility for awareness to the cortex alone. By identifying specific thalamic-cortical pathways involved in perception, the study offers new insight into how transient sensory experiences rise into conscious awareness.

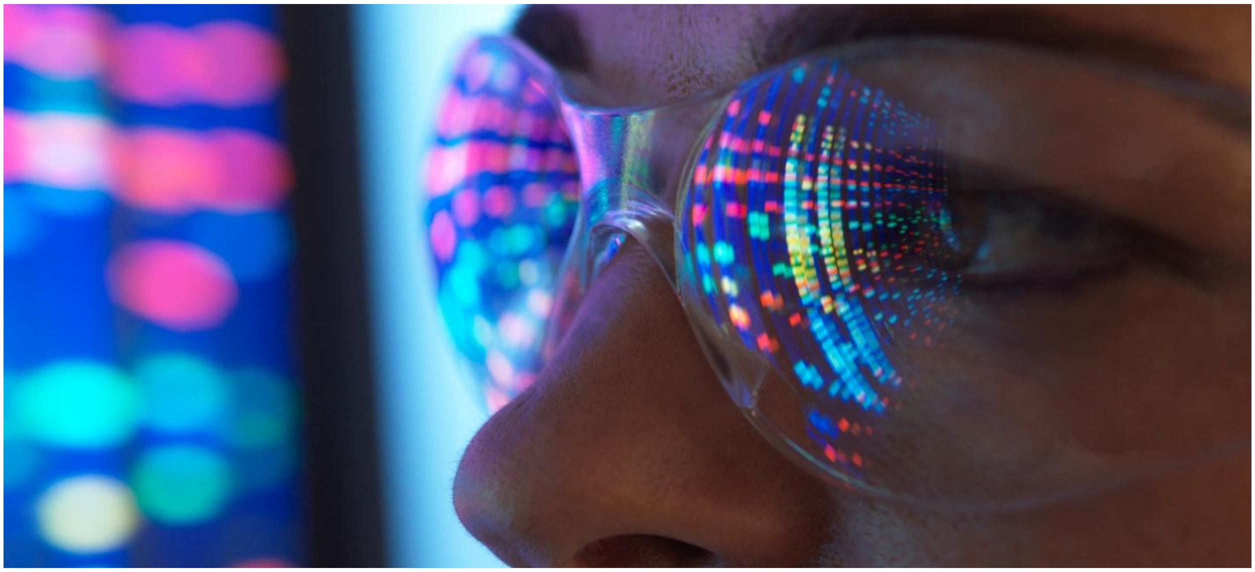
Clarifying the role of these subcortical networks could inform future approaches to treating disorders of consciousness and refining brain-machine interface design.

More information: Zepeng Fang et al, Human high-order thalamic nuclei gate conscious perception through the thalamofrontal loop, *Science* (2025). DOI: 10.1126/science.adr3675
Journal information: Science

Holographic-inspired lenses could unlock '3rd dimension of imaging' in future VR headsets and smart glasses

published November 7, 2024

Future VR headsets could use a new type of lens inspired by holographic devices. The bilayer bifocal lens relies on external voltage to change the intensities in the foci.



(Image credit: Andrew Brookes/Getty Images)

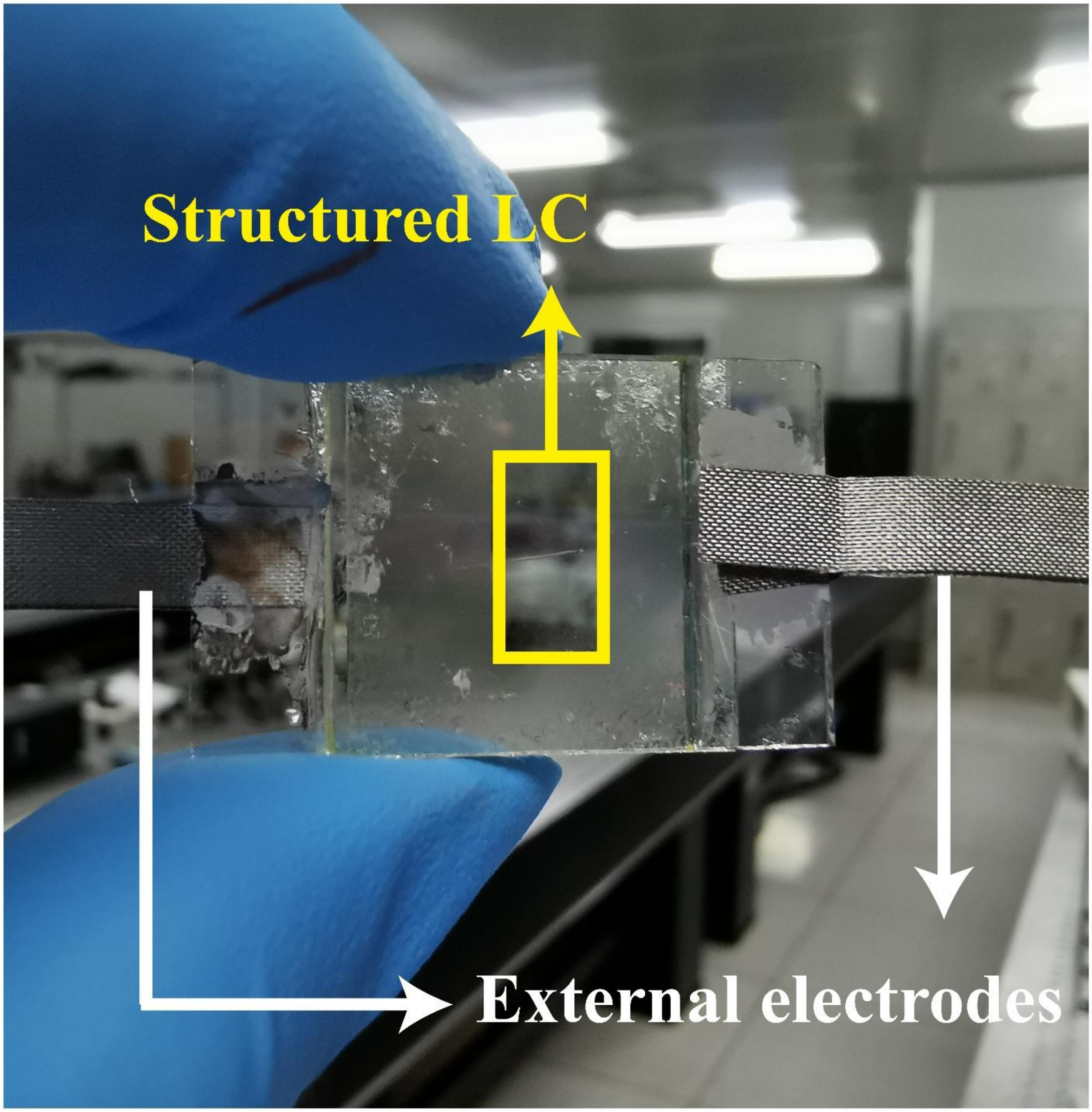
Future virtual reality (VR) headsets could use a new type of lens inspired by holographic devices, researchers in China say. This proposed new type of bifocal lens can switch between one focus and another at the flick of a switch, letting wearers witness intensities in the lenses change akin to a hologram.

These lenses would be made from two layers of liquid crystal structures that can switch between two foci with external voltage. The researchers described their findings in a new study published Oct. 1 in the journal Optics Letters.

The technology could be applied in imaging devices, optical computing and optical interconnectivity — in addition to future mixed-reality and VR headsets, the team said.

Specifically, they can be used for polarization imaging — often used to enhance image contrast or for edge imagining, which highlights the outline of objects or see finer details. Polarization can be referred to as the light's third dimension, with polarization cameras often detecting physical properties unseen by conventional imaging.

"We believe that the light control mechanism we created using the multilayer structure could also be used to design other optical devices, including holographic devices and beam generators, or for optical image processing," study lead author Fan Fan, professor of physics and electronics at Hunan University, said in a statement.



Researchers developed a bifocal lens based on two layers of liquid crystal (LC) structures. The intensities for the two focal lengths can be easily adjusted by applying external voltage. (Image credit: Fan Fan, Hunan University)

The team focused on creating bilayer structures, rather than single-layer structures, which most liquid-crystal devices are made from. The structures were made from a liquid crystal cell as well as a liquid crystal polymer — both of which are standard materials in the development of lenses intended for holographic imaging uses. This let researchers alter the intensity of the two foci. The development of multi-functional holographic devices was an inspiration but the technology could be used "beyond the field of holographic displays," Fan said.

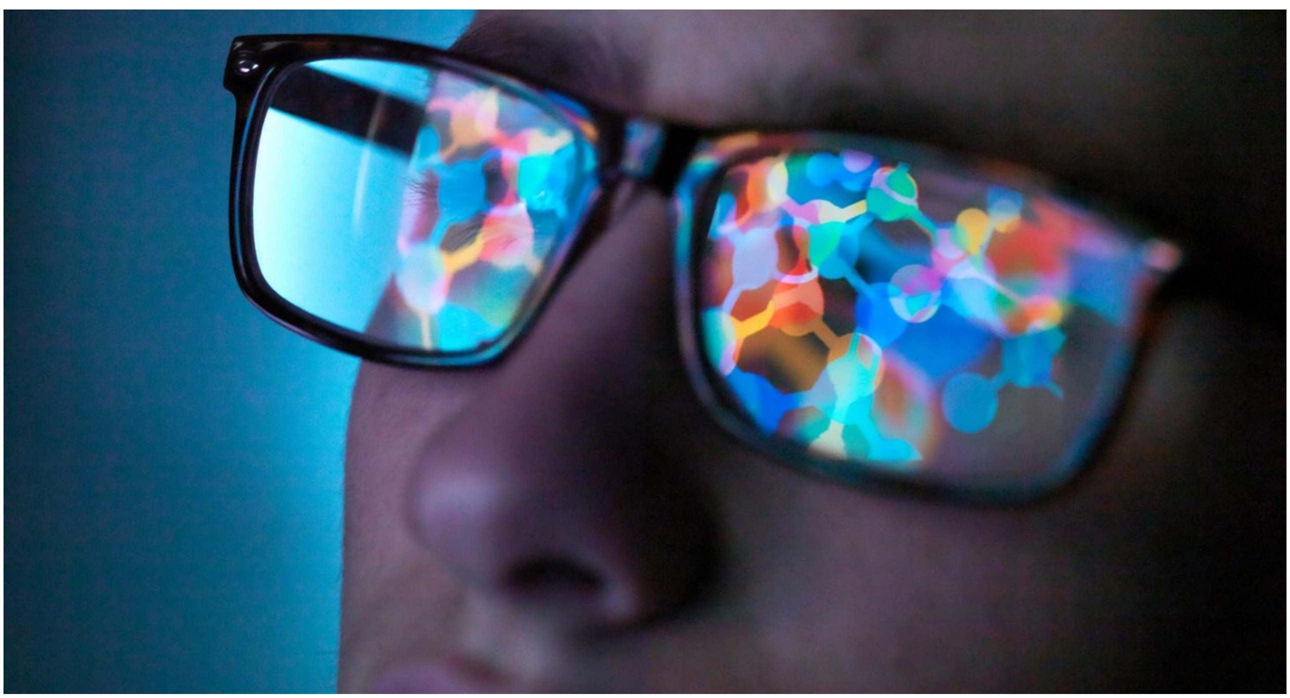
Some bifocal lenses can create different focal points based on the incident light's polarization — but this new design enables the focus to switch on command, manipulating the polarization states of the output beams. The liquid crystal layer also allows the lenses to switch rapidly between focus points when voltage is applied.

The scientists are planning to use the new lenses in several kinds of multifunctional devices. For the optical components found in this technology to be more practical, however, they stressed the cost of the mass production of components would have to be lowered. If this happens, the team could design and incorporate fast and accurate layer-to-layer alignment technology, the researchers said in the statement.

New display tech paves the way for 'most realistic' holograms in regular eyeglasses

published May 28, 2024

Building on current holographic technology, a team of optical display experts have invented a way to improve 3D displays that's small enough to work in regular glasses.



Researchers are even closer to realistic holograms. (Image credit: Andrew Brookes via Getty Images)

Researchers have invented a device that's small enough to fit in a regular pair of glasses and could solve an age-old trade-off in holographic displays — leading to the most realistic holograms ever.

Holograms are conventionally created using projecting devices called spatial light modulators (SLMs). Light is emitted through the device so that it changes the shape of the light wave at a specific distance, creating a visible surface.

But because SLMs are made from liquid crystal/silicon (LCoS) display technology, current hologram technology is suited to narrow fields of view like a flat screen or small viewing area (ie a small object). The viewer must be positioned inside a narrow viewing angle – anywhere outside it and the light diffracts too much, making the light invisible.

It's possible to widen the angle within which the image is clear, but fidelity is lost because current LCoS technology doesn't have the number of pixels available to maintain the image across a wider field. That means holograms tend to be either small and clear or large and diffuse, sometimes disappearing altogether if the viewer looks in another direction that's far enough away from the angle within which it's visible.

Felix Heide, assistant professor of computer science at Princeton and the paper's senior author, explained how important the viewing angle is. "To get a similar experience using a monitor, you would need to sit right in front of a cinema screen," he said.
The new technology, detailed in a study published April 24 in Nature Communications, could lead to the creation of more detailed holograms no matter which direction the viewer is looking in or how fast they change direction. The apparatus required to project them too is so small and light that wearers don't need tools like bulky VR headsets.

The finding would also make applications where holograms are used — such as in VR and AR displays — more widespread because the display technology can be easier to use, lighter and ultrathin. Heide mentioned examples from getting directions while driving to assisting in surgery, and even seeing instructions about how to fix a leaky pipe.

The Princeton team's key innovation was to create a second optical element that works with the SLM, filtering its output to expand the field of view while preserving the detail and stability in the hologram with a much lower decline in image quality.

Described in the paper as a small piece of frosted glass, the device is etched with a pattern that scatters the SLM's light into frequency bands not easily perceived by humans. This improves the image quality and expands the field of view.

The trade-off between image quality and field of view has been the biggest obstacle to realistic holograms, but as co-author Nathan Matsuda said: "The research brings us one step closer to resolving this challenge."

Meta just stuck its AI somewhere you didn't expect it — a pair of Ray-Ban smart glasses published May 11, 2024

Ray-Ban smart glasses will now use Meta AI virtual assistant software so that wearers can speak with their smart glasses and ask questions about what they're looking at.

Smart glasses have arguably failed to take off, but the addition of artificial intelligence (AI) could be the key to developing a truly transformational wearable technology.
In the US and Canada, Ray-Ban Meta smart glasses have received a rollout of multimodal AI technology with software called the "Meta AI virtual assistant." With multimodal AI — which means generative AI that can process queries that involve more than one medium (for example, both audio and imagery) — the device can better respond to queries based on what a wearer is looking at.

"Say you're traveling and trying to read a menu in French. Your smart glasses can use their built-in camera and Meta AI to translate the text for you, giving you the info you need without having to pull out your phone or stare at a screen," Meta representatives explained April 23 in a statement. The device first takes a photo of what a wearer is looking at, then the AI taps into cloud-based processing to serve up an answer to a query, delivered by speech, such as "what type of plant am I looking at?"

(Image credit: Meta / Ray-Ban)

Meta first explored integrating multimodal AI into the Ray-Ban Meta smart glasses in a limited release in December 2023.

Testing the AI functionality in this device, a reporter from The Verge found that it mostly responded correctly when asked to identify the model of a car. It could also describe a type of cat, for example, and its features in an image snapped via the camera. But the AI ran into trouble in accurately identifying the species of plants belonging to one reporter and struggled to correctly identify a groundhog in their neighbor's backyard.

Multimodal machinations

AI-powered virtual assistants are nothing new, with the likes of the Google Assistant, Amazon Alexa and Apple's Siri all providing smart answers to queries in natural language. But the crux of the Meta AI in the Ray-Ban smart glasses is its multimodal functionality.

The ability to fuse and process data from multiple sensor modules — for example, cameras and microphones — means a multimodal AI can generate more accurate and sophisticated outcomes versus unimodal AI systems. Google's Gemini multimodal AI model , for example,can process a photo of some cookies and respond with the recipe.

Trained on identifying patterns in different types of data inputs through multiple neutral networks — collections of machine learning algorithms arranged to mimic the human brain — multimodal AIs can process input data from text, images, audio and more.

In smart glasses, it means an AI can make sense of the world the wearer is viewing by combining sensors on the glasses with these neural networks. As a result, the system can answer more sophisticated queries and offer smarter contextual information.

But in the case of the Ray-Ban Meta device, the AI has some distance to go before it meets the AI-processing capabilities found in the latest smartphones; these benefit from more powerful chipsets and onboard sensor fusion – where data is taken from multiple sensors and processed together, for example to offer scene recognition in camera apps allowing for lighting and color balance to be intelligently adjusted, or combining data from thermometers and optical sensors in smartwatches to offer better feedback on one's workout.

Smart glasses could boost privacy by swapping cameras for this 100-year-old technology

published November 29, 2023

Researchers have built a tool called PoseSonic that can accurately track a glasses wearer's upper body movements.

Smart glasses of the future could swap out optical cameras for sonar, which uses sound to track the movements of its wearer, according to a new study. The sonar-based tech could improve accuracy and privacy, as well as make them cheaper to produce.

Scientists at Cornell University have created a technology, dubbed "PoseSonic". That combines micro sonar powered by CHIRP technology — a miniaturized version of the same technology used to map oceans or track submarines — with artificial intelligence (AI) to build an accurate echo profile image of the wearer. The micro sonar captures sound waves

that are too quiet for human hearing. The tech's creators published their research 27. Sept in the journal ACM Digital Library.
"We think our technology offers tremendous potential as the future sensing solution for wearables, especially when wearables are used in everyday settings," said study co-author Cheng Zhang, an assistant professor at Cornell, and director of its Smart Computer Interfaces for Future Interactions (SciFi) Lab. "It has unique advantages over the current camera-based sensing solutions," Zhang told Live Science in an email.

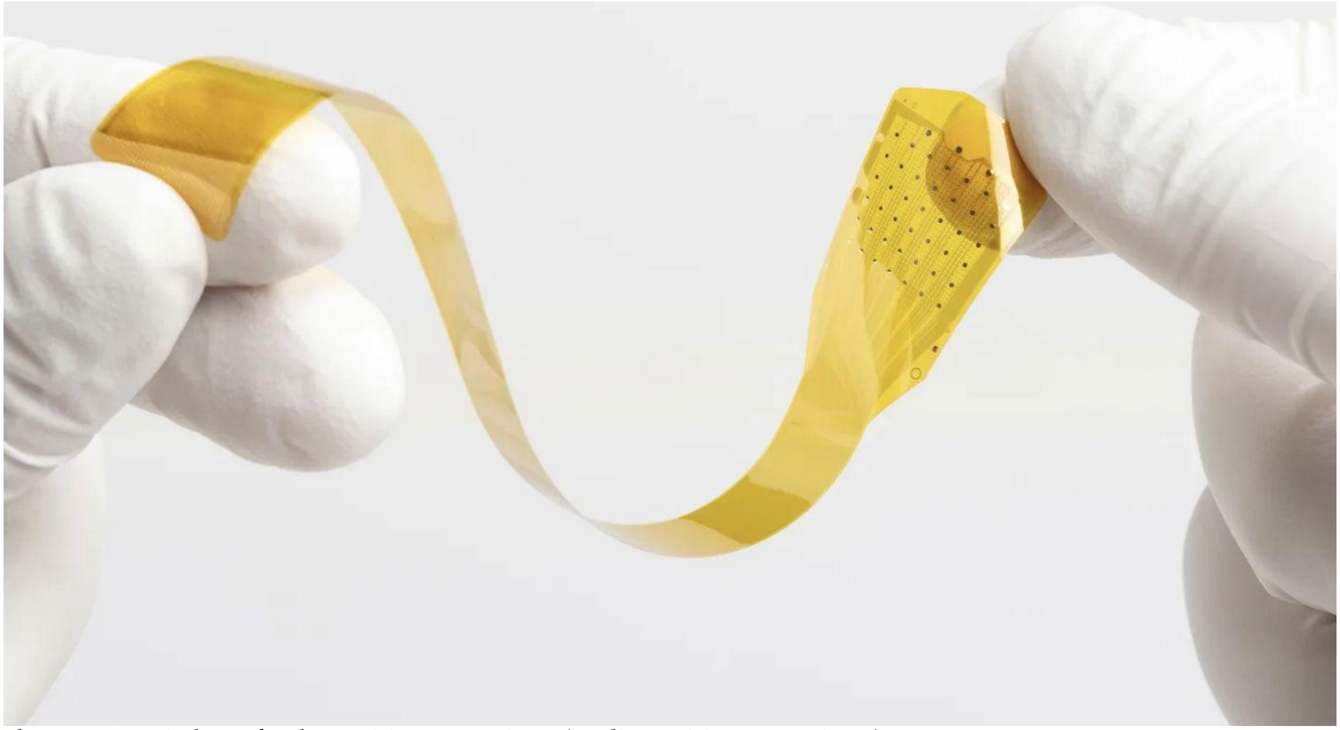
Augmented reality (AR) smart glasses currently on the market, such as Ray-Ban Stories by Meta, use cameras to track the wearer, alongside wireless technologies like Bluetooth, Wi-Fi and GPS. But continuous video drains the battery quickly and may pose a privacy risk. Acoustic-based tracking, however, is cheaper, more efficient, unobtrusive and privacy-conscious, Zhang said.
PoseSonic uses microphones and speakers fitted alongside a microprocessor, Bluetooth module, battery and sensors. Researchers created a working prototype for less than $40 — and this cost can likely be reduced further if manufactured at scale. The ill-fated Google Glass, by contrast, cost $152 to make, according to IEEE, but this was ten years ago.

PoseSonic's speakers bounce sound waves that are inaudible to humans off the body and back to the microphones, which helps the microprocessor generate a profile image. This is fed into an AI model that estimates the 3D positions of nine body joints, including the shoulders, elbows, wrists, hops and the nose. The algorithm is trained using video frames for reference, which means unlike other similar wearable systems, it can work on any user without first being trained on them specifically.

Because the audio equipment uses less power than cameras, PoseSonic can run on smart glasses for more than 20 hours continuously, Zhang said, and a future version of the technology could be integrated into an AR-enabled wearable device without being uncomfortable or too bulky.

Sonar is also better for privacy than using cameras, according to the researchers, as the algorithm processes only the sound waves it produces itself to build the 3D image, instead of using other sounds or capturing images. This data can be processed locally on the wearer's smartphone, rather than sent to a public cloud server, which means it cuts the changes of data getting intercepted.

Zhang suggested two scenarios where acoustic tracking in smart glasses could be of practical use, including recognizing upper body movements in day-to-day life, such as eating, drinking or smoking, and tracking the wearer's movements while exercising. Future generations of this technology could help users monitor their behavior and allow for more detailed feedback beyond just the number of steps or the calories consumed — extending to an assessment of how the body moves during physical activity.



The Layer 7 Cortical Interface by Precision Neuroscience (Credit: Precision Neuroscience)

PRECISION NEUROSCIENCE GAINS EDGE IN BRAIN-COMPUTER INTERFACE RACE WITH FDA CLEARANCE

APRIL 28, 2025

With the field of brain-computer interface (BCI) technologies growing increasingly competitive, Precision Neuroscience has emerged as a sigificant contender in the race to unite human minds with machines.

A four-year-old company, Precision Neuroscience announced on April 17 that its core brain implant system had received approval from the U.S. Food and Drug Administration (FDA) for commerical use and limited implantation uses. According to the company's announcement, this marks the first full regulatory clearance granted to a wireless BCI.

This milestone highlights the company's rapid technological advancement, drawing attention from rivals such as Elon Musk's Neuralink and Synchron, backed by Amazon founder Jeff Bezos and Microsoft co-founder Bill Gates.

The FDA approval pertains to Precision's Layer 7 Cortical Interface, a sophisticated microelectrode array used to decode neural signals and translate them into commands for external technologies. The FDA's clearance allows Precision to implant the device in patients for up to 30 days—marking the first time in history a BCI system has received such approval for long-term use in a clinical setting.

"This is a foundational moment for Precision," said Dr. Benjamin Rapoport, Precision's co-founder and chief science officer. Rapoport, who also helped co-found Neuralink, left that company the following year after its founding.

The Layer 7 Cortical Interface features an ultra-thin microelectrode array—thinner than a human hair—that adheres to the brain's surface without causing damage. Resembling a strip of yellow Scotch tape, the array is composed of 1,024 electrodes designed to record, monitor, and stimulate electrical activity on the brain's surface.

The FDA approval will enable surgeons to use the system during brain surgeries to map brain signals, a crucial step in advancing BCI technology. However, this is not the company's ultimate goal for the device, but it does present an immediate opportunity to collect critical data while generating early revenue.

To date, Precision Neuroscience has temporarily implanted the Layer 7 device in 37 patients, with some cases observed at Mount Sinai Hospital in New York. Until now, the implants were used for shorter periods during ongoing brain surgeries unrelated to BCI research. With the FDA's green light, the company can now collect data over extended periods, further advancing the development of future brain-computer interface systems.

Dr. Rapoport explained that the new clearance will allow Precision to collect high-quality data, which will be pivotal as the company works toward its long-term goal: developing a brain implant system that can help paralyzed patients restore lost functions such as movement and speech.

With competition in the BCI sector intensifying, Precision Neuroscience's FDA approval could position the company at the forefront of the industry, rivaling Neuralink and other tech giants. As neurotech innovations continue to evolve, Precision's work could play a crucial role in transforming the lives of individuals with paralysis, offering them a potential pathway to regain independence and improve their quality of life.

Meanwhile, companies like Neuralink continue to perform well, even as political shifts in the U.S. have introduced new uncertainties. Since the Trump administration's return to office in January, drastic cuts to federal employees were made in February, including layoffs within the U.S. Food and Drug Administration—some of whom were connected to the review of Neuralink's technologies. This political turbulence has coincided with a growing exodus of American postgraduate and PhD students and scientists relocating to Canada and other countries worldwide.

Despite the political uncertainty impacting the broader scientific community, advancements in BCI technology are not slowing down—in fact, they appear


CREDIT: Pixabay/Melmak

MIT DEVELOPS ULTRA-THIN SENSOR SKIN THAT COULD REDEFINE NIGHT VISION AND WEARABLE TECH

·APRIL 23, 2025

An electronic sensor "skin" developed by MIT engineers—the thinnest pyroelectric material ever fabricated—could revolutionize electronics by enabling ultra-thin, flexible sensors for next-generation night vision devices and autonomous vehicles.

Pyroelectric materials generate an electrical current in response to thermal fluctuations. This 10-nanometer-thick film's extreme thinness actually enhances its sensitivity to minute temperature changes.

A NEXT-GENERATION INFRARED SENSOR

Laboratory testing revealed that the material is highly sensitive to far-infrared heat and radiation. The film could help solve longstanding optical sensing challenges, such as creating lightweight night-vision eyewear and improving autonomous vehicle navigation under difficult conditions. Unlike current state-of-the-art infrared sensors, which require bulky cooling systems, the pyroelectric film offers greater precision without the need for cooling.

"This film considerably reduces weight and cost, making it lightweight, portable, and easier to integrate," said Xinyuan Zhang, a graduate student in MIT's Department of Materials Science and Engineering. "For example, it could be directly worn on glasses."

Beyond local biological and environmental sensing, MIT researchers envision astronomical applications for their film. In addition to developing the material, the team also created a new technique for peeling the film from its growth substrate—a process they believe could be adapted for producing other types of semiconductor films.

FABRICATING THE ELECTRONIC SKIN

Jeehwan Kim, associate professor of mechanical engineering and materials science and engineering at MIT, leads the research group focused on creating ever-thinner flexible electronics. Working alongside a team led by Professor Chang-Beom Eom at the University of Wisconsin–Madison, they aim to incorporate computing skins seamlessly into contact lenses and wearable fabrics, placing sensors and smart technologies at extremely close range. Larger applications, like bendable displays and stretchable solar cells, are also on the horizon.

Kim's team developed a novel method called "remote epitaxy." In this process, a single layer of crystalline substrate acts as the scaffold for growing new material, while an ultra-thin graphene coating—acting like Teflon on a frying pan—prevents the new material from sticking too tightly. This allows the researchers to easily peel the film away, preserving the substrate for reuse.

A SURPRISING PEEL

In their experiments, the MIT team tested various semiconductor blends before noticing that the pyroelectric material PMN-PT unexpectedly peeled away from the substrate easily, even without the graphene layer.

“It worked surprisingly well,” Zhang says. “We found the peeled film is atomically smooth.”

Investigating why the delicate film held together during removal, the researchers identified lead atoms as the key factor. In PMN-PT’s chemical structure, lead atoms’ orderly arrangement attracts their own electrons, rather than allowing them to bond strongly with the substrate—a property known as low electron affinity.

A NEW SENSOR

Capitalizing on this discovery, the researchers produced 10-nanometer-thick PMN-PT films. They then applied the films to small chips, creating a 100-pixel heat sensor.

Testing revealed the films’ exceptional sensitivity to temperature changes, comparable to the best night-vision systems. Conventional night vision devices rely on photodetectors that must be cooled to prevent signal noise from distorting images. In contrast, PMN-PT sensors achieve high sensitivity without cooling, maintaining image quality while dramatically reducing device bulk and weight.

Further testing showed the film could detect wavelengths across the entire infrared spectrum, expanding its potential applications beyond night vision. The team identified other promising uses, such as helping autonomous vehicles detect pedestrians and obstacles in dark, foggy, or rainy conditions. Additional possibilities include gas sensors for environmental monitoring and thermal diagnostics to detect malfunctioning semiconductor chips through sudden heat changes.

FUTURE FILMS

Looking ahead, the team plans to adapt their peeling technique to materials that do not contain lead. They are exploring ways to modify the process by applying lead only to the growing surface.

"We envision that our ultrathin films could be made into high-performance night-vision goggles, considering its broad-spectrum infrared sensitivity at room-temperature, which allows for a lightweight design without a cooling system," Zhang says. "To turn this into a night-vision system, a functional device array should be integrated with readout circuitry. Furthermore, testing in varied environmental conditions is essential for practical applications."

The paper "Atomic Lift-off of Epitaxial Membranes for Cooling-free Infrared Detection" appeared on April 23, 2025 in *Nature.*

Apple Focusing on Smart Glasses which Might Replace iPhone: Reports

Even though Apple's massive fame for its product lineups is margined to infinity, the Cupertino tech conglomerate is promptly in need of variety. The last time this tech world witnessed Apple releasing new product was the iPad which despite being an inarguable success proved difficult to maintain its momentum. Augmented reality, being a new and exciting platform, wouldn't be of a huge competition (at least as of present) for Apple. Hence Apple working on something massive with AR software is very much a possibility.

Things get clearer with the latest report which has been subjected to Apple's potential replacement for its flag bearer, the iPhone. Apple's smart glasses have been longly rumored device anticipated to come with the augmented reality feature. The standalone AR device has had its fair share of leaks and anticipations in the recent past. But the latest report indicates that the alleged Apple Glass would be nothing unlike the regular pair of glasses with the design kept simple and stylish. What's great, years ago Google's AR glass saw the light of the day but was failed to impress fans due to the looking design. With the simple smart glass, Apple is apparently set to leave no stones unturned.

Alleged Apple Glasses Might Replace iPhones in Near Future [Image

Source]

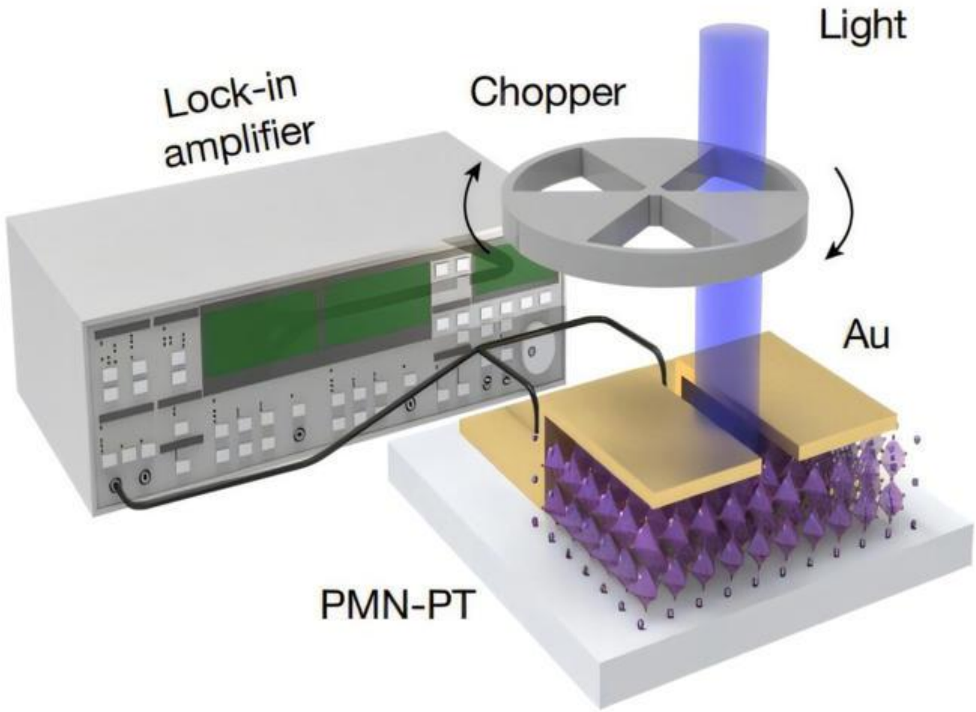
In terms of design, Apple's smart glass will likely be manufactured with high-end metal. The frame might have a slew of cameras, reports Gizbot. In addition, there would be wireless antennas which will enable users to use this particular Apple device as an alternative to their smartphones. So in a way, we are plausibly approaching the world of smart glasses, the potential replacement for smartphones (iPhones).

Little do we know that like the iPhone X's controversial 'notch', this Apple glasses might house the camera as well as one of the ambient sensors. The sides of the device will be occupied with Bluetooth and Wi-Fi components. Also, like the iPhone, this smart glasses is believed to come with split antenna design.

Fabricated will be the arms of the glasses which will bestow a comfortable design. With the inclusion of Siri, Apple's glasses will also sport display maps, videos as well as texts.

While the glasses are expected to be sans the power port, wireless charging is the ultimate mode to fuel it accordingly. Despite Apple refusing to confirm the existence of smart glasses publicly, reports already shed lights that the Cupertino tech giant is developing an AR-based device via Tim Cook's speech, and we already know that it apparently will happen and, "it will happen in a big way, and we will wonder when it does, how we ever lived without it. Like we wonder how we lived without our phone today."

New electronic 'skin' could enable lightweight night-vision glasses



Schematic showing the setup for characterizing a pyroelectric device fabricated based on ALO-enabled freestanding membranes. Credit: Nature (2025). DOI: 10.1038/s41586-025-08874-7. https://www.nature.com/articles/s41586-025-08874-7

MIT engineers have developed a technique to grow and peel ultrathin "skins" of electronic material. The method could pave the way for new classes of electronic devices, such as ultrathin wearable sensors, flexible transistors and computing elements, and highly sensitive and compact imaging devices.

As a demonstration, the team fabricated a thin membrane of pyroelectric material—a class of heat-sensing material that produces an electric current in response to changes in temperature. The thinner the pyroelectric material, the better it is at sensing subtle thermal variations.

With their new method, the team fabricated the thinnest pyroelectric membrane yet, measuring 10 nanometers thick, and demonstrated that the film is highly sensitive to heat and radiation across the far-infrared spectrum.

The newly developed film could enable lighter, more portable, and highly accurate far-infrared (IR) sensing devices, with potential applications for night-vision eyewear and autonomous driving in foggy conditions.

Current state-of-the-art far-IR sensors require bulky cooling elements. In contrast, the new pyroelectric thin film requires no cooling and is sensitive to much smaller changes in temperature. The researchers are exploring ways to incorporate the film into lighter, higher-precision night-vision glasses.

"This film considerably reduces weight and cost, making it lightweight, portable, and easier to integrate," said Xinyuan Zhang, a graduate student in MIT's Department of Materials Science and Engineering (DMSE). "For example, it could be directly worn on glasses."

The heat-sensing film could also have applications in environmental and biological sensing, as well as imaging of astrophysical phenomena that emit far-infrared radiation.

What's more, the new lift-off technique is generalizable beyond pyroelectric materials. The researchers plan to apply the method to make other ultrathin, high-performance semiconducting films.

Their results are reported in a paper appearing in the journal *Nature*. The study's MIT co-authors are first author Xinyuan Zhang, Sangho Lee, Min-Kyu Song, Haihui Lan, Jun Min Suh, Jung-El Ryu, Yanjie Shao, Xudong Zheng, Ne Myo Han, and Jeehwan Kim, associate professor of mechanical engineering and of materials science and engineering, along with researchers at the University Wisconsin at Madison led by Professor Chang-Beom Eom and authors from multiple other institutions.

Chemical peel

Kim's group at MIT is finding new ways to make smaller, thinner, and more flexible electronics. They envision that such ultrathin computing "skins" can be incorporated into everything from smart contact lenses and wearable sensing fabrics to stretchy solar cells and bendable displays.

To realize such devices, Kim and his colleagues have been experimenting with methods to grow, peel, and stack semiconducting elements, to fabricate ultrathin, multifunctional electronic thin-film membranes.

One method that Kim has pioneered is "remote epitaxy"—a technique where semiconducting materials are grown on a single-crystalline substrate, with an ultrathin layer of graphene in between. The substrate's crystal structure serves as a scaffold along which the new material can grow.

The graphene acts as a nonstick layer, similar to Teflon, making it easy for researchers to peel off the new film and transfer it onto flexible and stacked electronic devices. After peeling off the new film, the underlying substrate can be reused to make additional thin films.

Kim has applied remote epitaxy to fabricate thin films with various characteristics. In trying different combinations of semiconducting elements, the researchers happened to notice that a certain pyroelectric material, called PMN-PT, did not require an intermediate layer assist in order to separate from its substrate.

Just by growing PMN-PT directly on a single-crystalline substrate, the researchers could then remove the grown film, with no rips or tears to its delicate lattice.

"It worked surprisingly well," Zhang says. "We found the peeled film is atomically smooth."

Lattice lift-off

In their new study, the MIT and UW Madison researchers took a closer look at the process and discovered that the key to the material's easy-peel property was lead.

As part of its chemical structure, the team, along with colleagues at the Rensselaer Polytechnic Institute, discovered that the pyroelectric film contains an orderly arrangement of lead atoms that have a large "electron affinity," meaning that lead attracts electrons and prevents the charge carriers from traveling and connecting to another materials such as an underlying substrate. The lead acts as tiny nonstick units, allowing the material as a whole to peel away, perfectly intact.

The team ran with the realization and fabricated multiple ultrathin films of PMN-PT, each about 10 nanometers thin. They peeled off pyroelectric films and transferred them onto a small chip to form an array of 100 ultrathin heat-sensing pixels, each about 60 square microns (about .006 square centimeters). They exposed the films to ever-slighter changes in temperature and found the pixels were highly sensitive to small changes across the far-infrared spectrum.

The sensitivity of the pyroelectric array is comparable to that of state-of-the-art night-vision devices. These devices are currently based on photodetector materials, in which a change in temperature induces the material's electrons to jump in energy and briefly cross an energy "band gap," before settling back into their ground state.

This electron jump serves as an electrical signal of the temperature change. However, this signal can be affected by noise in the environment, and to prevent such effects, photodetectors have to also include cooling devices that bring the instruments down to liquid nitrogen temperatures.

Current night-vision goggles and scopes are heavy and bulky. With the group's new pyroelectric-based approach, NVDs could have the same sensitivity without the cooling weight.

The researchers also found that the films were sensitive beyond the range of current night-vision devices and could respond to wavelengths across the entire infrared spectrum.

This suggests that the films could be incorporated into small, lightweight, and portable devices for various applications that require different infrared regions. For instance, when integrated into autonomous vehicle platforms, the films could enable cars to "see" pedestrians and vehicles in complete darkness or in foggy and rainy conditions.

The film could also be used in gas sensors for real-time and on-site environmental monitoring, helping detect pollutants. In electronics, they could monitor heat changes in semiconductor chips to catch early signs of malfunctioning elements.

The team says the new lift-off method can be generalized to materials that may not themselves contain lead. In those cases, the researchers suspect that they can infuse Teflon-like lead atoms into the underlying substrate to induce a similar peel-off effect. For now, the team is actively working toward incorporating the pyroelectric films into a functional night-vision system.

"We envision that our ultrathin films could be made into high-performance night-vision goggles, considering its broad-spectrum infrared sensitivity at room-temperature, which allows for a lightweight design without a cooling system," Zhang says.

"To turn this into a night-vision system, a functional device array should be integrated with readout circuitry. Furthermore, testing in varied environmental conditions is essential for practical applications."

More information: Jeehwan Kim, Atomic lift-off of epitaxial membranes for cooling-free infrared detection, *Nature* (2025). DOI: 10.1038/s41586-025-08874-7. www.nature.com/articles/s41586-025-08874-7

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MARCH 3, 2025

Wearable tech has far to go before challenging smartphones

by Mona GUICHARD

Ray-Ban and Meta's connected glasses saw success in 2024.

Wearable gadgets like smart watches and glasses are growing more capable every year, but experts say smartphones will remain ubiquitous for the foreseeable future—not least thanks to artificial intelligence features.

A slew of wearable products and prototypes were on show at the Mobile World Congress in Barcelona Monday, even as smartphone makers and network operators played up AI integration as making handsets more useful.

Such "new product ranges allow manufacturers to diversify the hopes until now placed in phones" said Cesar Corcoles, an IT and telecoms professor at the Open University of Catalonia.

The trade show in Barcelona will see "prototypes and demonstrations of smart glasses that place a small, very limited screen in front of our eyes."

Smart glasses have seemed on the horizon for more than a decade, with Google's Glass headset and camera released in 2013—although it has since been discontinued.

Meta has encountered more success recently with its frames developed alongside Ray-Ban, offering features including a built-in camera, music playback and voice interactions with the company's AI.

Yann LeCun, star AI researcher at the company which owns Facebook and Instagram, is often seen showing off the glasses at public appearances.

Worldwide, the market for smart glasses appears to be surging in terms of unit sales, with a 210-percent year-on-year increase in 2024 according to specialist research firm Counterpoint—far faster than the seven-percent growth in smartphone shipments calculated by analysts Canalys.

'Cool gimmick' for now

But comparing the number of devices rather than growth rates, last year's roughly two million pairs of smart glasses barely register compared to the 1.2 billion smartphones sold.

Counterpoint predicts the glasses market will grow further in the coming years as more producers—from social media giants to smartphone makers—look to claim a piece of the action.

Other wearable categories may need longer to take off, with the recent shutdown of "AI Pin" maker Humane a sign some wearable tech is not yet mature.

Designed to be worn at chest level like a brooch, the would-be smartphone replacement incorporating a camera and mini projector was designed to be used via AI-powered voice interactions but received poor reviews.

Humane has now been sold to HP after the device failed to make the hoped-for impact.

The "AI Pin" was "just not that useful yet", Canalys expert Jack Leathem said.

Voice-controlled devices are "a cool gimmick, but humans have become very, very used to text-based interactions on touchscreens," he added—habits it would take a powerful sales pitch to change.

"The most challenging thing is getting people to change their behavior," agreed Shen Ye of smartphone maker HTC's Vive wearables arm.

"We still use a QWERTY keyboard because it's what we're used to... even though there are probably much better ways of typing," he added.

AI on your phone

Beyond consumer inertia, wearable tech is still up against engineering challenges stemming from its bid to squeeze smartphone-like functionality into a smaller package.

"There are limits around the computing power currently and battery performance," Leathem said. "You can't make them that compact."

That's one reason why smart watches able to make calls and send messages largely remain tethered to wearers' smartphones for now.

"Every smart watch that comes out now is there to interact with a smartphone, not to replace it. It's an accessory," Leathem said.

What's more, manufacturers are incentivized to get consumers buying a wider range of gadgets rather than simply swapping one for another.

And even as wearables become more useful, AI is expected to pump more value into smartphones themselves.

The latest offerings from Apple, Samsung or China's Xiaomi have bet on offering users integrated "AI assistant" features.

"All the money is going into AI... their vision of the future is keeping the same smartphone form factor, but making it way more useful," Leathem said.

Canalys predicts that the share of smartphones sold worldwide with AI features will leap from 16 percent at present to more than half by 2028.

Future wearable devices could draw power through your body using background 6G cellphone signals

published December 3, 2024

Excess energy from wireless 6G networks could be harvested by a copper coil and the human body.


(Image credit: Oscar Wong via Getty Images)

Your body could become a battery for wearable devices, thanks to a breakthrough in harvesting waste energy from 6G wireless communication.

Researchers from the University of Massachusetts Amherst found that waste radio frequency (RF) energy given off by visible light communication (VLC), if used to deliver 6G, can be harvested with small, inexpensive copper coils and transmitted to power other devices via the human body. 6G is a future wireless communication technology that is currently in development and is set to be deployed before the end of the decade.
As outlined in a 2022 research paper, the crux of this mechanism lies with VLC — which transmits data through extremely fast flashes of visible light from sources such as LEDs. VLC is one method through which 6G signals might hypothetically be transmitted in the future. But LEDs also emit side-channel RF signals, as a form of leaked energy. The researchers found that this could be harvested by a coiled copper wire, whose energy recycling efficiency is boosted when touching human skin.

According to the study, skin contact boosted efficiency by up to 10 times compared to using the coil on its own. The human body also proved to be better at amplifying the coil's ability to collect leaked radio energy than wood, plastic, cardboard or steel.

Body batteries

From this, the researchers created "Bracelet+" — a simple copper wire coil that could be worn as a bracket on the upper forearm. The design can also be adapted to be worn as a necklace, anklet, belt or ring, although the scientists found the bracelet occupied a happy medium between power harvesting and wearability.

"The design is cheap — less than fifty cents," said the authors of the study in a statement. "But Bracelet+ can reach up to micro-watts, enough to support many sensors such as on-body health monitoring sensors that require little power to work owing to their low sampling frequency and long sleep-mode duration."

With this in mind, such technology could solve the issue of limited battery life on wearable devices. Even highly rated smartwatches, like the Apple Watch, tend to need charging on a near-daily basis, which can mitigate how useful they are unless charging is part of one's daily routine. And now that smart rings are growing in popularity, there are even more devices that require regular power top-ups.

The energy harvesting technology that the Bracelet+ facilitates could, therefore, become a form of in-situ charger for next-generation wearable devices, providing of course that such devices come with a way of taking power from the bracelet.

Of course, this relies on 6G networks that use VLC, which are currently far away from deployment, let alone widespread adoption and integration into consumer or industrial devices.

But this could be the advent of turning the human body into a form of battery to power technology, only in a more harmonious fashion than the future envisioned by "The Matrix."

"Ultimately," said lead author of the study Jie Xiong, professor of information and computer sciences at UMass Amherst, in a statement, "we want to be able to harvest waste energy from all sorts of sources in order to power future technology."

MARCH 4, 2025

Smart contact lenses

Dubai-based startup Xpanceo is aiming to fit smart features including an "extended reality" display, health monitoring and wireless power reception into a flexible contact lens.

Demonstrator models at their stand show off proofs of concept for each of the capabilities that co-founder Roman Axelrod says they want to pack into a single prototype device "by the end of 2026".

For now the devices are relatively clunky, with a large metal coil needed to receive the wireless power to light up a single pixel on one demonstration lens.

Those components would be miniaturized using "two-dimensional materials... only one atom thick," Axelrod said.

"That is the scientific know-how that differentiates us".

Here’s more of what you’ll see through Meta’s $1,000 smart glasses

Here’s more of what you’ll see through Meta’s $1,000 smart glasses

Meta is reportedly preparing a higher-end version of its Ray-Ban Meta smart glasses with a built-in screen to launch as early as by the end of the year, *Bloomberg* reports.

The new glasses, codenamed Hypernova, can run apps and display photos, all controlled using hand gestures and capacitive touch on the sides of the frame. *Bloomberg* reports that the screen will only be visible on the right lens at the lower-right quadrant, and is best viewed when looking downward. When the device is turned on, a home screen appears and displays icons horizontally, similar to a Meta Quest.

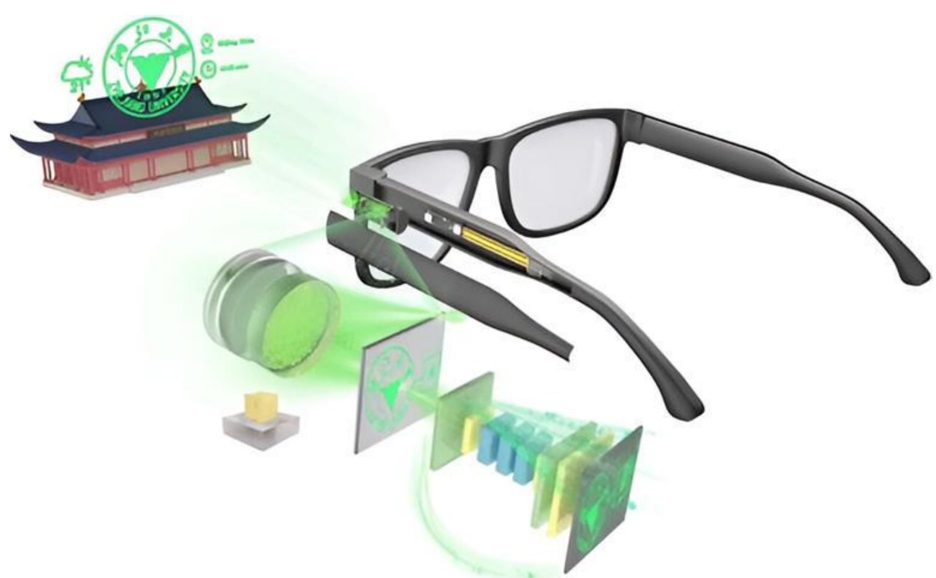
Hypernova will also feature an improved camera compared to the current model, and will continue building upon the idea of having an AI chatbot on your face, according to *Bloomberg*.

Bloomberg says that Hypernova will cost over $1,000 and could sell for as high as $1,300 to $1,400. For comparison, the current Meta Ray-Ban smart glasses start at $299.

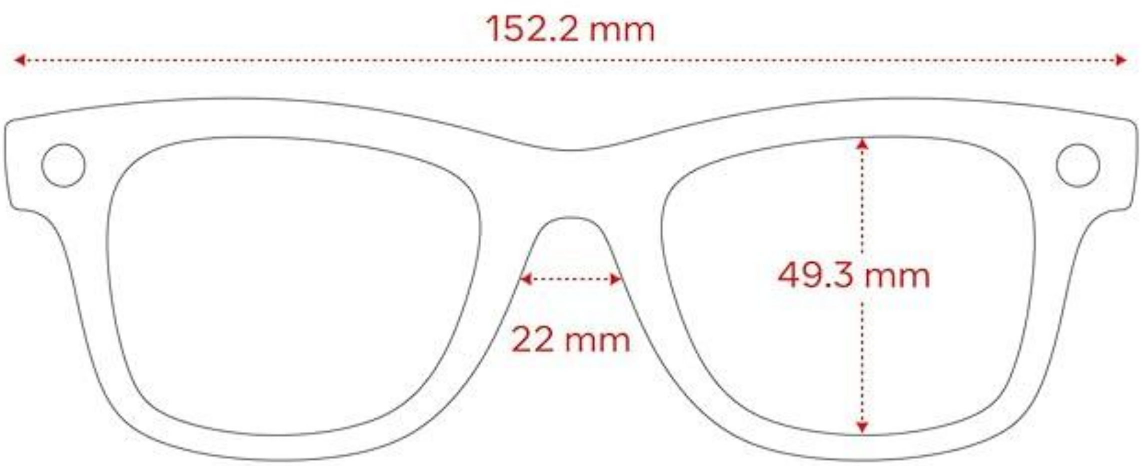
Meta is reserving advanced augmented reality technology for its still-in-development Orion glasses. In contrast, the Hypernova will target the "mid-tier" smart glasses shown off in droves at CES, such as the Rokid Glasses that display green text.

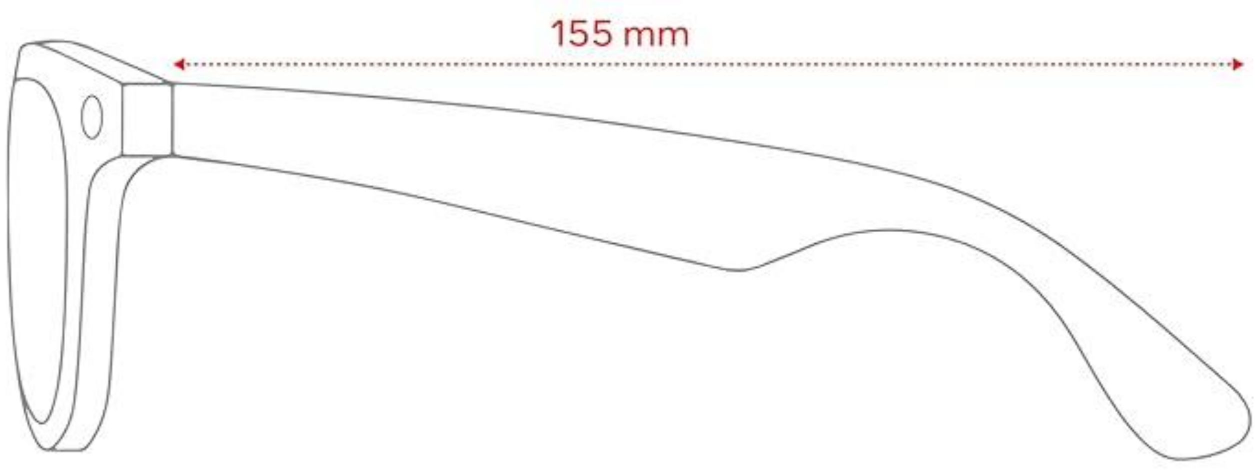
However, the Hypernova will command a higher price tag than other options, likely since it will come with the Orion's "neural" wristband controller, codenamed Ceres.

Meta is also working on a next version of Hypernova, with the codename Hypernova 2, that will have two screens, *Bloomberg* reports. The company is apparently planning to launch Hypernova 2 in 2027.



Large fit





Also available in regular fit

New Ray-Ban Meta Glasses for 2025 could get the upgrade we've been waiting for

New Ray-Ban Meta Glasses for 2025 could get the upgrade we've been waiting for© Future

When Meta revealed the Project Orion AR glasses during Meta Connect in September, it hinted at an impressive future for smart glasses, even if Orion is still a prototype.

We may get a teaser of what the future looks like next year as a report from The Wall Street Journal suggests that a new set of Ray-Ban Meta smart glasses will feature a "single small in-lens screen." Additionally, it could launch with a sensor wristband controller similar to the one being tested with the Orion glasses.

That information comes from a "person familiar with the project," though the report noted that Meta would not confirm heads-up displays glasses. Meta's vice president of wearables did tell the Journal that one of the most requested features is a viewfinder that would show basic information like notifications. He noted that Meta is working on multiple "sizes and form factors."

It seems to fit with a leaked Meta roadmap from 2023 that revealed Meta planned to launch a viewfinder pair of co-branded Ray-Ban glasses in 2025. That report also indicated that a "neural interface band" that allows for hand movement controls would debut alongside the third-generation of Ray-Ban smart glasses. A strong indicator of the sensor strap's existence was revealed with Project Orion. The strap could turn into a smart watch as suggested by the road map, though it's unclear when or if Meta is actually working on a "Meta Watch."

The road map specifically mentions "Orion" and reportedly set a launch window of 2027 as part of a new line of AR glasses dubbed "Innovation."

Assuming the road map and the Journal reports are accurate, as they appear to be, we will probably expect to see Meta release the viewfinder version in September or October around the annual Meta Connect event. Of course, Meta could shake things up, but its launch history suggests a fall window is most likely.

A viewfinder sounds interesting, but we do wonder if Meta will make other upgrades to make the display an effective tool. Currently, the Ray-Bans have an effective 6 hours of active use. We found in our review that livestreaming absolutely drained the battery and a tiny display with AR capabilities could easily eat away at it.

I also am curious if they can retain their stylish look or become a bit blockier the way the Orions are or more like the Xreal One AR glasses, which are nice but not a fashion statement.

Ray-Ban Meta upgrades

Just recently Meta rolled out three big upgrades for the Ray-Ban Meta smart glasses with Meta AI. This comes via the v11 software update.

The first upgrade is Shazam integration, which means you can say "Hey Meta, what is this song?" and your glasses will use the built-in mic to identify the track.

In addition, Meta AI can now 'see' what you're looking at via its camera. You'll be able to ask Meta AI questions about what you're looking at and get answers.

Lastly, live translation through the Ray-Ban Meta glasses promises to let you get real-time translations in French, Italian or Spanish — either via the open-ear speakers or as text on your phone.

Ray-Ban Meta smart glasses just got three big upgrades — here's the new features

last updated December 17, 2024

Shazam, live translation and new video AI powers


(Image credit: Future)

We were rather impressed with the 2nd gen Ray-Ban Meta smart glasses when we reviewed them, but thanks to Meta AI they've got steadily better over time. Even something as mundane as grocery shopping can be transformed with the AI implementation if you're wearing them.

But the latest update is the most significant yet. Teased at Meta Connect back in September, three new updates have arrived at the same time, making the glasses all the more useful. However, two of the features are only available to those on the early access program, and all three are currently for those in the U.S. and Canada only.

As detailed on the Meta blog, the three upgrades arrive with the v11 software update. The one that's available outside of early access is Shazam integration.

If you somehow hear a track you want to hear more of amidst all the Christmas muzak that's currently on repeat, you can simply say "Hey Meta, what is this song?" and your glasses will use the microphone to listen and come up with the answer for you to stream at your leisure. Again, this is only available in North America, so if you're elsewhere, you'll just have to rely on the Android and iOS apps.

Live AI: Meta AI can now 'see'

Then there are the two extras that require you to be a member of the Early Access program. Live AI is the first of these, adding video to Meta AI on your glasses. When activated, Meta AI can now "see" what you're looking at, and converse naturally about what's going on before your very eyes.

Meta thinks this will be hugely useful for activities when your hands are busy (think cooking or gardening), or just when out and about. You'll be able to ask Meta AI questions about what you're looking at, for example how you can make a meal out of a bunch of ingredients in front of you. There will be battery drain though, with Meta suggesting you'll get around half an hour of live AI use on a full charge.

Still, it's an exciting development, and one that Meta teases will improve over time: "Eventually live AI will, at the right moment, give useful suggestions even before you ask," the post reads.

Meta gets an F in first AI safety scorecard — and the others barely pass published December 16, 2024

(Image credit: Shutterstock)

As artificial intelligence evolves, it's clear there's some need for oversight. Most AI labs openly support regulation and provide access to frontier models for independent evaluation before release — but they could be doing more.
The world is turning to AI to solve all manner of problems, but without proper oversight, it could always create more.

Future of Life has developed a report card for the different AI labs including OpenAI, Meta, Anthropic and Elon Musk's xAI. The AI Safety Index is an independent review looking at 42 indicators of "responsible conduct".

AI Safety Index has worrying stats for the biggest AI companies

Firm	Overall Grade	Score	Risk Assessment	Current Harms	Safety Frameworks	Existential Safety Strategy
Anthropic	C	2.13	C+	B-	D+	D+

Firm	Overall Grade	Score	Risk Assessment	Current Harms	Safety Frameworks	Existential Safety Strategy
Google DeepMind	D+	1.55	C	C+	D-	D
OpenAI	D+	1.32	C	D+	D-	D-
Zhipu AI	D	1.11	D+	D+	F	F
x.AI	D-	0.75	F	D	F	F
Meta	F	0.65	D+	D	F	F

Source: Future of Life Institute
Grading: Uses the US GPA system for grade boundaries: A+, A, A-, B+, [...], F

The panel includes a series of luminaries in education and think tanks to check on how AI companies are operating, and the initial results are alarming.

Looking at Anthropic, Google DeepMind, Meta, OpenAI, x.AI and Zhipu AI, the report has found "significant gaps in safety measures and a serious need for improved accountability." According to the first report card, Meta scores lowest (x.AI isn't far behind), while Anthropic comes out on top — but still only gets a C.

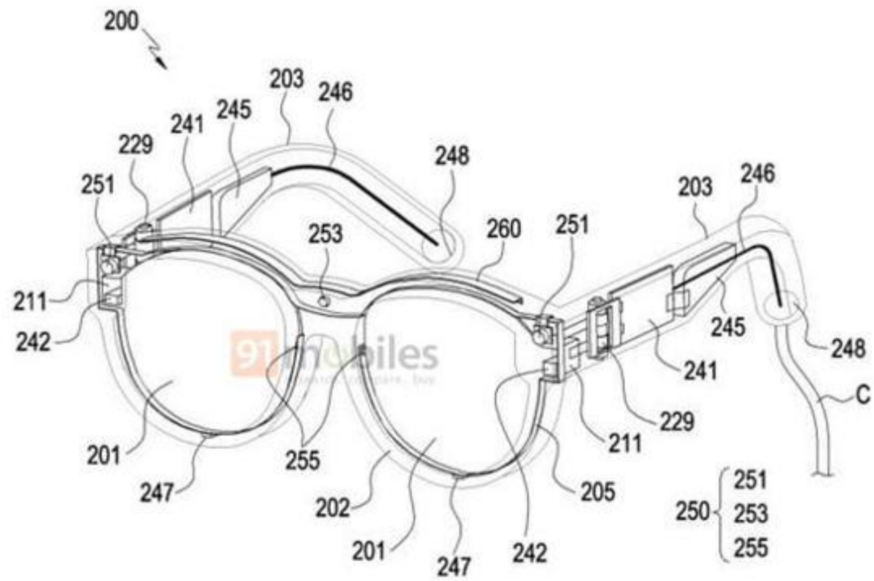
All flagship models were found to be "vulnerable to adversarial attacks", while also having the potential to be unsafe and break away from human control.

Perhaps most damning, the report says "Reviewers consistently highlighted how companies were unable to resist profit-driven incentives to cut corners on safety in the absence of independent oversight."

"While Anthropic's current and OpenAI's initial governance structures were highlighted as promising, experts called for third-party validation of risk assessment and safety framework compliance across all companies."

In short, this is the kind of oversight and accountability we need to see in the burgeoning AI industry before it's too late, as the more powerful the models get, the more real the harms become.

Samsung patent hints at plans for smart glasses



Samsung smart glasses patent

According to a recent rumor, Samsung is expected to introduce a bunch of new products in January 2025. The Galaxy S25 series is a pretty obvious candidate, but the rumor also suggests that the Galaxy Ring 2 could be part of the announcement, along with a pair of smart glasses. A recently discovered patent reveals the potential design of the Samsung smart glasses, along with interesting features such as speakers protected by electromagnetic interference.

A familiar look

This patent was discovered by the folks over at 91mobiles. It shows what appears to be a pair of regular-looking glasses, except that it comes with a bunch of tech shoved inside it. If this looks familiar, it is because it's hard not to draw comparisons to another pair of smart glasses on the market.

Meta introduced its own smart glasses back in 2023. The company created it in collaboration with Ray-Ban. While the concept of smart glasses isn't new, Meta's efforts made these hi-tech glasses look more casual and less nerdy.

Samsung's take on smart glasses doesn't appear to be too different from what's available in the market. It houses a bunch of sensors that can detect touch and pressure so users can interact with it without taking it off. It also comes with a built-in set of speakers. The speakers are the more interesting bit of this patent.

According to the patent, Samsung has come up with a way of protecting the speakers of the smart glasses from electromagnetic interference. This occurs when a power line and speakers are close to each other. The magnetic field generated by the powerline creates noise when that happens.

Samsung's patent suggests that the company has figured out a way to overcome that issue. Reducing unwanted noise is important for a pair of smart glasses, especially for listening to music and making calls, even though it might seem trivial.

Not Samsung's first rodeo

While this patent hints at a potentially new form factor, it would not be Samsung's first attempt at a headset. Some of you might recall that the company dipped its toes in the scene with the Samsung Gear VR headset.

More recently, the company teased a new headset codenamed "Moohan" (which means "infinity", in Korean). For those unfamiliar, Moohan is a mixed-reality headset that runs on Google's Android XR platform. Some believe that this could be Samsung's answer to Apple's (very expensive) Vision Pro headset.

It's interesting to see Samsung explore a variety of headset designs. Both the Gear VR and Moohan seem designed for indoor use, such as at home or the office. In contrast, this patent could allow users to wear the device outdoors. Google attempted something similar with Google Glass back in the day, but the public didn't react very well to it.

Reports claimed that establishments banned the headset over concerns that users were being recorded without permission.

On my son's behalf, I sought out the smart glasses that 'give sight to the blind'

Like many 4-year-olds, there's nothing my son loves more than cars. Despite my own complete lack of interest in the topic, he can already identify make and model of cars from across the street with uncanny accuracy, spurred on by his growing collection of Matchbox and Hot Wheels.

But as we've had to explain to him, we still don't know if he'll be ever to drive one himself. The brain tumor that he was born with left him with stunted vision, particularly in one eye, with little hope of improvement.

That's why one startup's CES pitch this year promising a pair of prototype smart glasses that could grant "sight for blind people" caught me off guard. Determined to see if it could really be true, I had a new agenda for my week in Las Vegas; to attempt to reinvigorate my own belief that tech advancements are still capable of transforming lives — and rediscover hope for my son's future.

Our 4-year old son was born with a very rare pituitary brain tumor, known as a craniopharyngioma. When it was discovered at 10 months old, the tumor was pressing up against his optic nerves and choking his pituitary gland. That meant a lack of normal hormone function that controls basic bodily functions like thirst, growth, cortisol production, and thyroid function — as well as a loss of vision.

Our world crashed around us as we attempted to envision the steps ahead, and more importantly, his future. It wasn't a malignant cancer, and it rarely resulted in loss of life. But in terms of quality of life, we'd heard enough horror stories to keep us up at night.

But don't worry — I promised a story about hope, and that's what this is.

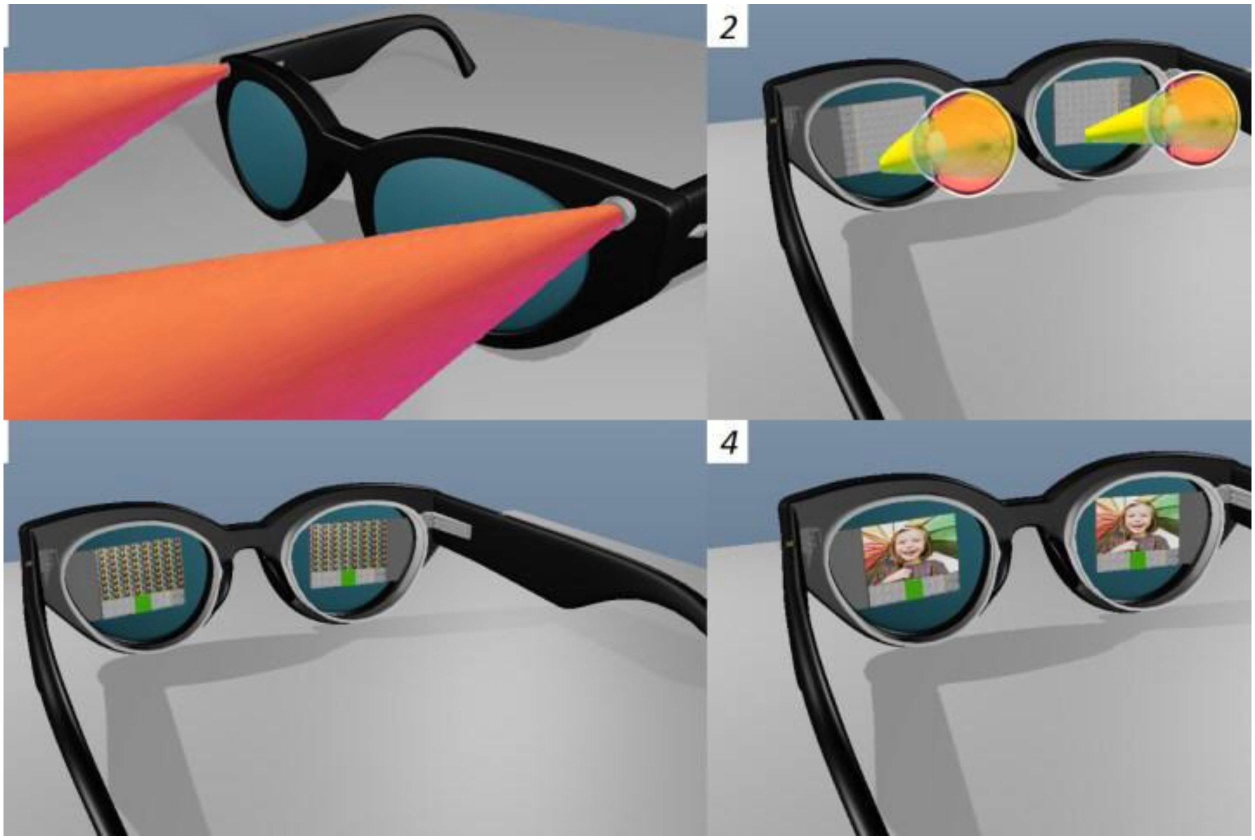
My first thoughts upon seeing the company's pitch in my inbox were of my own family — my mother with AMD (Age-related Macular Degeneration) and also my son, who experienced loss of vision from his brain tumor.

So, there I was, wading through the sea of people in Eureka Park, the Wild West of CES, attempting to find a small booth for a startup that went by the strange name, Soliddd. The company was there showing off its prototype smart glasses, known as Soliddd Vision, a piece of technology that aims to recover sight to people with low-vision conditions, including macular degeneration. The claim is huge: think of it like hearing aids for your eyes. Or, according to its ambitious CEO, Neal Weinstock, “giving sight to the blind.”

As a kid, it’s poor vision that affects our son’s daily life most. Despite being tumor-free since his miraculous surgery in 2023, he still requires daily supplementary hormone replacements and experiences poor vision in one of his eyes. You’d never know it from his attitude on life, but he’s been patching one eye for four hours a day for most of his life, and lack of vision affects lots of daily kid activities, like playing hide-and-seek or being able to spot an airplane in the sky.

But again, hope.

I tried on the delicate pair of prototype glasses. At this stage, they felt less like a pair of glasses and more like a small headset. The technology behind them, though, has the potential to be downright revolutionary. The frames have two cameras pointing out to capture the world and two pointing in to calibrate to the movement of your eyes.



The feed from the exterior cameras image is then projected into the micro display on the lens — but not just once. The lens actually has an array of displays on it, all showing the same image. What the founder and CEO of the company discovered was that the eye could be tricked into piecing this array of high-resolution images together into a single image.

Weinstock is an engineer with a background in 3D work, and the early prototypes of the Soliddd Vision were actually an example of autostereoscopic, or glasses-free 3D. But after working with Rich Muller, a physicist at University of California, Berkeley, he came upon the realization that there was an application for restoring vision.

“What the brain makes of these multiple images is something that people in computer science grok better than ophthalmologists,” Weinstock told me. “First of all, the ophthalmologists think that the resolution in these far regions of the eye is so low compared to the fovea. But everyone knows that your iPhone or Samsung phone are putting together multiple images from separate cameras and constructing better acuity in terms of a person’s vision. That’s what the brain does.”

Phone manufacturers had actually unknowingly mimicked the operation of the brain, and now that understanding is being reverse-engineered. By creating an array of Maxwellian displays, also known as retina-projection displays, Soliddd can aim a pinhole light through the natural lens of the eye without engaging the focusing mechanism, as Weinstock explained.

The brain does what it's always done — take the vision from your left eye and your right eye and add them together to create the single clearest image. With Soliddd Vision, the brain is taking this array of images from the lens and projecting them to the entirety of the retina — and self-selecting to create a perfectly in-focus image.

"We divide the content coming in from the cameras into an array of all the same image, which goes through the lens and delivers to the eye in perfect focus — directly to the retina," the chairman of Soliddd, Derek Myers, explained to me. "Those optic nerves are then capable of reading that and constructing a single image — in perfect focus. Therefore eliminating the areas of the eye that are degenerative."

Although wearing the glasses myself didn't immediately give me perfect vision, I could see what he was saying. Peering through the prism of screens, and after a couple of small adjustments, I was, indeed, seeing them as a single image. And with that, a spark of hope.

Early tests are promising

Soliddd says it's already working with early patients with conditions such as AMD (Age-related Macular Degeneration) and even coronary dystrophy, which can affect much younger people. One early patient is just 19, and after using the prototype glasses, reported fully restored central vision.

The form factor is important, of course, which Soliddd admitted. After all, if a pair of glasses was inconvenient, uncomfortable, or socially obtrusive, people would be far less likely to adopt them into their daily lives. Soliddd says it will be benefitting from all the advancements happening in the wider industry around compact form factors, which remains one of the biggest hurdles to adoption of smart glasses. We've all seen the success of glasses like the Ray-Ban Meta smart glasses, and much of that has to do with form factor.

I was shown renderings of what the company expects the consumer version of this product to look like, though, and they certainly seemed promising.

The company is considering the entire product package too, including the resolution and image quality — as well as ergonomics, privacy, and security concerns. All things that matter quite a bit when you're augmenting one's vision.

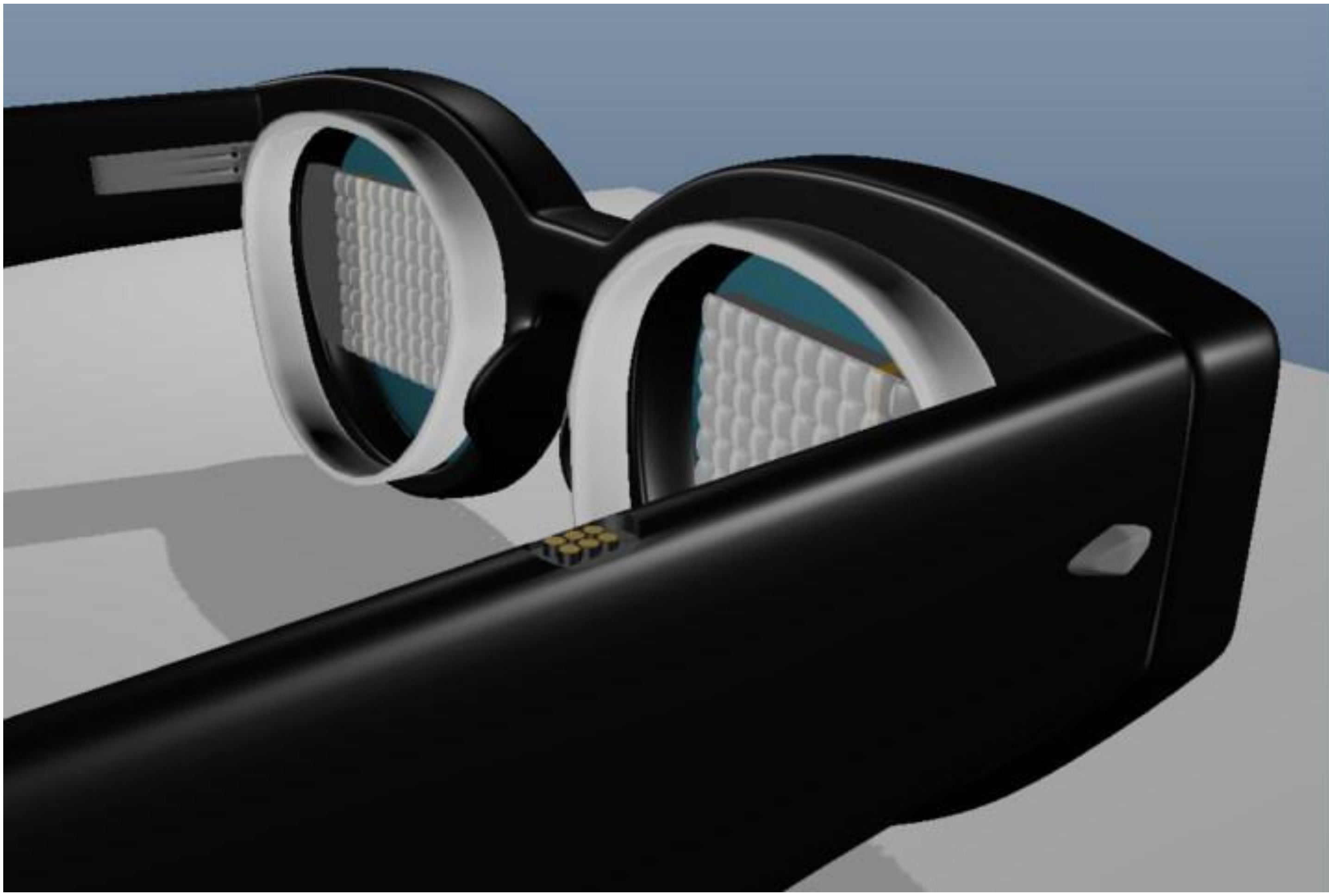
Perhaps even more exciting, though, Myers explained that future updates to the product could include a more fine-tuned solution for the specific mapping of a patient's individual retina. This could be important for someone like our son, who lacks peripheral vision on one side of his eye.

As he explained these things, I couldn't help but think of my son — perhaps in his teens or 20s — and what his life would be like. Don't get me wrong — on the other side of his surgery, I have so much hope and optimism for his future. And yet, what would technology in its infancy today would be fully matured in 10 or 20 years? It'd be disingenuous not to hope, especially since we've benefitted so much from advances in technology that aided in his own treatment.

His brain surgery, which was successfully completed entirely through his nasal cavity, used advanced technology and techniques that never would have been possible a few decades ago. That's because of endoscope cameras and tiny instruments, yes. But the first time the surgery had been done on a child of his age was only four years earlier by the same surgeon, who used a 3D-printed skull and virtual reality to ensure the surgery could be completed.

In our son's case, the result was a clean resection of the tumor with as minimal an impact as possible. On one hand — a tried-and-true miracle. On the other, more proof that advances in technology really do *matter*.

A not-so-distant future


Soliddd

Soliddd is currently fundraising, but it already has plans to put out a consumer product in the near future, as early as the first quarter of next year.

But let me clear: As of now, I don't know for sure that something like Soliddd could help my son's vision. He may have damage to his actual optic nerves from the tumor, which is wholly different from retinal deterioration. Furthermore, this first version of smart glasses may only have a few hours of battery life, designed for limited, at-home use.

But visual deficits that could benefit from such glasses run deep in my family. My mother has AMD, and my nephew may have some form of retinal damage as well. AMD is thought to be a generic condition that can be passed down generation to generation. Who knows — it may even be something I have to experience at some point, and is certainly therefore possible to pass on to our children.

As I described my son's condition to another Soliddd representative, he gave me a knowing grin.

"I can't tell you how many people have said that coming through here. You do the business conversation, and then it's my mom, my dad, my uncle, my grandpa."

As I've seen in my mother's own battle with AMD, there's no easy cure for the disease. It tends to progress over time, and the best treatments we have now can only hope to slow the deterioration of the retina. Technology like Soliddd provides an alternative solution. But for me, it's less that Soliddd's specific solution is the end-all-be-all. It's that CES and the tech world at large are full of ideas just like this. A smart walking cane with GPS and AI built into it for the blind, advanced smart hearing aids, and even an at-home AI stethoscope.

I'm not one to bank all my hope for the future in technological progress, but I walked away from CES this year dropping the skepticism and reigniting my sense of optimism about the potentially life-changing technology that is currently in development — and could be just a few years away.

Maybe someday, it could even mean that our son gets to live his dream of driving a car. I have more hope today than ever.

JANUARY 11, 2025

Smart glasses enter new era with sleeker designs, lower prices

Halliday-branded smart glasses on display at the Consumer Electronics Show in Las Vegas, where wearable tech innovations are on prominent display.

Producers of hi-tech connected eyewear are multiplying their innovations with increasingly discreet models in an attempt to make a difference in a highly competitive—and fast-emerging—market.

Live translation, GPS, cameras: glasses are quickly adopting new functionalities.

"There are so many of these smart wearables, and more of them are going on your face," said Techsponential analyst Avi Greengart at the Consumer Electronics Show (CES) in Las Vegas, where numerous smart glasses manufacturers showcased their latest innovations.

The industry has come a long way from its early days. Gone are the conspicuous protrusions of Google Glass and the bulky frames and cables of Epson's Moverio from the early 2010s.

Today's smart glasses, all paired with smartphone apps, increasingly resemble traditional eyewear. The Ray-Ban Meta, developed by Mark Zuckerberg's social media giant, currently leads the market with this new approach.

According to a recent MarketsandMarkets study, the sector's growth is "driven by advancements in augmented reality, artificial intelligence, and miniaturization technologies, which are pushing the boundaries of what these wearable devices can achieve."

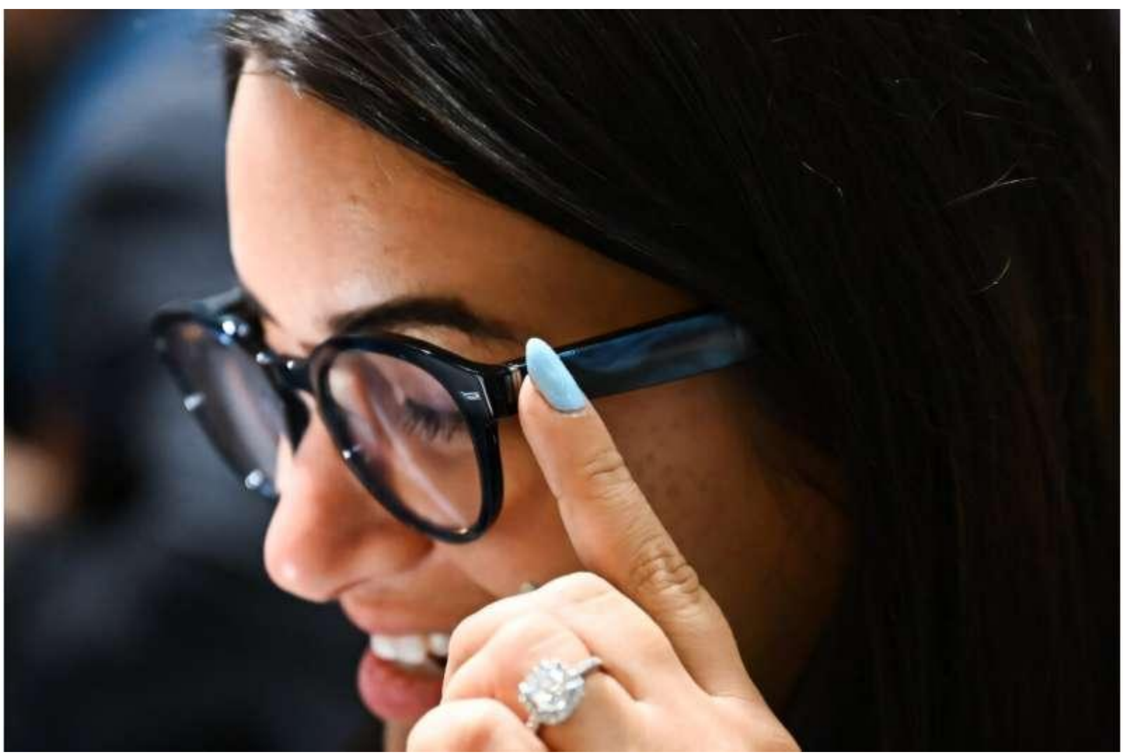
However, integrating technology into fashionable frames requires careful compromise.

The Ray-Ban Meta, for instance, can capture photos and videos, play music, and provide information about objects in view, but doesn't offer augmented reality with superimposed images.

Meta representative Robin Dyer explained that while AR capabilities may come later, they would likely double the current price.

200 dollars

Price is a major battleground in this market, particularly with the entry of Chinese manufacturers.



Amazon's Echo Frames connected glasses on display at CES on January 7, 2025 in Las Vegas.
While Google Glass initially retailed for around $1,500 in 2013, today's smart glasses are approaching the price of premium conventional frames.

Meta's James Nickerson noted that their Ray-Ban collaboration starts at $300, just $50 more than standard Ray-Bans, offering "a cool camera" as a bonus.

California startup Vue has pushed prices even lower, offering basic models with voice assistant and music capabilities for $200.

Some manufacturers, like XReal, focus on augmented reality, projecting smartphone, computer, or gaming console displays—though this is a market for which Apple's Vision Pro failed to create excitement last year.

For AR, recent advances help move away from the bulk of a virtual reality headset towards that of classic sunglasses, even if they require a cable to be connected to the device.

Meta's ambition is to launch its own pared down version, the Orion, currently in the test phase but not expected to be marketed until 2027 at the earliest.

Chasing cool

Companies like Even Realities and Halliday are pioneering ultra-thin frames that look identical to standard glasses while offering basic AR capabilities.

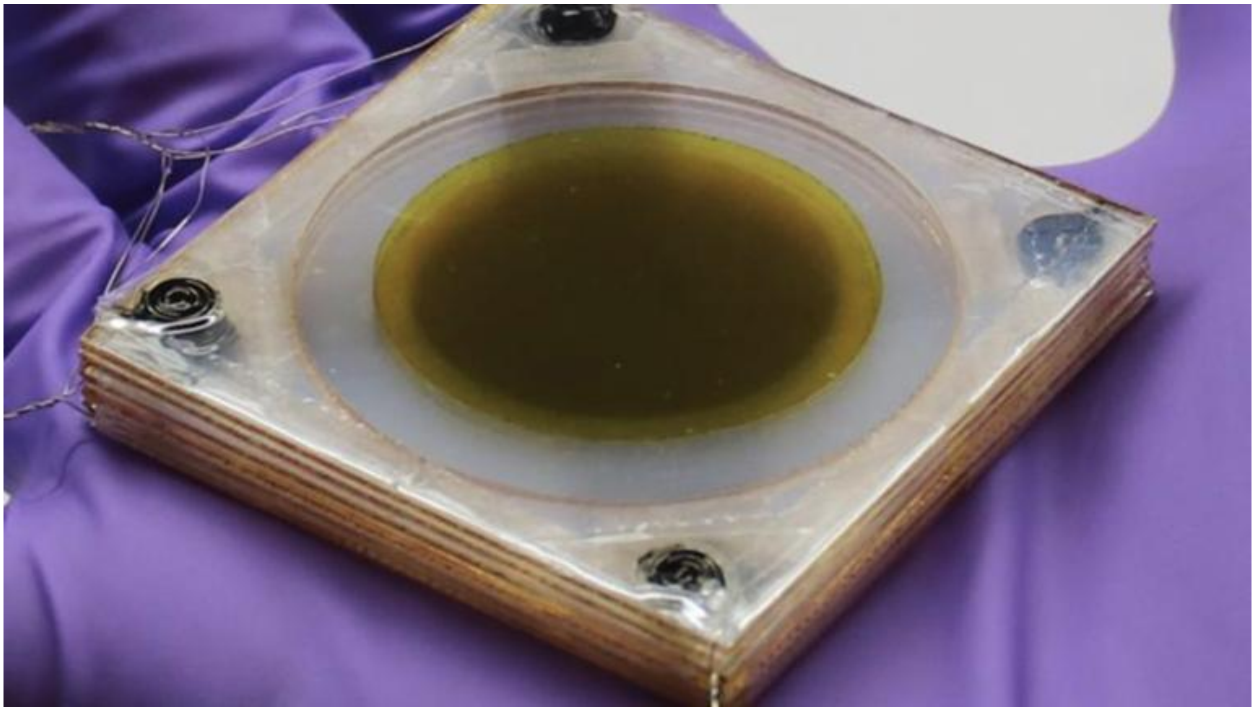
"If we want to make a good pair of smart glasses, we must first make a pair of cool glasses," emphasized Carter Hou, Halliday's second-in-command.

Halliday's $489 model, launching in March, displays text in the upper corner of the wearer's vision. Using AI, it can suggest responses during conversations, provide real-time translation, and function as a discrete teleprompter.

Even Realities has also taken a minimalist approach.

"We got rid of the speaker, we got rid of the camera," explained the company's Tom Ouyang. "Glasses are for the eyes, not the ears."

Cooling pump made of thin films drops temperatures by 16 degrees, can transform wearables



Cooling pump made of thin films drops temperatures by 16 degrees, can transform wearables

A new cooling innovation developed by scientists pumps away heat continuously using layers of flexing thin films. The design is based on the electrocaloric effect, in which an electric field causes a temporary change in a material's temperature, according to researchers.

Developed by UCLA materials scientists, the prototype could lower ambient temperatures of its immediate surroundings by 16 degrees Fahrenheit continuously and up to 25 degrees at the source of the heat after about 30 seconds during lab experiments.

Qibing Pei, a professor of materials science and engineering at the UCLA Samueli School of Engineering, stated that their long-term goal is to develop this technology for wearable cooling accessories that are comfortable, affordable, reliable and energy-efficient — especially for people who work in very hot environments over long hours.

Material is composed of a circular stack of six thin polymer films

"As average temperatures continue to rise with climate change, coping with heat is becoming a critical health issue. We need a variety of solutions to the problem and this could be the basis for one," added Pei.

Scientists revealed that the experimental material is composed of a circular stack of six thin polymer films, just under an inch in diameter and one-quarter of an inch thick for the entire stack. Each layer is coated with carbon nanotubes on both sides. The resulting material is ferroelectric, which means it changes shape when an electric field is applied.

When the device's electric field is switched on, the stacked layers compress against each other in pairs. When the electricity switches off, the stacked pairs come apart to then press against the other neighboring layers. As this alternating process repeats itself, the self-regenerative, accordion-like cascading action continually pumps heat away, layer by layer, according to a press release.

Polymer films use a circuit to shuttle charges

Hanxiang Wu, one of the study's co-lead authors and a postdoctoral scholar working in Pei's lab, stated that the polymer films use a circuit to shuttle charges between pairs of stacked layers, which makes the flexible cooling device more efficient than air conditioners.

Scientists maintained that traditional cooling technology relies on air conditioning and refrigeration, which require vapor compression that not only consumes a great deal of energy but also uses carbon dioxide as a coolant. The new device is a simpler design that does not require greenhouse-gas-generating coolants or liquids. It operates solely with electricity, which can be sustainable when generated through renewable energy sources such as solar panels, as per the release.

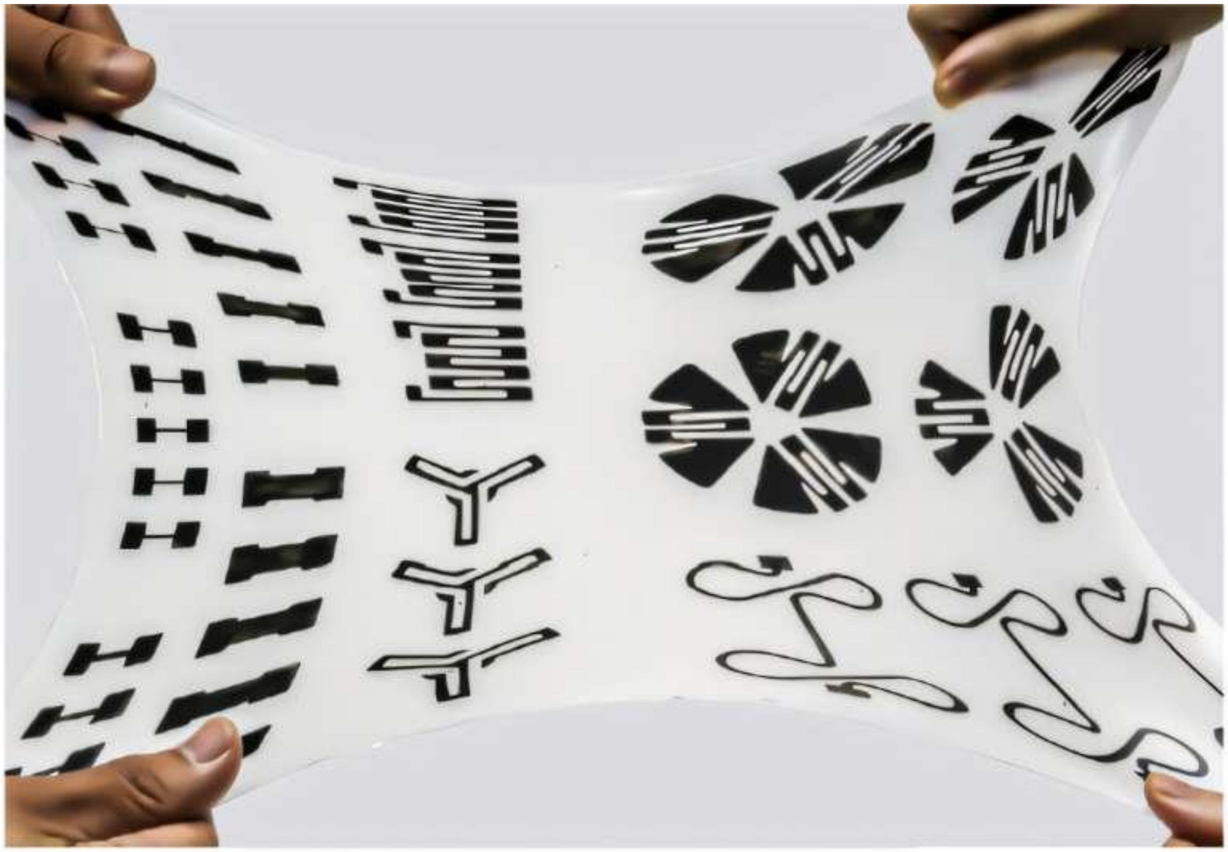
Wenzhong Yan, a postdoctoral scholar in mechanical engineering, stated that this cooling device integrates advanced materials with an elegant mechanical architecture to deliver energy-efficient cooling by embedding functionality directly into its structure, reducing complexity, energy use and computational demands.

Pei highlighted that electrocaloric cooling would be most-ideal for next-generation wearables that can keep us cool under strenuous conditions. “It could also be used to cool electronics with flexible components,” said Pei.

JANUARY 23, 2025 FEATURE

A new method to fabricate soft electronics via particle engulfment printing

by Ingrid Fadelli , Tech Xplore



Soft sensors engulfed on A4-size elastomer. Credit: Rongzhou Lin.

The electronics industry has been rapidly advancing over the past few decades, leading to the development of countless devices of different sizes and shapes, which are designed for a variety of applications.

These include stretchable electronics, which are sensors and other devices that can be used to create smart watches, fitness trackers, bio-medical sensors to monitor specific health conditions and soft robots.

Flexible electronics are typically made using soft polymers, elastic materials comprised of long molecular chains that can undergo significant deformation without breaking. To broaden their functions or boost their performance, these polymers are often combined with microscale or nanoscale particles that have specific optoelectronic or magnetic properties, also known as functional particles.

Most existing approaches to introducing functional particles in polymers work by dispersing the particles into liquid molecules that bond with other molecules to form a polymer before the material is solidified. Yet many of these strategies are only applicable to some polymer-particle combinations or are difficult to implement on a large scale.

Prof. John Ho's research group at the National University of Singapore and Prof. Yong Lin Kong's group at Rice University recently introduced a new method for fabricating soft electronics, which is outlined in a paper in *Nature Electronics*.

The first author of this paper is Dr. Rongzhou Lin, who was a post-doctoral scholar at the time and is now a faculty member at the South China University of Technology.

The new approach developed by the researchers leverages a soft matter physics phenomenon called 'particle engulfment' to embed particles into a soft polymer. Particle engulfment is a spontaneous process that occurs when the so-called elastocapillary length of a polymer's matrix surpasses the characteristic length of particles.

"Elastocapillary length is the length scale at which the surface stress becomes important over bulk elastic stresses," Prof.Yong Lin Kong, the co-corresponding author of the paper, told Tech Xplore.

"For example, when a particle with a size smaller than the elastocapillary length (e.g., a very soft substrate) is left on the surface, the surface stress of the substrate can dominate, so much so that it becomes energetically favorable for the particle to be 'subsumed' by the solid substrate itself.

"This phenomenon itself is not new and was already studied by others within the soft matter physics community, including as part of a beautiful work by Prof. Eric Dufresne at Cornell University. However, prior work studied particle engulfment with a few particles and it had so far not been employed to fabricate electronics."

While they were trying to create an effective soft strain sensor, the researchers found that existing approaches to disperse CNT particles into polymer solutions did not reliably produce the conductive polymers needed for high-performance stretchable sensors. Yet accidentally, they discovered the advantages of leveraging particle engulfment to create these conductive polymers for stretchable electronics.

"Conventional methods for creating strain sensors using carbon nanotube (CNT) typically involve dispersing CNTs into a polymer precursor with the use of solvents," Rongzhou Lin, first author of the paper, told Tech Xplore.

"However, we encountered challenges in producing conductive composites using this approach. Unexpectedly, we discovered that applying rubber CNTs onto cured silicone resulted in the easy formation of conductive composites."

When they investigated this phenomenon further, the researchers found that nanomaterials can spontaneously embed themselves into the polymer matrix via the particle engulfment phenomenon. They then integrated this approach with a printing set-up, using a stencil mask to control the exposed areas, which was found to successfully incorporate a broad range of functional particles into soft polymers.

To demonstrate the potential of their proposed method, the team used it to create elastic electronics with multiple layers incorporating various materials. The devices they fabricated could be suitable for different real-world applications, as they were found to possess wireless sensing, communication and power transfer capabilities.

"To the best of our knowledge, this was the first successful use of particle engulfment to make soft electronics," Lin said.

In addition to demonstrating the possibility of using particle engulfment to develop system-level electronics with tissue-like properties, this study also opens up new possibilities for soft matter physics research. Future studies could leverage the methods employed by the team to further study the physics underpinning particle engulfment.

"As this is the first experimental study on the engulfment of high concentrations of particles, our experimental data can potentially unravel new physical insights that have not been previously explored," Kong added.

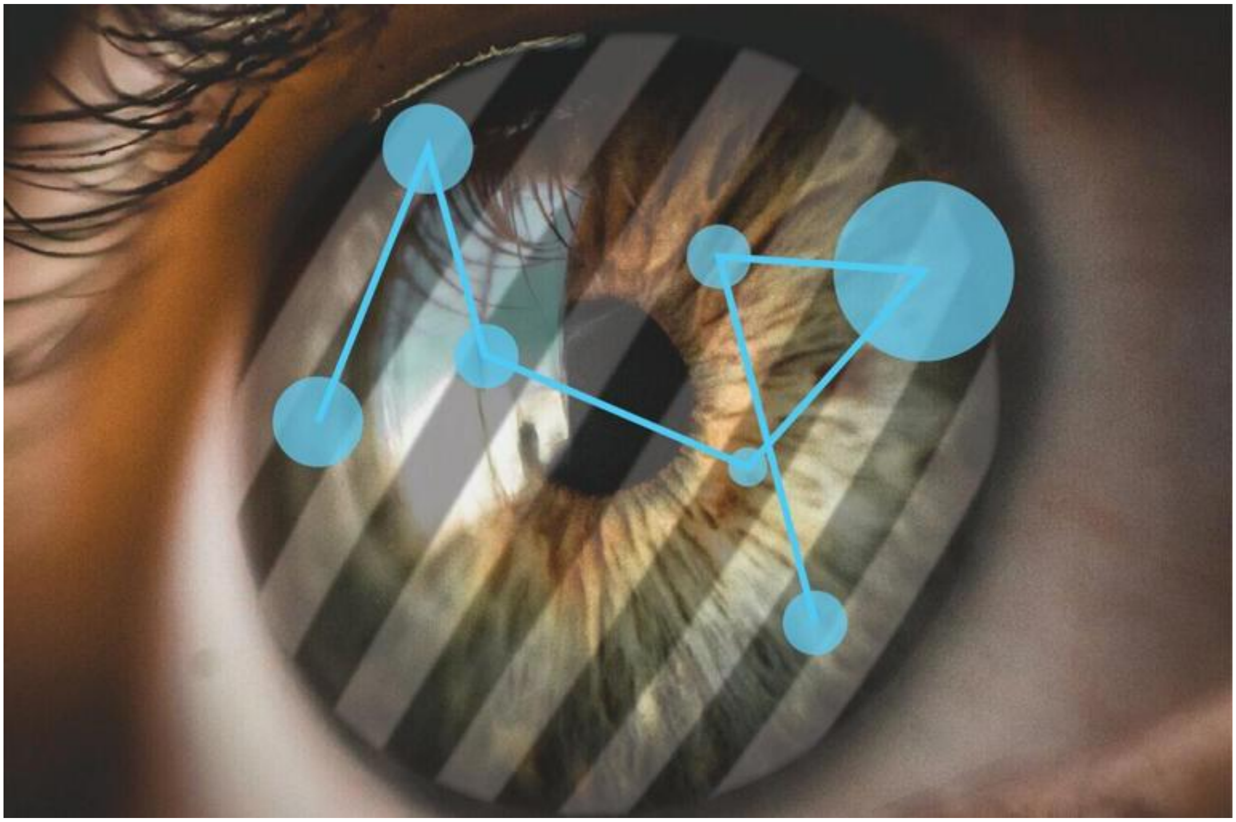
"Our intriguing observations open new questions in soft matter physics, such as multi-layer engulfment of particles that could inspire future applications."

As the new strategy devised by the researchers is both scalable and reliable, it could soon also be employed by other teams, contributing to the further advancement of the electronics industry.

In the future, it could be used to fabricate a broader range of electronics, including electronic skins for robots and stretchable sensors for wearable devices.

More information: Rongzhou Lin et al, Soft electronics based on particle engulfment printing, *Nature Electronics* (2025). DOI: 10.1038/s41928-024-01291-0.
Journal information: Nature Electronics

Neuroscientists reveal how brain coordinates attention and eye movements



Two new studies from the Center for Neuroscience (CNS), Indian Institute of Science (IISc) explore how closely attention and eye movements are linked and reveal how the brain coordinates the two processes.

Attention is a unique phenomenon that allows us to focus on a specific object in our visual world, and ignore distractions. When we pay attention to an object, we tend to gaze towards it. Therefore, scientists have long suspected that attention is tightly coupled to rapid eye movements, called saccades. In fact, even before our eyes move towards an object, our attention focuses on it, allowing us to perceive it more clearly—a well-known phenomenon called pre-saccadic attention.

However, in a new study published in *PLOS Biology*, the researchers at CNS show that this perceptual advantage is lost when the object changes suddenly, a split second before our gaze falls upon it, making it harder for us to process what changed.

"Our study provides an interesting counterpoint to many previous studies which suggested that pre-saccadic attention is always beneficial," explains Devarajan Sridharan, Associate Professor at CNS and corresponding author of the study.

In the study, Priyanka Gupta, a Ph.D. student in Sridharan's lab, trained human volunteers to covertly monitor gratings (line patterns) presented on a screen, without directly looking at them, and to report when one tilted slightly. "Importantly, the participants did this task just before their eyes moved, in the pre-saccadic window. So, we were able to study the relationship between pre-saccadic attention and the detection of changes in the visual environment," explains Gupta.

A tracker was used to monitor their eye movements before, during and after their gaze fell on the object. "To our surprise, participants found it harder to detect the changes in the pre-saccadic window," Gupta adds.

In a follow-up experiment, they made the participants monitor two gratings presented one after the other quickly, again, just before their eyes moved. What the team found was that if the orientation of the second grating suddenly changed during this time, the participants tended to mix up the orientations of the two gratings—explaining the loss of the attentional advantage.

"This is essentially a basic science study," says Sridharan. But such insights, he adds, can be useful for how we track multiple objects in rapidly changing environments—in driving or flight simulators, for example.

In the other study, published in *Science Advances* and carried out with collaborators at Stanford University, the researchers devised an unusual experiment—this time, to decouple attention from eye movements—in monkeys. Their goal was to tease out what is happening in the brain while these processes play out.

The monkeys had been trained on a counter-intuitive task called an "anti-saccade" task. Like the human study, the monkeys covertly monitored several gratings on a computer screen without directly looking at them. But when any one grating tilted slightly, the monkeys had to look away from it instead of focusing more sharply on it. This helped the researchers delink the location of the monkey's attention, from the location where its gaze ultimately fell.

Using a special kind of electrode called a "U-probe," they also recorded signals from hundreds of neurons across different layers of a specific region in the monkey's brain called the visual cortex area V4. What they found was that neurons in the more superficial layers of the cortex generated attention signals, while neurons in deeper layers produced eye movement signals.

Interestingly, these neurons also showed different activity patterns. "The superficial neurons increased their firing rates, to signal the object that needs to be attended to and prioritized for decision-making," says Adithya Narayan Chandrasekaran, first author of the *Science Advances* study and a former research assistant in Sridharan's lab at CNS. On the other hand, the deep neurons were tuning down their "noise," possibly to allow the animal to perceive the object better.

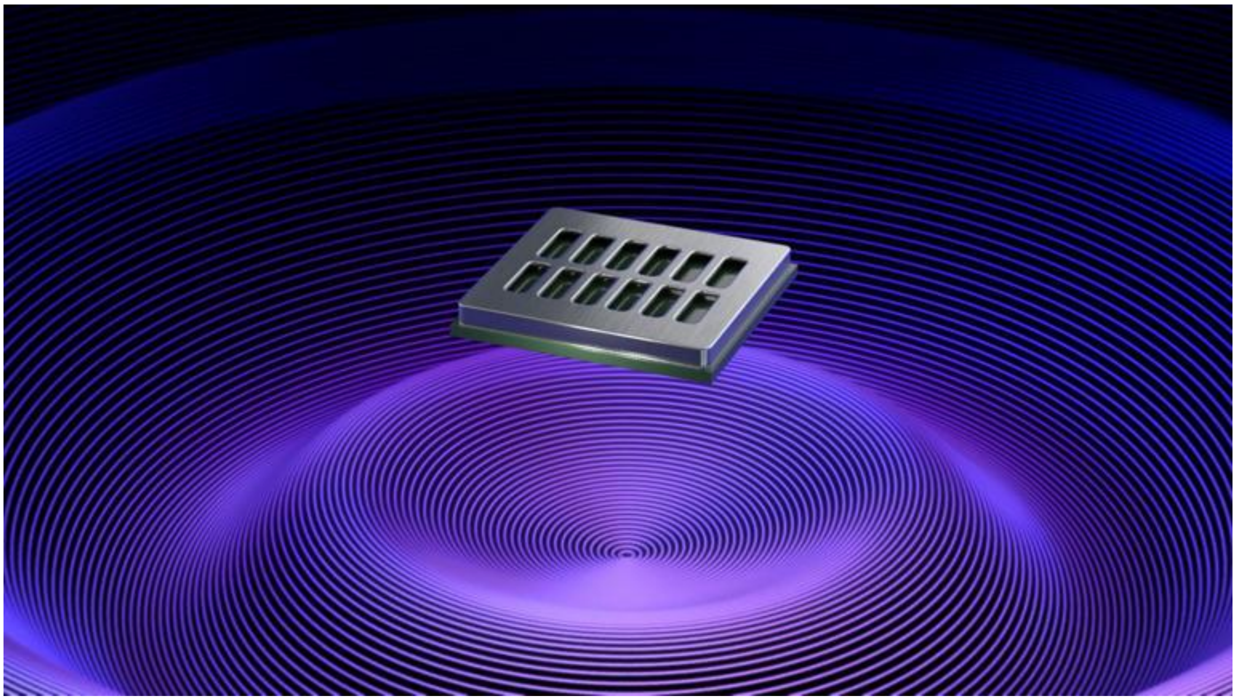
The researchers believe that uncovering such brain signatures can eventually point to what fails in attention disorders. Sridharan says, "Discovering such mechanisms is vital for developing therapies for disorders like ADHD."

More information: Priyanka Gupta et al, Presaccadic attention does not facilitate the detection of changes in the visual field, *PLOS Biology* (2024). DOI: 10.1371/journal.pbio.3002485

Adithya Narayan Chandrasekaran et al, Dissociable components of attention exhibit distinct neuronal signatures in primate visual cortex, *Science Advances* (2024). DOI: 10.1126/sciadv.adi0645

Provided by Indian Institute of Science

Tiny Speaker Promises Big Sound From Smartwatches and Smart Glasses



Tiny Speaker Promises Big Sound From Smartwatches and Smart Glasses© xMEMS Labs

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The latest micro fidelity driver from xMEMS Labs is not meant to go inside typical audio products like earphones or headphones. Instead, the full-range Sycamore speaker aims to bring audio to a wide variety of wearable devices that broadcast sound near your ear rather than inside it.

The jump in quality should make such devices far better at delivering enjoyable audio experiences beginning in late 2025.

The Sycamore micro-electromechanical systems (MEMS) driver measures 8.41 by 9 by 1.13mm (HWD) and weighs 150 milligrams. It's one-seventh the size of a typical dynamic driver and one-third the thickness, xMEMS Labs says. This, in turn, reduces the area needed behind the driver to produce good sound.

It's this incredibly small size that allows it to fit inside the confines of spaces like smartwatches, smart glasses, and other wearables. The "membrane" that moves is made from silicon rather than a more fluid material like paper or rubber, and it is much more rugged, earning an IP58 rating for protection from sweat or rain—a key feature for devices meant to be worn.

(Credit: xMEMS Labs)
Despite its small size, xMEMS' Sycamore doesn't skimp on performance; the driver covers a full range of audio, including sub-bass, mid-bass, and high frequencies, xMEMS Labs claims. It can do so at surprisingly high volumes, which allows it to push sound across the air between the device and the wearer's ear.

Target devices include open wireless earbuds, XR headsets, and more. "The applications for Sycamorel...are limited only by designers' imagination," xMEMS Labs says.

Sampling for the Sycamore begins in early 2025, with full production slated to start in October.

Groundbreaking neural technology can help people recall lost memories

The scientists in this study developed a new model aimed at assisting the hippocampus in recalling specific information.

The scientists in this study developed a new model aimed at assisting the hippocampus in recalling specific information. (CREDIT: Creative Commons)
A group of scientists from Wake Forest University School of Medicine and the University of Southern California (USC) has achieved a significant milestone in neuroscience by successfully utilizing a neural prosthetic device to recall specific memories.
Their findings, published online in Frontiers in Computational Neuroscience, mark a pioneering step forward in memory research.
The groundwork for this breakthrough stems from a previous study conducted by the Wake Forest and USC team in 2018, led by Dr. Robert Hampson, a professor specializing in regenerative medicine, translational neuroscience, and neurology at Wake Forest University School of Medicine.

This earlier study demonstrated the effective implementation of a prosthetic system harnessing an individual's own memory patterns to enhance the brain's capacity to encode and retrieve memories.

In their initial research, the team utilized an electronic prosthetic system based on a multi-input multi-output (MIMO) nonlinear mathematical model. By manipulating the firing patterns of multiple neurons in the hippocampus, a brain region crucial for memory formation, they achieved promising results.

Building upon their prior work, the scientists in this study developed a new model aimed at assisting the hippocampus in recalling specific information.

When the brain tries to store or retrieve particular memories, such as remembering to turn off the stove or locating misplaced car keys, distinct groups of cells collaborate in neural ensembles to activate and store the information. Leveraging recordings of this brain activity, the researchers devised a memory decoding model (MDM).

During the study, the research team delivered neurostimulation to study participants during visual recognition memory tasks. (CREDIT: Wake Forest University School of Medicine)

This model enabled them to decipher the neural activity associated with storing different pieces of specific information. Subsequently, the decoded neural activity was translated into a pattern or code, which was used to administer neurostimulation to the hippocampus during memory retrieval processes.

Dr. Brent Roeder, a research fellow in the department of translational neuroscience at Wake Forest University School of Medicine and the study's corresponding author, emphasized the significance of their approach: "Here, we not only highlight an innovative technique for neurostimulation to enhance memory, but we also demonstrate that stimulating memory isn’t just limited to a general approach but can also be applied to specific information that is critical to a person."

Delayed match to sample (DMS) task performed on a touch screen by patients seated in either the hospital bed or a chair. (CREDIT: Frontiers in Computational Neuroscience)

To test the efficacy of their method, the team recruited 14 adults with epilepsy undergoing a diagnostic brain-mapping procedure involving surgically implanted electrodes placed in various brain regions to identify seizure origins. These procedures took place at Atrium Health Wake Forest Baptist Medical Center, Keck Hospital of USC in Los Angeles, and Rancho Los Amigo National Rehabilitation Center in Downey, California.

During visual recognition memory tasks, the researchers administered MDM electrical stimulation to assess its impact on memory retention. The results revealed significant improvements in memory recall among participants who received the stimulation, with approximately 22% showing noticeable enhancements in performance.

Sample patterns from an individual patient for each of the categories. Unique patterns that were 4 s in length were derived for each subject for every patient using the MDM applied to each patient's own neural recordings. (CREDIT: Frontiers in Computational Neuroscience)

Moreover, when focusing on participants with impaired memory function who underwent bilateral brain stimulation, nearly 40% exhibited substantial improvements in memory performance. Dr. Roeder underscored the potential applications of their technology in aiding individuals with memory-related impairments: "Our goal is to create an intervention that can restore memory function that's lost because of Alzheimer's disease, stroke or head injury."

Despite these promising findings, Dr. Roeder stressed the need for further research to refine the technology and unlock its full potential in enhancing memory function. He expressed hope that advancements in MDM-based stimulation could empower individuals to live more independently by aiding in critical tasks such as medication management and home security.

Diagram of an individual-trial DR screen following DMS stimulation session. Images consist of the sample/match image, one Nonmatch image from the same trial, and one novel image not used in any prior testing. The "familiarity" choices displayed with each image are converted to a numeric ranking (0 = Do not recognize, 5 = Definitely saw) for scoring and analysis. (CREDIT: Frontiers in Computational Neuroscience)

This groundbreaking research builds upon over two decades of preclinical studies on memory codes led by Dr. Sam Deadwyler, emeritus professor of physiology and pharmacology at Wake Forest University School of Medicine, alongside Dr. Hampson and the USC team led by biomedical engineers Dr. Theodore Berger and Dr. Dong Song. The preclinical investigations utilized similar stimulation techniques to restore and bolster memory in animal models using the MIMO system developed at USC.

Funded by the U.S. Defense Advanced Research Projects Agency (DARPA), this research represents a significant stride forward in understanding and potentially enhancing human memory function. As scientists continue to unravel the complexities of the brain, innovations like these hold promise for addressing memory-related disorders and improving overall cognitive health.

Surprising connection between fatty acids and how the brain creates memories

Researchers have uncovered a significant breakthrough in understanding how the brain consolidates memories.

To investigate the significance of free fatty acids in memory formation, the researchers employed mouse models with the PLA1 gene removed, monitoring their neurological and cognitive functions over time.

"We saw that even before their memories became impaired, their saturated free fatty acid levels were significantly lower than control mice," Professor Meunier remarked. "This indicates that this PLA1 enzyme, and the fatty acids it releases, play a key role in memory acquisition."

The findings from this study not only advance our understanding of memory formation but also offer promising prospects for therapeutic interventions in neurodegenerative diseases like Alzheimer's. "Our findings indicate that manipulating this memory acquisition pathway has exciting potential as a treatment for neurodegenerative diseases," Professor Meunier stated.

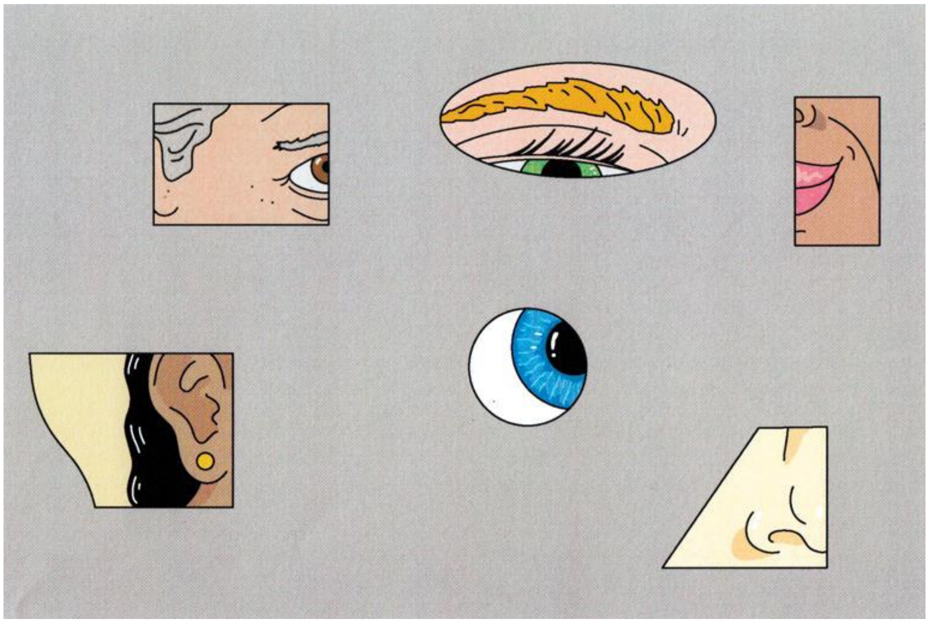
The research team acknowledges the valuable contributions of PhD candidates Saber Abd Elkader from the Australian Institute for Bioengineering and Nanotechnology, and Benjamin Matthews from the Queensland Brain Institute.

Behavioural responses to instrumental conditioning in DDHD2+/+ vs DDHD2−/− mice. Instrumental conditioning was performed on cohorts of DDHD2+/+ (WT) or DDHD2−/− (KO) mice vs controls, respectively. (CREDIT: The EMBO Journal)

This collaborative effort involved researchers from the University of New South Wales, University of Strasbourg, University of Bordeaux, The Scripp Research Institute, and the Baylor College of Medicine.

The research paper detailing these findings has been published in the prestigious EMBO Journal, marking a significant milestone in neuroscience research. With this groundbreaking discovery, scientists are now equipped with new insights into the intricate workings of memory formation, paving the way for innovative approaches to combat neurodegenerative disorders.

Are you a super-recognizer? The science of superior facial processing.



Are you a super-recognizer? The science of superior facial processing.© George Wylesol for The Washington Post

Do you remember the face of any stranger who passed by you today?

You probably can't, but super-recognizers can. These rare individuals can identify unfamiliar faces after a brief glimpse. And by studying them, researchers hope to understand how we recognize that a face belongs to someone we know — an important ability for a social species such as ours.

"The face is the most important visual stimulus for humans in their environment, probably throughout evolution," said David White, associate professor of psychology and lead investigator of the Face Research Lab at the University of New South Wales, Sydney. "We're a social species, and the information contained in the face is vital to behave rationally in a social environment."

We don't, for example, usually need to identify specific chairs, because knowing "it's just a chair" is enough, said Meike Ramon, an assistant professor and head of the Applied Face Cognition Lab at the University of Lausanne. "But for faces, it matters who each unique individual face belongs to."

Face processing on a spectrum

Our ability to recognize faces is part of a spectrum.

At one end are the 2 to 3 percent of people with face blindness — or developmental prosopagnosia — who have trouble recognizing faces that should be familiar to them, including those of loved ones or even their own.

At the other end are super-recognizers, first reported on in 2009, who excel at identifying or matching faces, even those that are unfamiliar to them — whether they are flipped upside-down, low resolution or presented at a different angle.

They have a "unique ability to derive a three-dimensional representation of a face, even when they see only one 2D image of the person," Ramon said. Super-recognizers are rare, though how rare is hard to estimate because there is no single agreed-upon method for categorizing them.

Most people's ability to process faces lies somewhere in between, where recognizing familiar faces is easy but deciphering unfamiliar ones is challenging.

What makes super-recognizers super

Super-recognizers are drawn to faces.

Even when they are presented with random pictures of everyday life, super-recognizers spend more time looking at faces, Ramon and her colleagues reported in one 2022 study.

Their eyes are also drawn immediately to the face, regardless of where that face is in the photo — and most closely near the optimal place for identification, below the eyes.

"It seems like faces are extremely salient for super-recognizers for reasons that we still don't know," Ramon said.

Their brains also respond differently to visual images less than a second after seeing them.

In a 2024 study, Ramon and her colleagues recorded brain activity from 16 super-recognizers and 17 control participants using EEG while they viewed a variety of pictures, such as of plants, animals, scenes and faces. Even just 65 milliseconds after an image pops up — faster than the blink of an eye — their brains already start responding differently from neurotypical brains.

Interestingly, super-recognizers exhibited this difference in neural activity regardless of what they were looking at, which suggests that their brains process visual information differently in general.

Other research suggests that super-recognizers have broader activation of the brain's face-processing networks, even when looking at unfamiliar faces.

The super-recognizer ability to process faces may simply reflect how good they are at processing all visual information. And conversely, people with face blindness not only struggle with faces but may also have difficulties processing other types of visual information.

Curiously, however, super-recognizer abilities may extend beyond the visual domain. A 2021 study of 529 participants reported that super-recognizers were also much better at identifying unfamiliar and familiar *voices*, despite having merely average pitch discrimination, which may point to a "common basis for person identity processing abilities" across different senses, White said.

Still, super-recognizers have weaknesses. Just like typical recognizers, super-recognizers also find it more difficult to distinguish between the faces of people of ethnicities different from their own.

Getting better at recognizing faces

Identifying unfamiliar faces is tricky, even for experienced professionals such as forensics examiners and customs agents. Unfortunately, it is not possible to train people to become super-recognizers, which appears to be a natural ability.

When White and his colleagues pit super-recognizers against trained forensic examiners, the differences in their process for face identification were clear, though they achieved equivalent accuracy.

Super-recognizers were more intuitive and made their judgments quicker with great accuracy after just 2 seconds. They looked at faces more, but there was no clear pattern in where they were looking, the 2023 study reported.

Forensic examiners, by contrast, were much more methodical and systematic. They took longer to make their decisions, requiring up to 30 seconds, but picked up on facial clues that most people would not pay attention to.

“What super-recognizers are doing is more of a black box,” White said. “It's more of an automatic processing.”

The growing recognition of super-recognizers has increased interest in using their powers to aid policing and security work, though there appears to be no formal, systematic approach for identifying and deploying them. Ramon has worked with Berlin Police and White has worked with the New South Wales Police Force to identify super-recognizers.

But super-recognizers aren’t perfect, White said.

In White’s research, when super recognizers and professionals made errors, super recognizers maintained a high confidence, while professionals were less confident.

So far, lessons on how to improve our facial processing come from trained experts.

In a 2021 study, White and his colleagues taught novice participants some of the tricks used by professional examiners, such as focusing on the ears, scars, freckles and blemishes. After just a six-minute training, the novices got somewhat better — an improvement of 6 percent in accuracy.

But more research on super-recognizers could help solve the mystery of how an unfamiliar face becomes a recognizable and familiar face. The fact that super-recognizers are able to do so well with unfamiliar faces may give us clues in how the brain makes that change, White said.

Samsung is eyeing smart glasses that could shake up the market

Samsung is ready to take a stab at another wearable segment, less than a year after introducing its first smart ring. A Shenzhen-based research company, Wellsen XR, shared in an investor note about Samsung's plans to launch smart glasses that could arrive late next year, or early in 2026.

"Samsung Electronics' plan to release AI smart glasses was confirmed earlier this month, and its first production volume is 500,000 units in the third quarter of 2025," says the note, which was reported by Maeil Business Newspaper.

Interestingly, Samsung is not chasing something too ambitious, or innovative in terms of the tech stack. Instead, the company is taking the safe route and eyeing the same formula as the runaway success that was the Meta Ray-Ban Stories smart glasses, down to the core internal hardware.

The Samsung smart glasses will reportedly come armed with Qualcomm's AR1 Gen 1 wearable silicon and an NXP semiconductor as a secondary processing unit. Multimedia capture duties will be handled by a 12-megapixel camera with a Sony CMOS sensor at its heart.

Ray-Ban Meta (top) and Solos AirGo 3 smart glasses. Andy Boxall / Digital Trends

The smart glasses are said to draw power from a 155 mAh battery and tip the scales at 50 grams. As far as capabilities go, the front camera sensor will come in handy for code scanning, gesture recognition, and more, aside from the usual photo and video capture duties.

Despite the fundamental similarities with the Meta Ray-Ban smart glasses, the software stack would be different. Instead of the Meta AI bundle that is now available on the Stories smart glasses with multi-modal capabilities, Samsung will look at Google.

Specifically, the Korean electronics giant will put Google's Gemini AI at the heart of its smart glasses. That partnership isn't surprising, since Samsung's Galaxy smartphones were also among the first to introduce native Gemini-powered features as part of its Galaxy AI bundle.

This would be quite a substantial edge, as Gemini already has been integrated deeply within Google's products, especially the Workspace suite that is used by hundreds of millions of users. At the moment, it can pull of a lot of meaningful tricks in products like Gmail, Docs, and more, while also letting users access custom AI agents.

Moreover, the Android collaboration would go a long way in seamlessly connecting the smart glasses with phones and other ecosystem products. However, Samsung won't be the lone player in the smart glasses game. Chinese archi rival, Xiaomi, is reportedly developing its own version that would try to emulate the success of Meta's offering.

These new smart glasses are set to bring spatial displays to the mainstream

I'm learning more about augmented reality (AR) smart glasses everyday, and I think they're probably the most underrated tech on the market right now. From Meta's ambition with futuristic frames to the immensely premium VITURE Pro specs for gaming, can it get any better?

Apparently so, as XREAL has just unveiled two new products including the world's first Cinematic AR glasses with the XREAL One and XREAL One Pro Series. These wearable displays are the first of their kind, and set to deliver next-generation three degrees-of-freedom (3DoF) spatial computing, while representing "the most advanced consumer AR glasses on the market" according to XREAL's co-founder and CEO, Chi Xu.

Our sister site, Tom's Guide, has already had the opportunity to get hands-on and try out these new XREAL One smart glasses with devices including an iPhone 16, a Steam Deck, and a MacBook. The verdict? They're pretty impressive.

These AR glasses are available for pre-order right now from XREAL's website starting at $499 / £449 for the standard specs, and $599 / £549 for the Pro option, which has a wider 57-degree field of view and brighter virtual screen.

((Image credit: XREAL))

XREAL has also developed its first silicon co-processing chip, the X1, which is built directly into the new specs and boasts independent spatial computing. Essentially, these AR glasses have the power to create a spatial display from nearly any compute device (though it must have the option for video-out over USB-C), introducing a cinematic virtual screen that is, for the first time, spatially controlled by the glasses themselves.

Explained in more simplified human words, what makes this launch so special is not only the unique X1 chip, but the fact that wearers can experience a stable virtual screen to display unlimited apps, games, websites, and productivity tools by anchoring this screen anywhere they choose in three-dimensional space, with the simple press of a button on the glasses.

This eliminates the need for the expensive Xreal Beam Pro device which is used for creating spatial displays and was required for previous XREAL specs like the Air models.

((Image credit: XREAL))

Other notable new features with the XREAL One and One Pro smart glasses include adjustable interpupillary distance (IPD) ranges, which is apparently a pretty big deal, plus multiple TÜV Rheinland eye health certifications meaning they're safe to replace physical monitors.

The glasses also have high-quality Sound by Bose fitted, plus there's an optional XREAL Eye detachable AI camera available for recording 12MP high-definition photos and video capture from the wearers' point of view. The front frame of the specs is interchangeable for a customised look, and the 4-microphone layout enables audio recording for meeting summaries, transcriptions and translations.

As both a photographer and gamer, these specs sound like an absolute dream. If you're hoping to preorder, keep in mind that the XREAL One Pro model won't be released until early 2025, but the regular XREAL One is expected to ship mid-December, which is perfect timing for Christmas.

Apple ramps up smart glasses project as it looks past Vision Pro

Apple ramps up smart glasses project as it looks past Vision Pro© Mac World

With Vision Pro failing to set the market alight-and being officially labeled as "not a mass-market product"–the big question is how Apple plans to build a commercially viable product in the VR/AR space, if that's even possible. Ultimately, the most appealing option for a mainstream audience would probably be a slimline pair of glasses with smart tech built in, but the state of technology and Apple's own developments mean this isn't likely to appear for some years yet.

There are signs of progress, however. In the latest edition of his Power On newsletter, knowledgeable Bloomberg reporter Mark Gurman claims that Apple recently commenced focus-group research to explore its options in the smart glasses market, in a sign of real intent. (This follows what was described as a technology investigation earlier this year.) Such groups previously preceded the launch of the AirPods and HomePod, and Vision Pro itself.

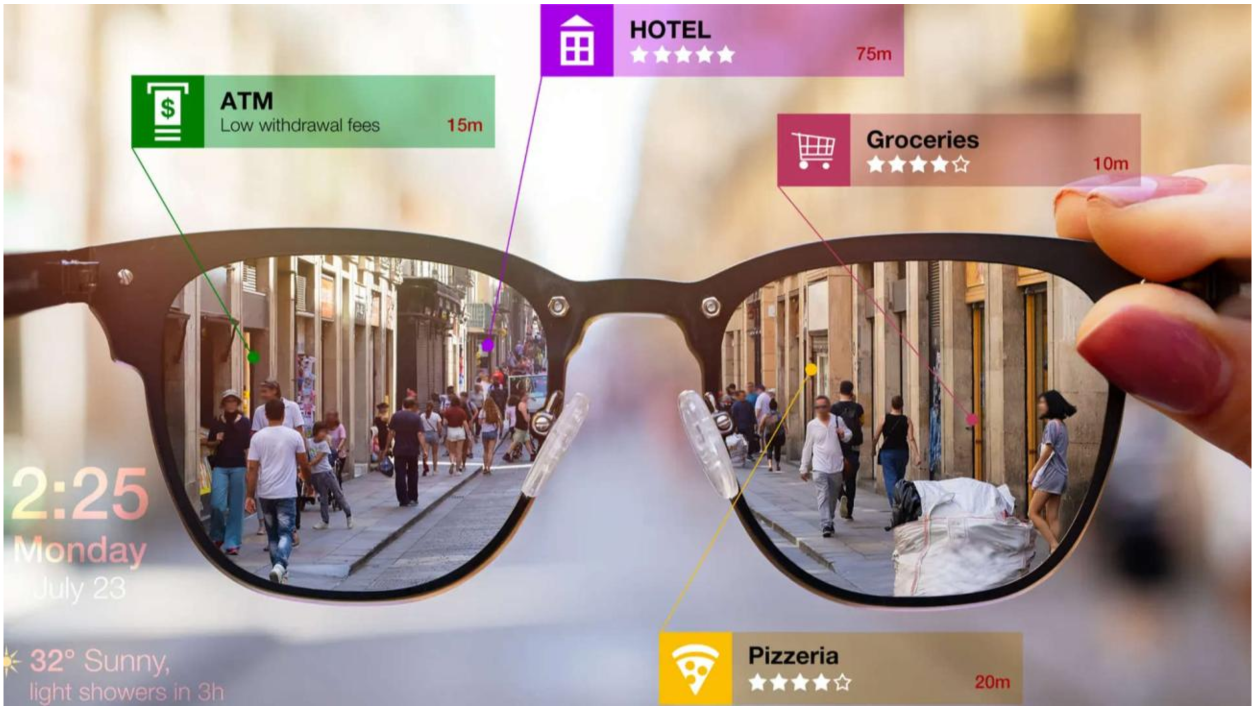
Rather than seek opinion from the public, Apple restricts focus group discussions to its own employees. This might seem less illuminating, but enables the company to keep a lid on future developments and prevent them from reaching the media… in theory. It isn't clear how Gurman obtained his information on the proceedings in this case.

The groups have been discussing their feelings about currently available smart glasses, which include products from Snap and Meta. Apple is behind in this market, as it is so often–one of Cook's mantras is "Not first, but best"–but those companies haven't cracked the formula yet. Indeed, as Gurman observes, their products are far more limited in terms of AR functionality than what Apple is planning.

So the question becomes this: should Apple pursue its own more ambitious plan, and attempt to reproduce Vision Pro's capabilities in a far smaller chassis? Or should it simply create "a version of its AirPods in glasses form," as Gurman puts it? That's the dilemma which the focus groups are intended to solve.

Whatever conclusion is reached, we won't officially know about it for some time. Gurman says five years is the minimum before Apple is able to create a "true AR" set of smart glasses that meets its expectations. But Apple isn't alone in this, with Meta and Snap experiencing similar issues with their own prototypes. Wherever the market is going, it isn't going there yet.

Apple's Ambitious Leap into Augmented Reality



The Future of Augmented Reality

Apple might soon wow us with AR glasses featuring cutting-edge MicroLED technology. Imagine sleek glasses that seamlessly blend the digital and real worlds, offering an unmatched visual experience.

Rumors point to a launch as early as 2026, with competitors like Meta gaining ground, so it's no surprise Apple is working hard to push this project forward. These glasses could mark the start of a new era for wearable technology, one that feels both futuristic and practical.

What Makes MicroLED So Special?

MicroLED combines the best features of OLED and LCD screens, offering incredible brightness, deep blacks, and energy efficiency. It's a display technology that promises stunning visuals unlike anything we've seen.

The challenge? It's extremely difficult and expensive to manufacture, especially for small devices.

If Apple can overcome these hurdles, the AR glasses could outshine competitors in both performance and design.

A Long Journey to Innovation

Apple has been exploring MicroLED tech for years, with whispers of it appearing in devices like the Apple Watch Ultra. This technology could deliver groundbreaking improvements in display quality and energy efficiency.

The road hasn't been easy. High production costs and technical difficulties have slowed progress, but Apple seems determined to bring this innovation to life.

Why 2026 Could Be the Year

Leaked reports suggest Apple's AR glasses may enter production in 2026, signaling a shift in focus toward AR devices. While they might not launch that year, production is a big step forward.

This timeline suggests Apple could be prioritizing these glasses over other rumored projects, like a foldable iPhone. It's clear they're committed to making AR a key part of their future.

Competition Is Heating Up

Meta's Orion AR glasses have sparked a surge of interest in augmented reality. Their success with Ray-Ban Meta smart glasses has shown the potential for wearable tech in everyday life.

Apple seems to be watching closely. To stay ahead, they'll need to deliver a product that's not only innovative but also accessible to a wide audience.

How the Vision Pro Fits In

Apple's Vision Pro headset offers powerful mixed-reality features but comes with a bulky design and a hefty price tag. AR glasses could be the streamlined, affordable alternative consumers are hoping for.

The Vision Pro's technology might pave the way for more compact, user-friendly AR glasses. Apple seems poised to shrink this innovation into a wearable form.

Could Apple Solve the Power Problem?

AR glasses require powerful chips that won't quickly drain their battery. While Apple's current chips, like the M2, deliver impressive performance, they're not ideal for compact, wearable devices.

By 2026, Apple could design a more efficient processor specifically for ultra-thin AR glasses. This innovation would ensure a perfect balance between high performance and energy efficiency, making the glasses practical and user-friendly for everyday use.

How AR Glasses Could Enhance Daily Tasks

AR glasses have the potential to simplify everyday activities in ways we've only imagined. From displaying step-by-step navigation while walking to providing hands-free updates on appointments and reminders, the possibilities are endless.

They could also change the way we shop, offering virtual previews of products or detailed reviews on the go. By blending digital convenience with real-world interactions, AR glasses could become an indispensable tool for modern life.

Apple's Secret Weapon

Apple's ecosystem is a major strength, and AR glasses could fit seamlessly into it. Imagine them syncing effortlessly with your iPhone, Apple Watch, and MacBook, enhancing daily tasks and creating a unified digital experience.

This deep integration would make the glasses incredibly intuitive and practical, appealing to anyone already invested in Apple's devices. It could turn the AR glasses into a must-have addition for loyal Apple users.

Challenges Ahead

The possibilities for AR glasses are limitless. They could transform real-time navigation, enhance video calls, and change how we interact with technology in everyday life.

Gamers, artists, and tech enthusiasts could find new ways to explore creativity and play, while others might use them for more practical tasks. These glasses promise an exciting fusion of the digital and physical worlds, offering something for everyone.

AR Glasses and Everyday Life

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Will They Be Affordable?

Apple's Vision Pro, priced at $3,500, is beyond the budget of most consumers. AR glasses could bridge the gap, offering advanced features at a more affordable price point.

By introducing a cost-effective option, Apple could appeal to a much broader audience, making AR technology accessible to more people. This move would not only expand Apple's reach but also help establish AR glasses as a mainstream innovation.

How Meta's Orion Glasses Could Influence Apple

Meta's progress in AR could motivate Apple to accelerate its own innovation. Competition often drives companies to push boundaries, and Meta's success may inspire Apple to aim higher.

To truly stand out, Apple will need to offer something revolutionary. AR glasses featuring advanced MicroLED technology could be the unique solution that sets them apart and captures consumer attention in a competitive market.

Looking Beyond 2026

Even if production starts in 2026, a launch might not happen until 2027 or later. This extra time allows Apple to refine its design and create an unforgettable product.

As we wait, advancements like the Vision Pro hint at what Apple might accomplish with AR glasses, offering a glimpse of what's to come.

The Future Is Closer Than You Think

AR glasses have felt like a far-off dream for years, but Apple could bring them to life sooner than we think. The combination of MicroLED and Apple's innovation could redefine wearable tech.

With competition growing and excitement building, one thing is clear: augmented reality glasses are shaping up to be the next big leap in technology.

Study discovers a 'brain thesaurus' that lets neurons derive meaning from spoken words

Using a novel technology for obtaining recordings from single neurons, a team of investigators at Massachusetts General Hospital, a founding member of the Mass General Brigham health care system, discovered a microscopic "thesaurus" that reflects how word meanings are represented by neurons in the human brain.

The research, which is published in *Nature*, opens the door to understanding how humans comprehend language and provides insights that could be used to help individuals with medical conditions that affect speech.

"Humans possess an exceptional ability to extract nuanced meaning through language—when we listen to speech, we can comprehend the meanings of up to tens of thousands of words and do so seamlessly across remarkably diverse concepts and themes," said senior author Ziv Williams, MD, a physician-investigator in the department of Neurosurgery at Massachusetts General Hospital and an associate professor of Neurosurgery at Harvard Medical School.

"Yet, how the human brain processes language at the basic computational level of individual neurons has remained a challenge to understand."

Williams and his colleagues set out to construct a detailed map of how neurons in the human brain represent word meanings—for example, how we represent the concept of animal when we hear the word cat and dog, and how we distinguish between the concept of a dog and a car.

"We also wanted to find how humans are able to process such diverse meanings during natural speech and through which we are able to rapidly comprehend the meanings of words across a wide array of sentences, stories, and narratives," Williams said.

To start addressing these questions, the scientists used a novel technology that allowed them to simultaneously record the activities of up to a hundred neurons from the brain while people listened to sentences (such as, "the child bent down to smell the rose") and short stories (for example, about the life and times of Elvis Presley).

Using this new technique, the investigators discovered how neurons in the brain map words to particular meanings and how they distinguish certain meanings from others.

"For example, we found that while certain neurons preferentially activated when people heard words such as 'ran' or 'jumped,' which reflect actions, other neurons preferentially activated when hearing words that have emotional connotations, such as 'happy' or 'sad,'" said Williams.

"Moreover, when looking at all of the neurons together, we could start building a detailed picture of how word meanings are represented in the brain."

To comprehend language, though, it is not enough to only understand the meaning of words, but also to accurately follow their meanings within sentences. For example, most people can rapidly tell the correct meaning of words such as "sun" and "son" or "see" and "sea" when used in a sentence, even though the words sound exactly the same.

"We found that certain neurons in the brain are able to reliably distinguish between such words, and they continuously anticipate the most likely meaning of the words based on the sentence contexts in which they are heard," said Williams.

Lastly, and perhaps most excitingly, the researchers found that, by recording a relatively small number of brain neurons, they could reliably predict the meanings of words as they were heard in real-time during speech. That is, based on the activities of the neurons, the team could determine the general ideas and concepts experienced by an individual as they were being comprehended during speech.

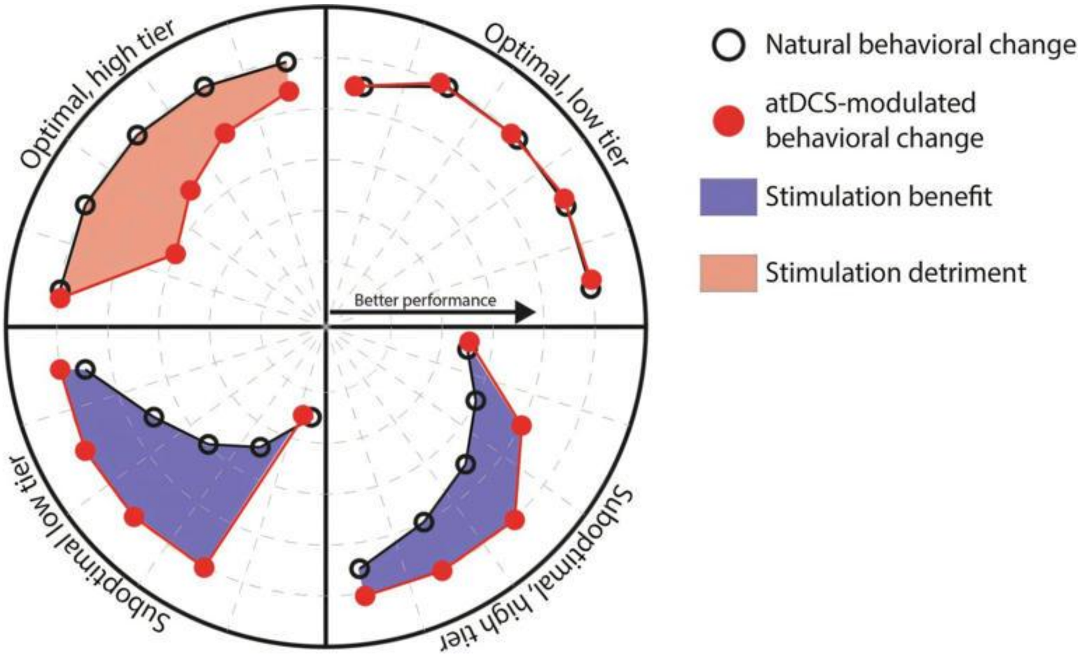
"By being able to decode word meaning from the activities of small numbers of brain cells, it may be possible to predict, with a certain degree of granularity, what someone is listening to or thinking," said Williams.

"It could also potentially allow us to develop brain-machine interfaces in the future that can enable individuals with conditions such as motor paralysis or stroke to communicate more effectively."

More information: Mohsen Jamali et al, Semantic encoding during language comprehension at single-cell resolution, *Nature* (2024). DOI: 10.1038/s41586-024-07643-2

Provided by Massachusetts General Hospital

Brain stimulation effectiveness tied to learning ability, not age



Main finding. Credit: npj Science of Learning (2024). DOI: 10.1038/s41539-024-00278-y

As we age, our cognitive and motor functions deteriorate, which in turn affects our independence and overall quality of life. Research efforts to ameliorate or even completely abolish this have given rise to technologies that show a lot of promise.

Among these is non-invasive brain stimulation: a term encompassing a set of techniques that can affect brain functions externally and noninvasively, without the need for surgery or implants. One such promising technique, in particular, is anodal transcranial direct current stimulation (atDCS), which uses a constant, low electrical current delivered via electrodes on the scalp to modulate neuronal activity.

However, studies exploring atDCS have produced inconsistent results, which has prompted researchers to explore why some people benefit from atDCS while others don't. The problem seems to lie in our understanding of factors that may influence responsiveness to brain stimulation, leading to responders and non-responders; among these, age has been suggested as one important factor.

Some studies suggest further factors such as baseline behavioral abilities and previous training might be important considerations, but an interplay of these factors with behavior has not been determined in detail, pointing to the need for refined predictive models of the effects of atDCS.

Now, scientists led by Friedhelm Hummel at EPFL have identified an important factor affecting an individual's responsiveness to atDCS. The team looked at how native learning abilities determine the effect of brain stimulation applied while learning a motor task.

Their work has been published in *npj Science of Learning*.

Their findings suggest that individuals with less efficient learning mechanisms benefit more from stimulation, while those with optimal learning strategies might experience negative effects.

The researchers recruited 40 participants: 20 middle-aged adults (50-65 years old) and 20 older adults (over 65). Each group was further divided into those receiving active atDCS and those receiving placebo stimulation.

Over ten days, participants practiced a finger-tapping task designed to study motor sequence learning at home while receiving atDCS. The task involved replicating a numerical sequence using a keypad, trying to be as fast and as accurate as possible.

The team then used a machine-learning model trained on a public dataset to classify participants as either "optimal" or "suboptimal" learners, based on their initial performance. This model aimed to predict who would benefit from atDCS, based on their ability to integrate information about the task efficiently early during training

The study found that suboptimal learners, who were seemingly less efficient at internalizing the task at the early stages of learning, experienced an accelerated accuracy improvement while performing the task when receiving atDCS. This effect was not limited to people of a certain age (e.g., older adults), with suboptimal learners being found among younger individuals as well.

In contrast, participants with optimal learning strategies, regardless of age, even showed a negative trend in performance when receiving atDCS. This difference suggests that brain stimulation is more beneficial for individuals who initially struggle with motor tasks. As such, atDCS seems to possess a restorative rather than an enhancing quality, with important implications for rehabilitation.

"By leveraging different methods in machine learning, we were able to untangle the influence of different factors on the individual effects of brain stimulation," says Pablo Maceira, the study's first author. "This will pave the way to maximize the effects of brain stimulation in individual subjects and patients."

The study implies that, in the long run, personalized brain stimulation protocols will be developed to maximize benefits based on an individual's specific needs, rather than a common trait such as age.

This approach could lead to more effective brain stimulation-based interventions, targeting specific mechanisms supporting learning, especially from the view of neurorehabilitation, for which the main basis is the re-learning of lost skills due to a brain lesion (e.g., after a stroke or a traumatic brain injury).

"In the future, clinicians could apply a more advanced version of our algorithm to determine whether a patient will benefit from a brain stimulation-based therapy, to enhance the effects of neurorehabilitation and personalize treatment," says Hummel.

More information: Pablo Maceira-Elvira et al, Native learning ability and not age determines the effects of brain stimulation, *npj Science of Learning* (2024). DOI: 10.1038/s41539-024-00278-y

Provided by Ecole Polytechnique Federale de Lausanne

Your Brain Is Not a Computer. It Is a Transducer

A new theory of how the brain works — neural transduction theory — might upend everything we know about consciousness and the universe itself.

By Robert Epstein
Aug 25, 2021 9:00 AMAug 25, 2021 1:24 PM

Let's start with my 95-year-old mom. Her memory is unreliable, but she's still lucid, churns out sarcasm like a pro, and plays a lightning-fast game of double solitaire. Today I finally quit after she won seven games in a row, and, yes, I was trying my best.

She also hears music continuously, and it's not the kind of music that drives us nuts when we can't get a tune out of our head. She mainly hears *original* music, and she will sometimes try to hum or sing what she's hearing. She says it's coming from "the neighbors downstairs," and it doesn't bother her, she says, because some of it isn't bad and because it helps her fall asleep. The fact that other people can't hear it doesn't bother her either. She simply smiles slyly and says, "Maybe you should get your hearing checked."

Am I concerned? Well, just a bit — not about the music but about its source. As I told my mom the other day, I would be more comfortable if the inconsiderate neighbors lived *upstairs*. She laughed and said, "I see what you're getting at, but don't worry. I'm *not* going to hell." Very determined, my mom. Was she planning to negotiate the issue with a hand of double solitaire?

Where is all this original music coming from? My mother has never composed music, and she insists she would be incapable of doing so "no matter how much you paid me." That's mom-speak for *case closed*.

In case you haven't noticed, we are surrounded by mysteries like this. Some, in my view, are highly suspect, such as demonic possession and communication with spirits. Others are undeniably real: dreams, daydreams, hallucinations, the *déjà vu* experience, and so on. My staff recently came up with a list of *58* such phenomena. You don't have to look far to find them.

Are we doomed to remain in the dark about these mysteries, or is there a way to peel back the veil? What if spirits, dreams, and my mom's music could all be accounted for by a relatively simple idea about how the brain works — an idea that might even be testable?

The idea, which is quite simple on its face, is that the brain is a bidirectional transducer.

Transduction Is All Around Us

A few inches to the left of the laptop computer on which I am now typing stands an imposing Sennheiser microphone that I use mainly when someone is interviewing me for a radio or TV show. A thick black cable protrudes from the back of the microphone and snakes its way to a boxy analogue-to-digital converter, which links to my computer via a bright red USB cable.

My computer links wirelessly to a router in the next room, and the router connects to AT&T, my internet service provider, through a telephone cable that runs from the router to a wall socket. That cable leads to dozens of other transition points through which crude representations of my voice pass before some semblance of it is finally heard by a talk-show host in, say, London.

If I'm speaking to a host of a BBC radio program, representations of his or her voice are also traveling in the other direction from his or her microphone through dozens of transition points until they finally activate a tiny speaker in my ear bud, through which I hear a semblance of his or her voice. If we're also using video to communicate, cameras are sending images to screens, again through many transition points, and again in both directions.

Representations of these images and sounds might be passing not only through multiple transition points but also through thousands of miles of copper or fiber optic cables, or are perhaps being transmitted to satellites hundreds of miles above the earth and then re-transmitted to receivers on the ground. Long ago, pathways like this could accommodate only one conversation at a time, with communications running in only one direction at a time, but now such pathways are bidirectional and are often shared simultaneously by thousands of different conversations.

Remarkably, when everything is working smoothly, my conversation with the London host is as seamless as it would be if we were in the same room. Even though I'm 5,500 miles away in San Diego, I can't detect any time gaps between my ramblings and the host's reply. Those gaps exist, but they're so short that neither I nor the host can perceive them.

What's happening here? Is my voice actually traveling 5,500 miles? Definitely not. If you were the proprietor of a 19th century mansion, you might have been able to shout into a speaking tube that snaked its way through your home and carried your voice all the way to the servants' quarters. In that case, the sound of your voice was literally carried to its destination by the air in the tube.

But when I speak into my microphone, the pattern of sound waves produced by my voice — a distinctive, non-random pattern of air pressure waves — is being *converted* by the microphone into a similar pattern of electrical activity. The better the microphone, the more accurately it duplicates the original pattern, and the more I sound like me at the other end.

That conversion process — the shifting of a meaningful, non-random pattern of activity — from one medium (say, the air in front of the microphone) to another medium (say, the wire at the back of a microphone) is called *transduction*.

And transduction is all around us, even in organic processes. Our bodies are completely encased by transducers. Our sense organs — eyes, ears, nose, tongue, and skin —transduce distinctive properties of electromagnetic radiation, air pressure waves, airborne chemicals, liquid-borne chemicals, textures, pressure, and temperature into distinctive patterns of electrical and chemical activity in the brain. Organic compounds can even be used these days to create new kinds of transducers, such as OECTs: **organic electrochemical transistors**.

Evolution didn't just create millions of new species of organisms, it also created millions of new types of transducers, and engineers are now using both organic and inorganic materials to create thousands more.

To repeat (because this is important): Transduction is all around us — forms of transduction that have evolved over eons and new forms of transduction that humans are inventing right now.

The Ultimate Transducer

What if evolution, at some point, produced a special kind of transducer that could shift signals from the physical world as we know it to a very different kind of world?

Nearly all religions teach that immaterial realms exist that transcend the reality we know. For Christians and Muslims, those realms are Heaven and Hell. One of the simplest and clearest statements of such a concept comes from ancient Greek mythology: As long as the deceased had the required toll in hand — well, actually in mouth — he or she would be transported by the ferryman Charon across the river Styx to Hades, the land of the dead — quite literally, to the *Other Side*. (I'll call it the OS from this point on.) Unfortunately, not everyone was eligible to make the crossing. If no one thought to bury you or to put that coin in your mouth, you were doomed to roam *this* side of the river as a ghost.

The idea of a realm transcending the one we experience directly has taken on many forms over the centuries. George Griffith, England's most prominent and prolific science fiction writer of the late 1800s, published a prescient novel about this realm in 1906: ***The Mummy and Miss Nitocris: A Phantasy of the Fourth Dimension***. The book's protagonist, professor Franklin Marmion, is a distinguished mathematician and physicist who anticipates discoveries and concepts that real quantum physicists would eventually propose decades later. Over the course of the story, Marmion not only reluctantly accepts the fact that a higher dimension must exist, he also acquires the power to shift his body there, learning, among other counterintuitive things, that multiple objects can occupy the same space at the same time.

Griffith might have been aware of a contemporary of his, William James, a prominent Harvard philosopher and also arguably America's first psychologist. In 1898, James published a short book entitled ***Human Immortality: Two Supposed Objections to the Doctrine***, in which he praised his contemporaries for boldly using scientific methods to investigate "providential leadings [sic] in answer to prayer, instantaneous healings, premonitions, apparitions at time of death, clairvoyant visions or impressions, and the whole range of mediumistic capacities."

James asserted that a universe-wide consciousness beamed human consciousness into our brains "as so many finite rays," just as the sun beams rays of light onto our planet. Our brains, being limited in their capabilities, he said, generally filter and suppress real consciousness, while sometimes allowing 'glows of feeling, glimpses of insight, and streams of knowledge' to shine through. He called this idea 'transmission-theory.'

Ideas like James's have been around for thousands of years. In his 2006 book, *Life After Death: The Burden of Proof*, alternative medicine guru Deepak Chopra says that ancient Hindu texts teach that the material world we know is nothing but a projection from the universal consciousness that fills all space. From this perspective, death is not an end; it is a merging of a relatively pathetic human consciousness with that of the dazzling universal one. To add gravitas to this idea, Chopra does what many recent authors have done: he suggests that modern formulations of quantum physics are consistent with his belief in a universal consciousness.

The connection between physics and modern theories of mind and consciousness is **tenuous at best**, but modern physicists do take the idea of parallel universes seriously. They debate the details, but they can hardly ignore the fact that the mathematics of **at least three** of the grand theories at the core of modern physics — inflation theory, quantum theory, and string theory — predict the existence of alternate universes. Some physicists even believe that signals can leak between the universes and that the existence of parallel universes **can be confirmed** through measurements or experiments. In a recent essay, physicist **A. A. Antonov** argues that our inability to detect the vast amount of dark energy that almost certainly exists in our own universe is evidence of the existence of parallel universes, six of which, he speculates, are directly adjacent to our own.

Again, setting the details aside, physicists agree that the three-dimensional space we experience is simply not the whole picture. As theoretical physicist Lee Smolin put it recently, "**Space is dead**."

Evidence for Transduction?

Hard evidence that supports a neural transduction theory is lacking at the moment, but we are surrounded by odd phenomena that are at least consistent with such a theory. And, no, I'm not talking about the claims that best-selling authors have made over the decades about proof that telepathy, out-of-body experiences, and communication with the dead are real. No such proof exists, in my view, but other well documented phenomena are difficult to brush aside.

When I was a graduate student at Harvard, I noticed a stranger roaming the hallway near my office and offered to assist her. Doris, it turns out, had heard voices for years, and she was hoping she could find someone in the psychology building — William James Hall — to help her eliminate them because they "caused trouble." I didn't have the heart to tell her that Harvard, at the time, had no clinical psychology program and that I was doing behavioral research with pigeons. If her voices had sent her there, they were troublemakers indeed.

When internal perception goes awry, people can be overwhelmed by hallucinations, visions, or distortions of reality so extreme they have to be hospitalized, and Doris had been hospitalized at times.

But is Doris that different from the rest of us? After all, even the healthiest among us hallucinate several times each night — we call it dreaming. And we all have at least two highly disorienting experiences each day called "hypnogogic states" — those eerie, sometimes creative interludes between sleeping and waking.

I have sometimes dreamt intricate full-length movies that seemed as good as any Hollywood film. Alas, most of the time, no matter how hard I try, I can't seem to hold on to even a shred of a dream during the few seconds when I'm staggering from my bed to the bathroom.

Where does all this content come from, and why do we have so little control over it?

In recent years, researchers have explored what they have clumsily labeled "paradoxical lucidity," or, even worse, "*terminal* lucidity." These labels refer to what some of us know as "the last hurrah" — the burst of mental clarity that sometimes occurs shortly before people die, even people for whom such clarity should be impossible.

For more than two centuries, medical journals have published credible reports of highly impaired, uncommunicative people who suddenly became lucid for a few minutes before they died. There are documented cases in which people with dementia, advanced Alzheimer’s, schizophrenia, and even severe brain damage —– people who have not been able to speak or to recognize their closest relatives for years — suddenly recognized their loved ones and spoke normally.

A 2020 study summarizing the observations of 124 caregivers of dementia patients, concluded that in "more than 80 percent of these cases, complete remission with return of memory, orientation, and responsive verbal ability was reported by observers of the lucid episode" and that ‘"[the] majority of patients died within hours to days after the episode." The periods of lucidity typically lasted 30 to 60 minutes.

Some of the historical reports of lucid episodes are truly extraordinary.

Here is one of many cases **reported by the German biologist Michael Nahm** and his colleagues in 2012:

In a case published in 1822, a boy at the age of 6 had fallen on a nail that penetrated his forehead. He slowly developed increasing headaches and mental disturbances. At the age of 17, he was in constant pain, extremely melancholic, and starting to lose his memory. He fantasized, blinked continuously, and looked for hours at particular objects.... He remained in the hospital in this state for 18 days. On the morning of the 19th day, he suddenly left his bed and appeared very bright, claiming he was free of all pain and feelings of sickness.... A quarter of an hour after the attending physician left him, he fell unconscious and died within a few minutes. The front part of his brain contained two pus-filled tissue bags the size of a hen’s egg (Pfeufer, 1822)....

And another:

Haig (2007) reported the case of a young man dying of lung cancer that had spread to his brain. Toward the end of his life, a brain scan showed little brain tissue left, the metastasized tumors having not simply pushed aside normal brain tissue but actually destroyed and replaced it. In the days before his death, he lost all ability to speak or move. According to a nurse and his wife, however, an hour before he died, he woke up and said good-bye to his family, speaking with them for about five minutes before losing consciousness again and dying.

If the brain is a self-contained information processor, how can we explain the sudden return of lucidity when the brain is severely damaged? For that matter, think about the variability that occurs in your own lucidity over the course of 24 hours, during which you are, at various times, completely unconscious, partially conscious, or fully conscious. If you add drugs and alcohol to the picture, the variability is even greater, and it can be quite bizarre.

The variability problem is addressed in an **intriguing paper** published by Jorge Palop and his colleagues in *Nature* in 2006, who note that patients suffering from a variety of neurodegenerative disorders often fluctuate over the course of a single day between states of extreme confusion and relatively normal mental states. Such radical changes, they note, "cannot be caused by sudden loss or gain of nerve cells." They speculate about changes in neural networks, but that doesn't solve the problem.

What if the variability is not caused by changes in processing power in the brain but rather by transduction effects? By changes occurring not in our local universe but in the OS? Or by minor changes occurring at the point of connection? Or by changes occurring in brain structures that are essential to signal transfers?

I've also been intrigued by what appear to be credible reports about visual experiences that some congenitally-blind people have had when they were near death. Experiences of this sort were first summarized in a **1997 paper** by Kenneth Ring and Sharon Cooper, later expanded into a book called *Mindsight* (1999). The paper and book describe the experiences of 14 people who were blind from birth and who had near-death experiences (NDEs), some of which included content that appeared to be visual in nature. Soon after Vicki U. was in a near-fatal car accident at age 22, she remembered "seeing" a male physician and a woman from above in the emergency room, and she "saw" them working on a body. Said Vicki:

I knew it was me.... I was quite tall and thin at that point. And I recognized at first that it was a body, but I didn't even know that it was mine initially. Then I perceived that I was up on the ceiling, and I thought, "Well, that's kind of weird. What am I doing up here?" I thought, "Well, this must be me. Am I dead?"

Vicki had never had a visual experience before her NDE, and, according to the researchers, did not even "understand the nature of light." While near death, she also claimed to have been flooded with information about math and science. Said Vicki:

I all of a sudden understood intuitively almost [all] things about calculus, and about the way planets were made. And I don't know anything about that.... I felt there was nothing I didn't know.

Several aspects of Vicki's recollections are intriguing, but the most interesting to me are the visual experiences. How can someone who has never had such an experience "No light, no shadows, no nothing, ever," according to Vicki — suddenly have rich and detailed experiences of this sort? Ring and Cooper found others like Vicki – congenitally blind people who not only had visual experiences when near death but whose NDEs were remarkably similar to some common NDEs of sighted people.

Just recently, an Australian woman **made the news** worldwide when, post surgery, she woke up with an Irish accent. Her strong Australian accent was completely gone. Called 'the foreign accent syndrome', this sudden switch in accents is rare but real. The shift doesn't make sense given the framework of reasoning we usually apply to the world, but what if it's a transduction error?

And why can't we remember pain? We can remember facts and figures and images, and we can even get choked up remembering strong emotions we've felt in the past — but *we can't remember pain*. Are sensations of pain getting filtered out by transduction pathways? Could that be why our dreams are pain free? That begs a question that is both eerie and obvious: Is the OS a kind of pain-free Heaven?

And have you ever met a stranger who made you feel, almost immediately, that you had known him or her your entire life? And sometimes this stranger has the same feeling about *you*. It's a strong feeling, almost overwhelming. We can try to explain such feelings with speculations about how a voice or physical characteristics might remind us of someone from our past, but there is another possibility — that in some sense *you had actually known this person your whole life*. If the brain is a bidirectional transducer, that is not a strange idea at all.

In fact, when viewed through the lens of transduction theory, *none* of these odd phenomena — dreams, hallucinations, lucidity that comes and goes, blind vision, and so on — looks mysterious.

And All That Jazz

This brings me, reluctantly, to the recent rise of "postmaterialist" science, or at least postmaterialist psychology. The latter is marked by — or perhaps blemished by — the founding of the journal *Spirituality in Clinical Practice* by the American Psychological

Association (APA) in 2014 and the founding of the Association for the Advancement of Postmaterialistic Sciences in 2017. (Disclosure: I have been a full member of the APA since 1983.)

Postmaterialism is all about controlled experiments that have supposedly proved, or at least supported, claims that mediums can communicate with the dead, that ghosts will happily comply when we ask them to climb into little boxes in a laboratory, that people can send their thoughts to strangers in another room telepathically, and that future events can somehow travel backward in time to impact people's current behavior.

I am *so* tempted here to start naming names and tearing down reputations, but my musical mom raised me better than that. I will say this: One of the early papers published in that new APA journal — a paper that was accepted without peer review — demonstrated thinking so shoddy it startled me.

Fortunately, I don't *need* to tear apart shoddy thinking or flawed experiments to advocate for transduction theory. In fact, if this theory proves to be valid, every fantasy of the postmaterialists will be fulfilled — every fantasy except one, that is, and that is *the postmaterialist claim itself*. That's because parallel universes are not wispy, physics-free spiritual entities; according to many mainstream physicists, they are just non-obvious companions of the material universe in which we happen to live.

A Better Brain Theory

Let's set aside both the mundane and the exotic reasons we should take transduction theory seriously and get to the heart of the matter: The main reason we should give serious thought to such a theory has nothing to do with ghosts. It has to do with the sorry state of brain science and its reliance on the computer metaphor. One of my research assistants recently calculated that Beethoven's thirty-two piano sonatas contain a total of 307,756 notes, and that doesn't take into account the hundreds of sections marked with repeat symbols. Beethoven's scores also include more than 100,000 symbols that guide the pianist's hands and feet: time signatures, pedal notations, accent marks, slur and trill marks, key signatures, rests, clefs, dynamic notations, tempo marks, and so on.

Why am I telling you about Beethoven? Because piano virtuoso and conductor Daniel Barenboim memorized *all thirty-two of Beethoven's sonatas by the time he was 17*, and he has since memorized hundreds of other major piano works, as well as dozens of entire symphony scores — *tens of millions* of notes and symbols.

Do you think all this content is somehow *stored* in Barenboim's **ever-changing, ever-shrinking, ever-decaying brain**? Sorry, but if you study his brain for a hundred years, you will never find a single note, a single musical score, a single instruction for how to move his fingers — not even a "representation" of any of those things. The brain is simply *not* a storage device. It is an extraordinary entity for sure, but not because it stores or processes information. (See my *Aeon* essay, "**The Empty Brain**," for more of my thinking on this issue, and for a truly great thrill, watch Barenboim play the third movement from Beethoven's 14th piano sonata **here**.)

Over the centuries — completely baffled by where human intelligence comes from — people have used one metaphor after another to 'explain' our extraordinary abilities, beginning, of course, with the divine metaphor millennia ago and progressing – and I use that word hesitatingly — to the current information-processing metaphor. I am proposing now that we abandon the metaphors and begin to consider substantive ideas we can test.

To be clear: I am *not* offering transduction theory as yet another metaphor. I am suggesting that the brain is truly a bidirectional transducer and that, over time, we will find empirical support for this theory.

Recall that Einstein's Special Theory of Relativity, published in 1905, and then his General Theory of Relativity, published in 1915, received no direct and convincing empirical support for years — first regarding predictions his equations made about the perihelion precession of Mercury's orbit, then about the bending of light around the sun (observed by Sir Arthur Eddington in 1919), and then about the gravitational redshift of light. It took a full century before his predictions about gravity waves were confirmed.

If we can cast some aspects of transduction theory into formal, predictive terms (I'm working on that now and am looking for collaborators), we might be able to make specific predictions about transduction — about subtle variations in reaction times, for example, or about how transduction errors might help us explain schizophrenia. We might also be able to predict quantitative aspects of dreams, daydreams, hallucinations, and more.

Ignore It at Your Peril

If transduction theory has merit, let's think about what happens if we ignore it. If we transported a 17th century scientist to the present day and showed him or her how well we can converse with someone using a cell phone, he or she would almost certainly want to look inside the phone. The remote voice must be *in* the phone, after all. To put this another way, a Renaissance scientist would naively view the phone as a self-contained processing unit, much as today's brain scientists naively view the brain.

But that scientist will never find the remote voice inside the phone, because it is not there to be found.

If we explain to the scientist that the phone is a transducer, however, he or she will now examine the phone in a different way, searching for evidence of transduction, which he or she — aided by appropriate instruments and knowledge — will eventually find.

And here is the problem: If you *never* teach that scientist about transduction, he or she might *never* unravel the mysteries of that phone.

This brings me to the claustrum, a small structure just below the cerebral cortex that is **poorly understood**, although **recent research** is beginning to shed some light. Many areas of the brain connect to the claustrum, but what does it do? If the claustrum turns out to be the place where signals are transduced by the brain, *you will probably never discover this remarkable fact if transduction is not on your list of possibilities.* (If you're a history buff, you might also be aware of another small brain structure — the pineal gland — that could conceivably be a transduction site. In his first book, *Treatise of man*, written in the early 1600s, French philosopher René Descartes identified this gland as the seat of the soul. Remarkably, in the late 1900s, **scientists discovered** that tissue in the pineal gland responds to electromagnetic radiation.)

If modern brain scientists begin to look for evidence that the brain is a transducer, they might find it directly through a new understanding of neural pathways, structures, electro-chemical activity, or brain waves. Or they might find such evidence indirectly by simulating aspects of brain function that appear to be capable of transducing signals. They might even be able to create devices that send signals to a parallel universe, or, of greater interest, that *receive* signals from that universe. Comparative studies of animal brains, which could conceivably have limited connections to the OS, might help move the research along.

Efficient and clear transduction might also prove the key to understanding the emergence of human language and consciousness; here is a possible explanation for what might have been the relatively sudden appearance of such abilities in humans (see Julian Jaynes's 1976 book, *The Origin of Consciousness in the Breakdown of the Bicameral Mind*). Neural transduction might also prove to be the mechanism underlying Carl Jung's concept of the "collective unconscious." Even Noam Chomsky's theory of universal grammar could get a boost from transduction theory; it would hardly be surprising that most or all human languages share certain grammatical rules if languages are all constrained by signals emanating from a common source. And then there's that 'flow' state my friend Mihaly Csikszentmihalyi taught everyone about. When I'm in a hyper-creative mode – now, for example, as I'm writing – I have almost no awareness of this world or of the passage of time. Is the OS the source of our creativity?

It might take decades for us to see significant advances in transduction research, but with vast resources already devoted to the brain sciences, we could conceivably move much faster. And if you're worried that transduction theory is just another one of those inherently untestable theories — like string theory or theories about parallel universes — think again. With neural transduction theory, we have an enormous advantage: *The transduction device is available for immediate in-depth study*.

Implications and Final Notes

Will transduction theory finally clear up the old consciousness problem? That I doubt, because I don't think there *is* a consciousness problem. Consciousness is just the experience we have when we're observing ourselves or the world. It seems grand simply because we're part of the system we're observing. It's a classic example of how difficult it can be to study a system of which one is an integral part; think of this problem as a kind of Gödel's theorem of the behavioral sciences. (For my whole spiel on this issue, see my 2017 essay, "**Decapitating Consciousness**.")

If transduction theory proves to be correct, our understanding of the universe and of our place in it will change profoundly. We might not only be able to make sense of dozens of odd aspects of human experience, we might also begin to unravel some of the greatest mysteries in the universe: where our universe came from, what else and who else is out there — even whether there is, in some sense, a God.

If you are as skeptical about flimsy theories as I am, by now you might be thinking: Has Epstein lost his mind (and, if so, where did it go)? Let me assure you that I am as hard-headed as ever. I won't believe in ghosts until Casper himself materializes in front of an audience and pushes me off the stage. But I am also acutely aware of how little we actually know, both about ourselves and our universe. If one simple idea — brain as transducer — might stimulate new kinds of research and might also bring order to what seem to be scores of unrelated, bizarre, and highly persistent human beliefs, I'm all for it.

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Samsung tipped to have smart glasses up its sleeve at Unpacked 2025

What you need to know

- Samsung might finally glimpse the long-rumored smart glasses at the Galaxy S25 series launch.
- It will likely be a sneak peek of the company's first AR glasses in mid-January.
- The smart glasses will reportedly be based on Samsung's Extended Reality (XR) platform.

Samsung might be prepping for its Galaxy S25 series launch, which is anticipated to happen in January 2025. While the trio of handsets are expected, a new report reveals that the company might have a smart glasses launch up its sleeve next month.

According to the Korean news outlet Yonhapnews, spotted by tipster Jukanlosreve on X, has indicated that Samsung might be showcasing a sneak peek of its first augmented reality (AR) glasses at the upcoming Galaxy S25 series Unpacked Event. It could be some sort of short video or an image reveal — likely a similar approach from the company where it showcased the Galaxy Ring for the first time during its 2024 Unpacked Event.

Just in: Samsung is set to unveil a prototype of its augmented reality (AR) glasses, currently in development, during the Galaxy S25 Unpacked event early next year, likely in the form of videos or images.Additionally, prior to revealing the prototype, Samsung plans to introduce…December 3, 2024

The upcoming smart glasses will likely rival the Meta's Ray-Ban glasses. They will be built on Samsung's Extended Reality (XR) platform, which is also tipped to be demoed at the upcoming Unpacked event. The Korean outlet further shares that the smart glasses will likely weigh 50 grams, coupled with the ability to make payments with the help of AI, gesture, and face recognition features.

While we might see a glimpse of the first smart glasses at the Unpacked event, which may include a prototype, the product is expected to be released sometime in the third quarter of 2025, notes the Korean publication. It is still unclear whether the alleged smart glasses are the ones that were rumored to be co-developed by Google and Qualcomm.

It's also been a while since we heard about Samsung's smart glasses, which were trademarked at the Intellectual Property Office in the U.K. last year. The product was then trademarked under the "Virtual reality headsets; Augmented reality headsets; Headphones; Smartphones; Smart glasses" categories.

Meanwhile, an alleged prototype was spotted before the launch of Apple Vision Pro. It included micro OLED displays powered by the Exynos 2200 chip and other highlighting features like eye-tracking cameras. However, it was soon scrapped after the Vision Pro's launch. Regardless, it is still encouraging to see Samsung still working on its version of smart glasses, which will likely be witnessed first at the Unpacked Event in 2025, which otherwise headlines the much-awaited Galaxy S25 series.

Neuroscientists discover a new pathway to forming long-term memories in the brain

Researchers from Max Planck Florida Institute for Neuroscience have discovered a new pathway to forming long-term memories in the brain. Their

work, published in *Nature Neuroscience*, suggests that long-term memory can form independently of short-term memory, a finding that opens exciting possibilities for understanding memory-related conditions.
Our brain works diligently to record our experiences into memories, creating representations of our daily events that stay with us for short time periods. Current scientific theories of memory formation suggest that short-term memories are stored in what we can imagine as a temporary art exhibition in our brain before being cleared out for representations of new experiences.

A tiny fraction of these short-term memories—those most relevant to us—are moved to a more permanent exhibit, our long-term memory, where they are stored for days, years, or decades.

The most prevalent theories suggest this is a linear process. Our experience is encoded into a short-term memory, which is then consolidated into a long-term memory. However, a new study by Dr. Myung Eun Shin, Dr. Paula Parra-Beuno, and MPFI Scientific Director Dr. Ryohei Yasuda suggests that there may be another way to long-term memory formation.

"This discovery is akin to finding a secret pathway to a permanent gallery in the brain," said Dr. Shin, the study's lead author.

"The prevailing theory suggested a single pathway, where short-term memories were consolidated into long-term memories. However, we now have strong evidence of at least two distinct pathways to memory formation—one dedicated to short-term memories and another to long-term memories. This could mean our brains are more resilient than previously thought."

The key finding: Disrupting short-term memory formation did not block long-term memory

The research team focused on a specific enzyme in neurons called CaMKII, which is critical for short-term memory formation. Previously, they developed an optogenetic approach that uses light to temporarily deactivate CaMKII. With this tool in hand, the team set out to use light to block short-term memory formation in a mouse.

Mice prefer dark spaces and, when given a choice, will immediately enter a dark space from a brightly lit one. However, if a mouse is frightened in a particular dark space, the memory of the frightening experience will alter its behavior, and the mouse will avoid entering the dark space again.

When the research team used their tool to disrupt memory formation, even those mice that had a frightening experience an hour earlier entered the dark space, suggesting they had no memory of the experience. The scientists had successfully blocked short-term memory formation.

What happened next was surprising to the research team. A day, week, or even a month later, these mice were altering their behavior to avoid where they were previously frightened.

Mice that didn't seem to remember the frightening experience an hour after it occurred, showed clear evidence of remembering at later times. In other words, blocking short-term memory of the event did not disrupt long-term memory.

"We were initially quite surprised by this observation, as it was inconsistent with how we thought memories were formed. We didn't think it was possible to have a long-term memory of an event without a short-term memory. However, when we repeated these experiments and used multiple tools and approaches to verify our findings, we were convinced," says Dr. Shin.

"Rather than long-term memory formation being a linear process that requires short-term memory, a parallel pathway to long-term memory formation that bypasses short-term memory must exist."

Implications for memory dysfunction

This study has changed the model of how memories are formed in the brain. Significant scientific advances often come after previous models of understanding are overturned, and the team is excited to see where this line of research will take them.

"This new finding has revised our understanding. We are now investigating how this newly discovered pathway to long-term memory formation occurs. We are excited to see what we can learn and what this could mean for preserving long-term memory retention, even when short-term memory is compromised by aging or cognitive impairment," says Dr. Yasuda.

More information: Shin, M.E., et al. Formation of long-term memory without short-term memory revealed by CaMKII inhibition, *Nature Neuroscience* (2024). DOI: 10.1038/s41593-024-01831-z

Provided by Max Planck Florida Institute for Neuroscience

In 2025, the AI-infused world will require humans bring strategy and judgement by Optimove

OpenAI — an artificial intelligence research company — created ChatGPT and launched the tool in November 2022. With that, 2023 became the year of humans understanding genAI's capabilities. Then 2024 was the year of genAI's integration into marketing automation solutions.

Now, 2025 will be the year humans wrest control of genAI to ensure it is properly used for its role to deliver real-time, precision marketing messages.

With that said, as we look forward beyond genAI, the year 2025 will be the year of the human to bring strategy and judgement into marketing automation that will be further infused with AI.

Amidst this wave of automation and innovation, the role of the human marketer is more vital than ever. The new marketer is "Position-less" — who is a professional armed with versatile AI tools, capable of wearing multiple hats, yet anchored by irreplaceable human traits: strategy, judgment, and creativity.

These marketers will not only leverage AI's capabilities but also ensure that every decision, campaign, and interaction resonate on a human level.

Here's how the humans will lead the charge in navigating key trends shaping the future of marketing.

1. Hyper-personalization needs human sensitivity

AI excels at analyzing data to deliver personalized recommendations and content in real time. However, hyper-personalization isn't just about algorithms—it's about understanding the emotional and cultural context of customer interactions.

- **AI's contribution:** Predictive analytics and dynamic content generation enable real-time relevance.
- **Human role:** Marketers bring the emotional intelligence needed to ensure personalization doesn't feel intrusive but rather empathetic and meaningful.

Marketers are the architects who balance data-driven precision with the nuance of human connection.

2. Omnichannel integration requires human intuition

Creating a seamless customer journey across channels is essential, especially as consumers increasingly research online and purchase offline. While AI can map touchpoints and optimize engagement, it is marketers who shape the narrative.

- **AI's contribution**: Algorithms determine the best timing and channels for interactions.
- **Human role**: Marketers ensure that every touchpoint aligns with the brand's story and values, crafting an emotionally cohesive customer experience.

With omnichannel strategies, humans ensure the "seamless" is also "meaningful."

3. Ethical data practices demand accountability

The rise of privacy regulations and the shift to zero-party data require brands to prioritize transparency and ethical data usage. Technology can handle compliance, but accountability is a human responsibility.

- **AI's contribution**: Tools streamline data collection and segmentation.
- **Human role**: Marketers ensure campaigns respect privacy, foster trust, and use data ethically to deepen customer relationships.

Marketers are the stewards of ethical practices, ensuring technology serves both customers and brands.

4. AI-Driven Creativity Still Needs Human Judgment

As noted, generative AI can create email copy, product recommendations, and even dynamic website content at scale. Yet it lacks the strategic foresight and emotional resonance required for effective marketing.

- **AI's contribution**: Automates content creation, accelerating execution.
- **Human role**: Marketers oversee AI outputs, ensuring alignment with brand identity and long-term goals.

Marketers remain the creative force behind every campaign, using AI as a tool, not a replacement.

5. Beyond 2025: Advanced technologies require Vision

Emerging tools like emotion AI, quantum computing and digital twin technology promise to revolutionize marketing. However, their potential depends entirely on how marketers apply them.

- **AI's contribution**: Enhances targeting, personalization, and customer experience.
- **Human role**: Marketers envision real-world applications that solve problems and enhance engagement.

Marketers must pair technology's possibilities with human ingenuity to drive meaningful innovation.

The human edge in an AI-driven world

In 2025, marketing success won't hinge solely on the tools and technologies brands adopt, but on how humans wield them. It will be the "Position-less Marketer" who embodies this shift, blending technical prowess with strategic vision, creativity, and empathy.

As AI accelerates what's possible, marketers must remain at the helm, ensuring every campaign feels authentic, every interaction resonates, and every innovation serves a purpose.

The future of marketing belongs to those who can seamlessly integrate technology with humanity. The Position-less Marketer is not just a response to AI's rise—it's the key to unlocking its full potential.

This is a new era of marketing, where humans and machines work hand in hand to deliver exceptional experiences. Now, use your best strategy and judgement.

How Samsung could finally unlock smart glasses' true potential

It might not feel like it yet, but the world of smart glasses is heating up.

On top of new entries from companies like Xreal, Meta took the next steps with its Ray-Ban smart glasses this year, imbuing them with AI and adding even more potential for future uses down the line. As I've written previously, Meta's Ray-Ban smart glasses are arguably my favorite (and maybe the most underrated) gadget of the year.

They have great audio capabilities, they make taking pictures and videos easy, and they actually look like normal, Ray-Ban, glasses. When it comes to style and capability, they stand alone in the smart glasses category.

At least for now...

Samsung enters the chat

Looks like Meta might not be alone in the world of fashionable smart glasses much longer.

According to a report this week from Korean outlet *Yonhap News*, Samsung may be preparing to launch its own pair of smart glasses soon, potentially during January's annual Galaxy Unpacked event where it typically introduces its flagship Galaxy phones.

On one hand, that's to be expected — Meta has already made a clear case that smart glasses with a camera and solid audio are a marketable commodity. On the other hand, it could represent one of the biggest sea changes in smart glasses we've seen yet.

Let me explain.

Meta's glasses are great. They do a lot more than you might expect for a relatively nascent product category and they might do even more in the future thanks to Meta AI which imbues the glasses with a bit of computer vision.

But as solid as they are, they're still lacking something — something that actually has almost nothing to do with the glasses themselves. That something is an ecosystem.

Competitors like Xreal offer more augmented reality but in a bigger form factor. (Image credit: XREAL)

Smart glasses, for all of their surprising use cases, still need to be coupled with a real computer, and in that case, that computer is your phone. Your phone is the only reason that Meta's Ray-Ban glasses are useful and thanks to that synergy they can play music, announce turn-by-turn navigation in your maps apps, take calls, and more.

But for everything Ray-Ban glasses *can* do thanks to your phone, there are just as many things that they can't. That has almost nothing to do with the glasses themselves or their technical limitations, but a lot to do with your phone.

Meta's Ray-Bans just don't have the deep system-level access to your phone to bring them the extra mile. Imagine for a moment a pair of glasses that plays nice with *everything* your phone does — I'm talking text messages, calls, voice assistants, timers, calendars, you name it.

Sounds useful, right? That's exactly what Samsung might have to offer.

A smarter pair of smart glasses

A pair of Samsung smart glasses has no real limitations when it comes to which apps it has access to and which it doesn't, and for that reason, they could unlock the true potential of the category.

Paired with system-level access, Samsung's rumored smart glasses would be a real-functional extension of your phone in the same way that a watch is — maybe even more so since it can capture media as well.

Think about it. A pair of deeply integrated smart glasses could take pictures and videos and send them directly to your photos app; it could take calls; it could send messages through voice; it could integrate with your phone calendar and send you reminders; it could interact with your phone's voice assistant to search the web or, heck, draft an email for you. By borrowing your phone's ecosystem and compute power, I can't think of anything that smart glasses *can't* do.

In short, they could cease on basically all the shortcomings of Meta's Ray-Bans.

This is all hypothetical for now, but when you start to unpack the possibilities, a pair of smart glasses made by a company that also manufactures phones just makes sense. It'd still be pretty far off from the AR future promised by prototypes like Meta's Orion, but it would also easily be the best pair of phone-like smart glasses we've seen yet.

As much as I love Meta's Ray-Ban glasses, favorites are a fleeting thing and if Samsung really pulls the trigger, we may have a new king of smart glasses.

Google patents smart glasses with display, speaker & eye-tracking

Many people would say that the Google Glass project was ahead of its time, and I'd agree. Well, it's possible Google will try again, as the company just patented smart glasses with a built-in display, speakers, eye-tracking, and more.

Google could have plans to launch a new pair of smart glasses

This patent surfaced in China, as it was patented with CNIPA (China's National Intellectual Property Administration), China's certification agency. First and foremost, this patent indicates that these glasses won't be a standalone product. Google allegedly has plans to offload processing to a smartphone, so the glasses will need to be connected to a smartphone.

In addition to a built-in display, speaker, and eye-tracking, these glasses also have a microphone included, and cameras, of course. Based on this patent, these glasses mainly rely on contextual data such as location to provide suggestions or accept commands.

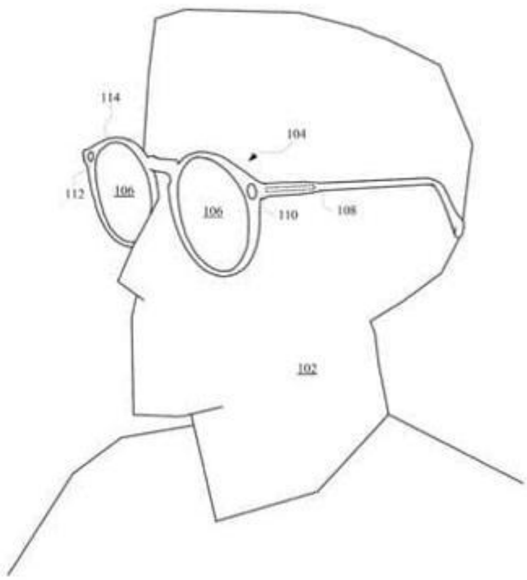
Users can interact with glasses via touch, voice, or gesture input. Something called 'gaze tracking' is also a part of Google's plans. Built-in cameras are included to identify your surroundings, and the displays can provide information and navigation.

Processing will be offloaded to a smartphone

Needless to say, Google's plan to offload processing to smartphones will save battery life. So these glasses could end up excelling in that regard if they ever become a reality. This is just a patent at this point, so don't get your hopes up just yet.

Chances are that Google will come up with such a product sooner or later, though. Samsung is allegedly working on its XR device and AR glasses, while Meta partnered up with Ray-Ban to introduce rather interesting smart glasses that my colleague fell in love with.

Is it time for Google to revive Google Glass… well, kind of? Well, it may be. This could be the ideal time for the company to do just that. Wearing various tech gadgets is normalized, while the technology caught up.



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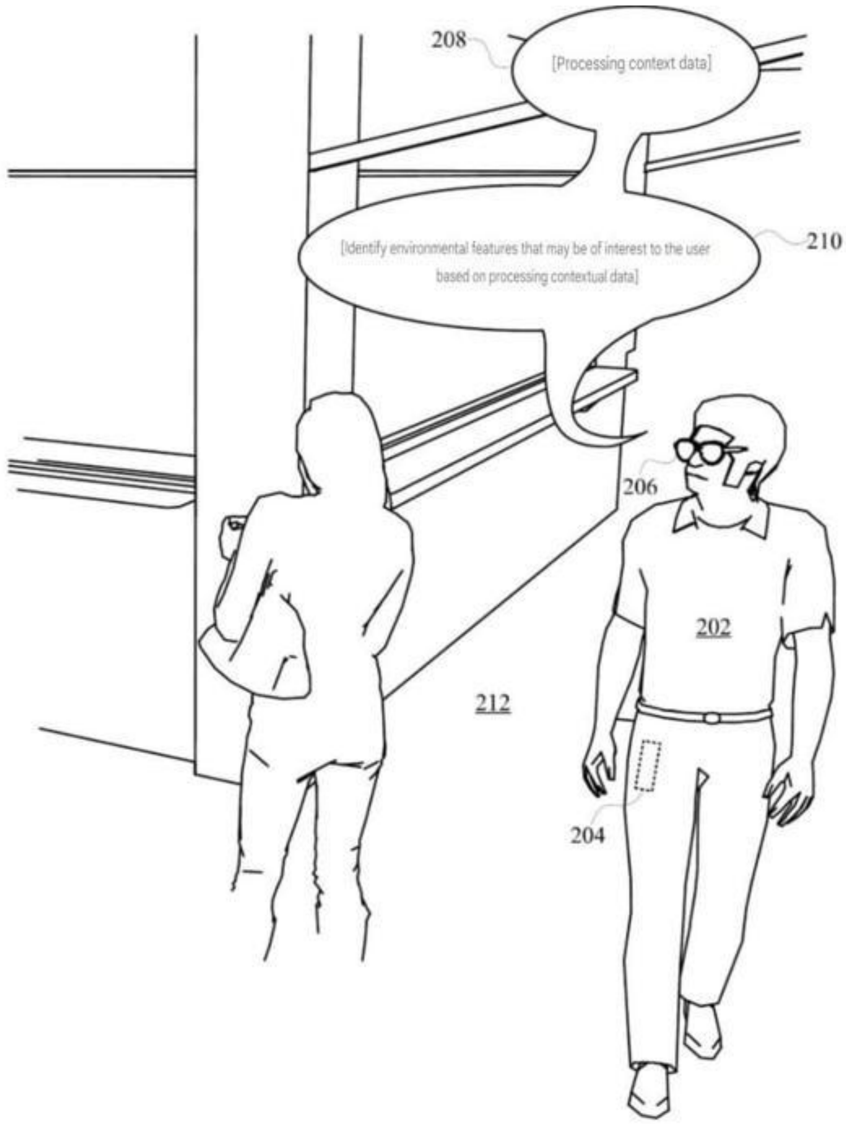
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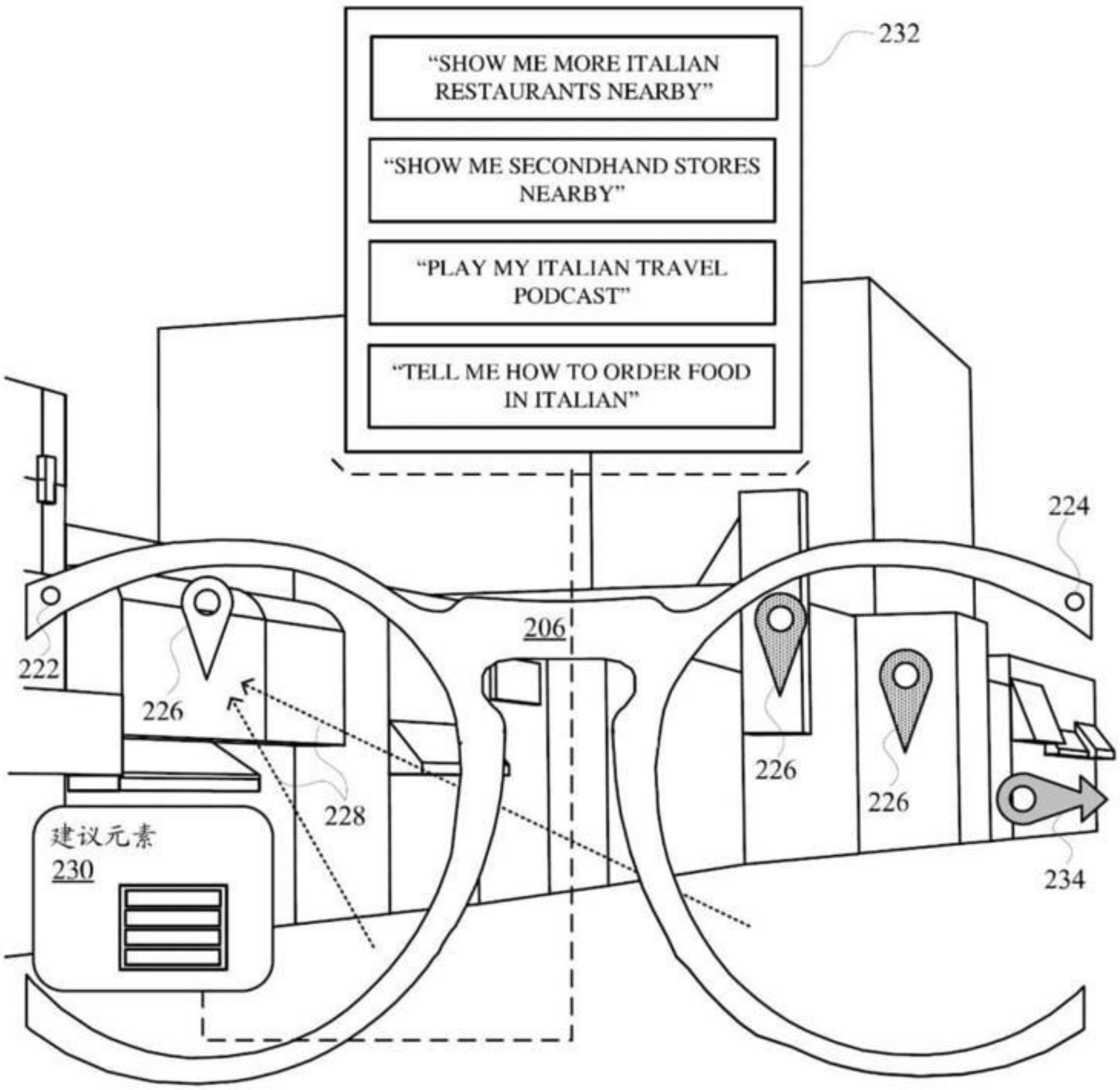
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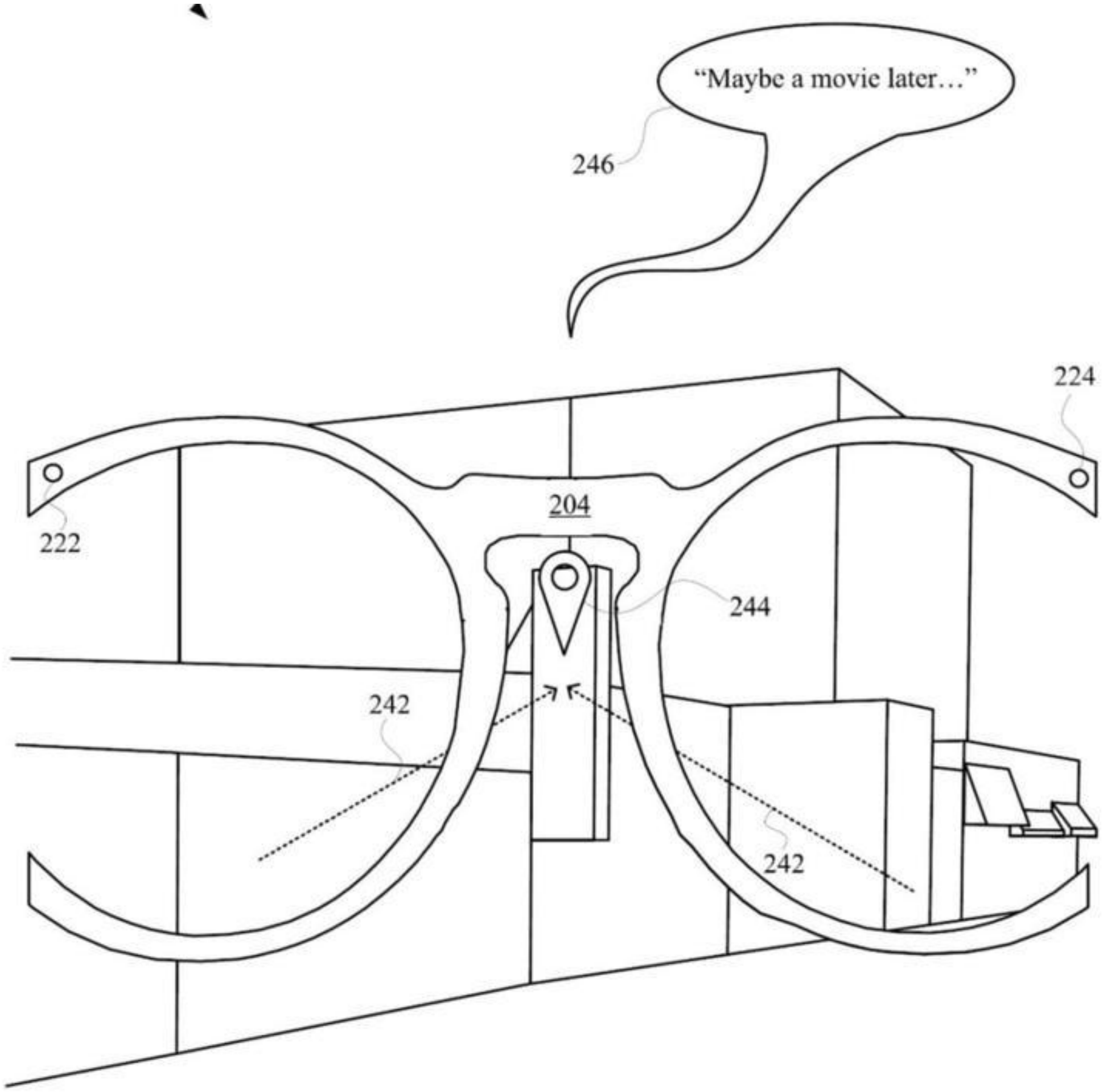

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The next Apple Watch Ultra could have satellite texting

Apple enabled non-emergency satellite messaging from iPhones earlier this year. According to *Bloomberg*'s Mark Gurman, it may do the same for the next Apple Watch Ultra in addition to adding the long-rumored blood-pressure monitoring feature.

Satellite messaging on the Watch Ultra has been rumored since before we even knew what Apple's XL-sized sporty take on its smartwatch line would be called. According to Gurman's description, it would work like it does on the iPhone, letting you send text messages from the watch without a cellular or Wi-Fi connection.

He also reports that Apple is swapping out Intel modems in the Apple Watch for a component from MediaTek but doesn't have any plans yet to use its upcoming in-house modems for the wearables. The new component included in "at least some models" could also support RedCap, the 5G service intended for wearables and IoT that sacrifices extra antennas and maximum bandwidth to reduce cost and extend battery life.

Adding satellite service could help Apple lure some Garmin inReach fans who might want to have one less thing to carry even if the inReach's hundreds of hours of battery life still win out for extended hikes. Presumably, service would be provided by Globalstar, Apple's satellite partner for the iPhone that it bought a 20 percent stake in last month.

As for blood-pressure monitoring, Gurman says that it "may arrive as soon as 2025 as well," but he reminds us that the feature has been delayed in the past. Like sleep apnea detection and other health features of the Apple Watch, this feature wouldn't offer specific measurements but could let you know if you seem to be experiencing hypertension.

Scientists use Matrix-style learning to 'write' skills into human brain noninvasively

e Matrix-style learning to 'write' skills into human brain noninvasively

A team of researchers from the University of Rochester, Yale University, and Princeton University has made a big stride in neuroscience.

They have shown a method to induce learning through the direct manipulation of brain activity patterns.

This technique uses real-time brain imaging and neurofeedback. It bypasses learning processes that require effort, study, or practice.

"With our method not only can we nudge complex patterns around in the brain toward known ones, but also—for the first time—write directly a new pattern into the brain and measure what effect that has on a person's behavior," said Dr Coraline Iordan, lead author of the study and assistant professor of brain and cognitive sciences at the University of Rochester.

Researchers focused on visual learning in their study

Participants were placed in a functional magnetic resonance imaging (fMRI) machine, which allows for the monitoring of brain activity in real-time.

They were then presented with abstract shapes on a screen. These shapes were programmed to "wobble," and participants were instructed to attempt to stop this movement using only their minds.

The participants did not know that the "wobbling" was connected to their brain activity. The researchers had pre-defined a specific brain activity pattern associated with a new visual category.

When a participant's brain activity aligned with this target pattern, the wobbling would cease. This feedback mechanism effectively "sculpted" the participants' brain activity, guiding them toward the desired pattern.

Learning without any conscious awareness

"Instead of teaching you something and measuring how your brain changes, we wrote a new category into your brain that would have appeared had you learned it yourself," explained Iordan.

Through this process, participants successfully learned to recognize new visual categories without any conscious awareness of what those categories were. This shows the brain's ability to learn without effort or instruction.

"One of the striking features of the study is that the neural responses and corresponding behavior to the new categories occurred without explicit awareness of those categories," said Dr Jonathan Cohen, a neuroscientist at Princeton University and co-author of the study.

"We essentially turned learning on its head and taught your brain something that caused you to vicariously gain information, even though you were never explicitly given that information," added Iordan.

Potential applications

This technology has many possible uses. It could change education by speeding up learning, particularly for individuals with learning challenges.

It could also be used for rehabilitation. For example, it could help stroke patients recover brain functions. Additionally, the ability to change brain activity could lead to treatments for mental disorders.

"This study is one of the most powerful demonstrations yet of brain training with real-time fMRI," concluded Dr Nicholas Turk-Browne, a psychologist at Yale University and co-author of the study.

"In the future, this discovery could inform the development of brain-computer interfaces and clinical interventions."

While this technology is still in its early stages, it represents a paradigm shift in our understanding of learning and brain plasticity. Further research is necessary to explore the long-term effects and optimize its application.

This is exciting to physicists. Usually the laws of physics, which are symmetrical across space and (in most cases) time, creating outcomes that are the same regardless of their direction in space and time.
But crystals break this symmetry, arranging themselves in a preferred spatial direction. This means that, even if physical laws are still symmetrical, they create different outcomes depending on the direction they act upon crystals.

In the same way that crystals break symmetry in space, time crystals break them in time. They exist in the lowest possible energy permitted by quantum mechanics, and oscillate between two states without slowing down.

These remarkable properties have led to many claims that time crystals are perpetual motion machines that violate the second law of thermodynamics, but this isn't the case. The crystals, which are driven by lasers, simply cannot lose or gain energy — all the laser light hitting them does is cause them to repeat their two-step shuffle. This means that, like many systems containing only a handful of atoms, the second law does not apply to them.
A number of time crystals have been made since Wilczek's proposal, each offering their own unique windows into this bizarre phase of matter. To build their time crystal, the researchers behind the new study turned to rubidium atoms excited into what are known as Rydberg states.

By firing laser light at a glass container filled with rubidium atoms, the physicists pumped the gas with tons of excess energy. The laser light excited the electrons found within the atoms, causing the spaces between their atomic nuclei and the electrons' outer shells to balloon to hundreds of times their usual size. This made something very interesting happen.

"If the atoms in our glass container are prepared in such Rydberg states and their diameter becomes huge, then the forces between these atoms also become very large," Pohl said. "And that in turn changes the way they interact with the laser. If you choose laser light in such a way that it can excite two different Rydberg states in each atom at the same time, then a feedback loop is generated that causes spontaneous oscillations between the two atomic states. This in turn also leads to oscillating light absorption."

In other words, a time crystal had appeared within the glass box.

"This is actually a static experiment in which no specific rhythm is imposed on the system," Pohl added. "The interactions between light and atoms are always the same, the laser beam has a constant intensity. But surprisingly, it turned out that the intensity that arrives at the other end of the glass cell begins to oscillate in highly regular patterns."

Now that they've created their new type of time crystal, the researchers will continue to experiment on it and test it for further applications. They have suggested that it could be used to create new, highly sensitive sensors, alongside helping scientists to better understand quantum synchronization — a phenomenon in which multiple quantum systems can be made to act in phase, that will aid in the development of better quantum computers.

Quantum secrets

"A time crystal keeps moving and repeats itself periodically in time in the absence of external encouragement," said Autti. This is possible because the time crystal is in its lowest energy state. The basic rules of quantum mechanics prevent the motion from becoming completely still, and so the time crystal remains "stuck" in its never-ending cycle.

"This means they are perpetual motion machines, and therefore impossible," remarked Autti.

The laws of thermodynamics suggest that systems in equilibrium tend toward more entropy, or disorder — a coffee cup sitting out will always cool, a pendulum will eventually stop swinging, and ball rolling on the ground eventually comes to rest. But a time crystal defies that, or simply ignores it, because the rules of thermodynamics don't seem to apply to it. Instead, time crystals are subject to quantum mechanics, the rules that govern the zoo of subatomic particles.
"In quantum physics, a perpetual motion machine is fine as long as we keep our eyes closed, and it must only start slowing down if we observe the motion," Autti said, referring

to the fact that the exotic quantum mechanical states required for time crystals cannot keep operating once they interact with their environment (for example, if we observe them).

This implies that physicists can't directly observe time crystals. The moment they try to watch one, the quantum rules that allow them to exist break down, and the time crystal grinds to a halt. And that concept extends beyond observation: Any strong enough interaction with the external environment that breaks down the quantum state of the time crystal will make it stop being a time crystal.

This is where Autti's team came in, trying to find a way to interact with a quantum time crystal through classical observations. At the tiniest scale, quantum physics reigns. But bugs and cats and planets and black holes are better described by the deterministic rules of classical mechanics.

"The continuum from quantum physics to classical physics remains poorly understood. How one becomes the other is one of the outstanding mysteries of modern physics. Time crystals span a part of the interface between the two worlds. Perhaps we can learn how to remove the interface by studying time crystals in detail," said Autti.

Magical magnons

In the new study, Autti and his team used "magnons" to build their time crystal. Magnons are "quasiparticles," which emerge in the collective state of a group of atoms. In this case, the team of physicists took helium-3 — a helium atom with two protons but only one neutron — and cooled it to within a ten-thousandth of a degree above absolute zero. At that temperature, the helium-3 transformed into a Bose-Einstein condensate, where all the atoms share a common quantum state and work in concert with each other.
In that condensate, all the spins of the electrons in the helium-3 linked up and worked together, generating waves of magnetic energy, the magnons. These waves sloshed back and forth forever, making them a time crystal.

Autti's team took two groups of magnons, each one operating as its own time crystal, and brought them close enough to influence each other. The combined system of magnons acted as one time crystal with two different states.

Autti's team hopes that their experiments can clarify the relationship between quantum and classical physics. Their goal is to build time crystals that interact with their environments without the quantum states disintegrating, allowing the time crystal to keep running while it is used for something else. It wouldn't mean free energy — the motion associated with a time crystal doesn't have kinetic energy in the usual sense, but it could be used for quantum computing.

Having two states is important, because that is the basis for computation. In classical computer systems, the basic unit of information is a bit, which can take either a 0 or 1 state, while in quantum computing, each "qubit" can be in more than one place at the same time, allowing for much more computing power.

"This could mean that time crystals can be used as a building block for quantum devices that work also outside the laboratory. In such a venture the two-level system we have now created would be a basic building block," Autti said.

This work is currently very far away from a working quantum computer, but it does open up interesting avenues of research. If scientists can manipulate the two-time-crystal system without destroying its quantum states, they could potentially build larger systems of time crystals that serve as true computational devices.

New solar cell technology could ditch batteries in gadgets for good by harvesting ambient room light

A new solar cell technology designed to recharge devices such as remote controls by harvesting ambient indoor light was just unveiled.

The technology was showcased by California-based Ambient Photonics at CES 2024, with the startup also partnering with Google to incorporate the technology into a new consumer product, which it hasn't yet revealed. They plan to launch it at some point in 2024, company representatives announced at the show.

The company is also working on a solar-powered computer mouse. None of these devices, including the unknown Google product, will require disposable batteries or need to be consciously recharged, according to the company.

The technology in the new cells is bifacial, which means it can harvest and generate energy from both sides, which lets it generate enough energy to power home electronics. Its previous cells were only single-sided, with the rear side providing 50% additional energy on top of the 100% efficiency of the front-facing side.

Inspired by photosynthesis — the process by which plants convert sunlight into energy — these photovoltaic cells contain light-sensitive dye molecules that turn photons, small particles of electromagnetic radiation, into electrons, negative subatomic particles.
This creates a charge differential that, in turn, allows electricity to flow. They work similarly to how chlorophyll, which makes plants green, creates power from photons in photosynthesis.

“In a dye sensitized solar cell, the amount of electrical power produced depends on how effectively the photons are absorbed by the dye," Joshua Wright, vice president of engineering at Ambient Photonics, told Live Science in an email.

Wright claimed his team achieved “superior dye chemistry” for producing “unmatched power density”, with the company publishing more information in a document outlining how its technology works. Ambient's dyes are based on over 40 organic sensitizer molecules — the active component of dye sensitized solar cell (DSSC) technology — which absorb light across the entire visible electromagnetic spectrum, like those in other solar panels.
Reducing the need for batteries could cut electronic waste, as TK billions of batteries go to landfills every year.

Although solar power technology has existed for decades, generating enough power for devices at low lighting levels has been a vexing problem. Previous attempts to create low-lighting solar cells haven't been sufficient, with Wright explaining that traditional photovoltaic innovations such as amorphous silicon cells "don’t yield sufficient power in the real-world, low-light operations conditions."

Ambient claims its technology harvests three times more light than comparable solutions.

"Also, the large price tag on high performance, low-light photovoltaic technologies like gallium arsenide cells has made them suitable only for space satellite and research applications, not mass-market electronics," he said.

Australian breakthrough: New smartphone battery could triple lifespan

Will charging the battery become a thing of the past?© Pexels, Iurii Laimin

Australian scientists have introduced an innovative type of battery designed for smartphones. They claim that the new battery will be more durable and suitable for reuse, potentially extending its lifespan up to three times.

If the predictions of Australian researchers are realized, smartphone replacements could become less frequent in the future. Many users are familiar with the issue where **the phone's battery loses its efficiency after about two or three years,**

causing the device to discharge quickly. The new batteries being developed are not only expected to last longer but also to be more recycling-friendly.

Are we on the brink of a smartphone battery revolution?

In their research, specialists highlight that **only 10% of used phones in Australia are recycled.** A similar situation exists in other parts of the world because processing devices with lithium-ion batteries is complicated and not cost-effective. To address this, scientists from RMIT in Melbourne used MXene—a compound comparable to graphene with high electrical conductivity—instead of lithium.

Although MXene rusts over time, engineers from RMIT have found a way to solve this problem. Tests have shown that exposing the battery to sound waves at a frequency of 10 Hz for a minute effectively removes rust, allowing the battery to be reused.

How long will the new battery last?

This process can be repeated twice, meaning that with the standard battery life in smartphones being about three years, new MXene batteries could last up to nine years.

Of course, this assumes that other smartphone components operate flawlessly. Even if the new batteries do not allow for less frequent phone changes, **the introduction of such a solution is a step towards more efficient battery recycling.** Ultimately, this could help reduce the amount of electronic waste. Researchers are already seeking business partners interested in implementing this technology in the market.

Transparent phones: The future of smartphones unveiled

The transparent phone has emerged as one of the most innovative solutions in the technology industry, capturing the interest of both tech enthusiasts and designers seeking new inspiration. What possibilities does this groundbreaking invention offer, and could it become a permanent fixture in the market?

Is it possible to use a transparent phone?
Images source: © Getty Images | Devrimb
KAW
10:48 AM EDT, October 10, 2024
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Not long ago, the transparent phone was associated solely with futuristic visions in science fiction movies. Technological advancements like OLED and microLED screens are turning this idea into reality. Companies like Xiaomi are experimenting with **transparent device prototypes to revolutionize the market**. Although significant progress is needed before the full implementation of such phones, their advantages and limitations are garnering more interest.

The transparent phone - an excellent example of innovative technology

The transparent phone once seemed like a distant dream from science fiction films. However, **this concept has become a reality thanks to rapid advances in screen technology**

and component miniaturization. **Transparent smartphones are designed to be see-through**, offering entirely new ways to interact with the device.

By utilizing transparent materials and innovative technologies such as **OLED** or **microLED screens**, **transparent phones can deliver high-quality images while maintaining their see-through quality**. This groundbreaking development is also enabled by the advancement of components concealed in narrow frames or specific sections, creating "invisible" electronic circuits. Tech companies like **Samsung** and **Xiaomi** are actively researching this solution, suggesting it may become a relatively widespread technology.

How to use a transparent phone?

The market currently has limited options for transparent phones. However, in recent years, several companies have showcased **prototypes** or announced their development efforts in this area. Among the most notable examples are the Samsung Galaxy and the **Xiaomi Mi MIX Alpha** model, which, while not entirely transparent, represents a step toward modern screens that occupy almost the entire phone surface. **Transparency technology** offers more intuitive operation, allowing users to **browse content on both the front and back of the device**.

Using a transparent phone may differ from using conventional devices. Transparent screens with touch interfaces enable fresh interaction. Additionally, with more dynamic content display capability, the **user can adjust the display's transparency** according to current needs. For instance, they might dim it while typing a message or increase transparency for a more futuristic effect. Although this technology needs further refinement, future models are anticipated to become **more functional and affordable**.

Pros and cons of the transparent phone

The advantages of a transparent phone primarily include its modern design and unique capabilities. With a transparent screen, the device stands out from traditional smartphones and attracts attention with its unconventional appearance. **Transparency can also enhance the intuitiveness of operation**, enabling users to utilize both sides of the phone to display information and manage content.

However, transparent phones also have their drawbacks. One of the main challenges is reduced battery capacity. Placing components in narrow frames means smaller batteries, which can impact the device's usage time. Another concern is the **limited durability of the construction**, as transparent materials tend to be more susceptible to damage than traditional casings. Repairing such a phone could also be costly and challenging due to its complex structure.

It's also worth mentioning the price – **producing transparent phones involves high costs**, making them accessible to only a select group of users. Nevertheless, this technology may find wider application in the future as production costs decrease and functionality improves.

Memory Is Not Confined to Our Brains, Scientists Discover

Microscope image of neurons from a mouse's cortex colored in red yellow and green

Our brain isn't the only place memories form in our body. New York University (NYU) researchers have discovered learning through repetition may be fundamental to all of our cells. The process may also help explain why taking breaks is such a powerful learning tool.

"Learning and memory are generally associated with brains and brain cells alone, but our study shows that other cells in the body can learn and form memories, too," says neuroscientist Nikolay Kukushkin.

Better understanding of how this process works could lead to more effective treatments for learning and memory problems, Kukushkin explains.

Many learn the hard way that cramming for exams doesn't create the most reliable or long term memories. Multiple cycles of chemical activity through a repeated behavior is what triggers the memory-formation process among our neurons, encoding increasingly stronger memories. This phenomenon is called the massed-spaced effect and is highly conserved in all animals at both the cellular and behavioral levels.

By exposing non-brain nerve and kidney cells to similar chemical patterns in the lab, Kukushkin and colleagues showed for the first time that these tissues experience massed-spaced effect too. Genes associated with memory formation in neurons also seemed to be activated within these cells, based on measures of a byproduct of the genes' expression called luciferase.

"The ability to learn from spaced repetition isn't unique to brain cells, but, in fact, might be a fundamental property of all cells," explains Kukushkin.

How the nerve and kidney cells responsed depended on the number of rounds of protein kinases A and C (PKA and PKC) they were treated with. These chemical 'training pulses' are known components of memory forming signaling cascades.

"A three-minute pulse did turn on the 'memory gene,' but only for an hour or two, whereas after four pulses, the gene was turned on stronger, and stayed on for days," Kukushkin writes for Psychology Today.

The cell responses also depended on the time between pulses. These factors varied how strongly the memory-forming molecules were activated, and for how long – exactly what happens with our neurons.

"Memory exists not only in the brain, but throughout our body, and this 'body memory' could play a role in health and disease," writes Kukushkin.

There's still much to learn about how this all works inside human bodies. Previously the researchers found increasing interactions between PKA and enzymes called extracellular signal-regulated kinases in sea hares (Aplysia) – animals commonly used to study neuron behavior – not only enhanced learning but could repair learning deficits too.

"We will need to treat our body more like the brain," Kukushkin recommends. "For example, consider what our pancreas remembers about the pattern of our past meals to maintain healthy levels of blood glucose or consider what a cancer cell remembers about the pattern of chemotherapy."

This research was published in *Nature Communications*.

Meta's Ray-Bans Can Now Do Real-Time Live AI And Translation

Meta's Ray-Bans are becoming live AI glasses now. Scott Stein/CNET© Provided by CNET

Meta's camera-equipped Ray-Bans have had a lot of AI features onboard already, but they're getting two more big ones. Always-on continuous AI assistance is arriving onto the glasses starting today for owners who have early access to Meta's features, as well as onboard translation. Both these features were demoed by Mark Zuckerberg at Meta's Connect developer conference earlier this year.

The features involve continuous audio and camera recording as opposed to specific individual prompts, allowing the Ray-Bans to be used for an extended period of time with the AI features turned on. Saying "Meta, start Live AI" begins the always-on feature. The glasses' LED light stays on when always-on live AI is activated, and Meta keeps a recording of the conversation that can be referred to throughout the AI session. For translation, it should work automatically while talking, with the translation coming in via the glasses with a slight delay.

The live AI assistance is similar to what Google just demonstrated on its own prototype glasses this month via Gemini and Android XR, arriving next year.

The always-on AI takes a hit on battery life: expect 30 minutes of use before needing a recharge, according to Meta. But this type of always-on camera-assisted AI is exactly what more tech companies are going to be exploring in the next year. I'll follow up with impressions when I get a chance to test it for myself.

Researchers map the spatio-temporal human brain dynamics of a visual image being recognized

A team of MIT researchers found highly memorable images have stronger and sustained responses in ventro-occipital brain cortices, peaking at around 300ms. Conceptually similar but easily forgettable images quickly fade away. Credit: Alex Shipps/MIT CSAIL© Provided by Medical Xpress

For nearly a decade, a team of MIT Computer Science and Artificial Intelligence Laboratory (CSAIL) researchers have been seeking to uncover why certain images persist in people's minds, while many others fade. To do this, they set out to map the spatio-temporal brain dynamics involved in recognizing a visual image.

And now for the first time, scientists harnessed the combined strengths of magnetoencephalography (MEG), which captures the timing of brain activity, and functional magnetic resonance imaging (fMRI), which identifies active brain regions, to precisely determine when and where the brain processes a memorable image.

Their open-access study, published this month in *PLOS Biology*, used 78 pairs of images matched for the same concept but differing in their memorability scores—one was highly memorable and the other was easy to forget.

These images were shown to 15 subjects, with scenes of skateboarding, animals in various environments, everyday objects like cups and chairs, natural landscapes like forests and beaches, urban scenes of streets and buildings, and faces displaying different expressions.

What the researchers found was that a more distributed network of brain regions than previously thought are actively involved in the encoding and retention processes that underpin memorability.

"People tend to remember some images better than others, even when they are conceptually similar, like different scenes of a person skateboarding," says Benjamin Lahner, an MIT Ph.D. student in electrical engineering and computer science, CSAIL affiliate, and first author of the study.

"We've identified a brain signature of visual memorability that emerges around 300 milliseconds after seeing an image, involving areas across the ventral occipital cortex and temporal cortex, which processes information like color perception and object recognition. This signature indicates that highly memorable images prompt stronger and more sustained brain responses, especially in regions like the early visual cortex, which we previously underestimated in memory processing."

While highly memorable images maintain a higher and more sustained response for about half a second, the response to less memorable images quickly diminishes. This insight, Lahner elaborated, could redefine our understanding of how memories form and persist. The team envisions this research holding potential for future clinical applications, particularly in early diagnosis and treatment of memory-related disorders.

The MEG/fMRI fusion method, developed in the lab of CSAIL Senior Research Scientist Aude Oliva, adeptly captures the brain's spatial and temporal dynamics, overcoming the traditional constraints of either spatial or temporal specificity.

The fusion method had a little help from its machine-learning friend, to better examine and compare the brain's activity when looking at various images. They created a "representational matrix," which is like a detailed chart, showing how similar neural responses are in various brain regions. This chart helped them identify the patterns of where and when the brain processes what we see.

Picking the conceptually similar image pairs with high and low memorability scores was the crucial ingredient to unlocking these insights into memorability. Lahner explained the process of aggregating behavioral data to assign memorability scores to images, where they curated a diverse set of high- and low-memorability images with balanced representation across different visual categories.

Despite strides made, the team notes a few limitations. While this work can identify brain regions showing significant memorability effects, it cannot elucidate the regions' function in how it is contributing to better encoding/retrieval from memory.

"Understanding the neural underpinnings of memorability opens up exciting avenues for clinical advancements, particularly in diagnosing and treating memory-related disorders early on," says Oliva. "The specific brain signatures we've identified for memorability could lead to early biomarkers for Alzheimer's disease and other dementias.

"This research paves the way for novel intervention strategies that are finely tuned to the individual's neural profile, potentially transforming the therapeutic landscape for memory impairments and significantly improving patient outcomes."

"These findings are exciting because they give us insight into what is happening in the brain between seeing something and saving it into memory," says Wilma Bainbridge, assistant professor of psychology at the University of Chicago, who was not involved in the study. "The researchers here are picking up on a cortical signal that reflects what's important to remember, and what can be forgotten early on."

More information: Benjamin Lahner et al, Visual perception of highly memorable images is mediated by a distributed network of ventral visual regions that enable a late memorability response, *PLOS Biology* (2024). DOI: 10.1371/journal.pbio.3002564

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Provided by Massachusetts Institute of Technology

F35 Helmet: Gen III Mounted Display System (HMDS)

Introduction

In the high-stakes world of multi-role tactical aircraft piloting, split-second decision-making can quite literally be a matter of life or death. As technology continues to advance, the tools available to pilots have become increasingly sophisticated, none more so than th**e F-35 Gen III Helmet Mounted Display System** (**HMDS**). This revolutionary interface offers pilots intuitive access to an extensive array of flight, tactical, and sensor information, ultimately enhancing situational awareness, precision, and safety to unprecedented levels.

A Glimpse into the Future

The F-35 Gen III HMDS serves as the pilot's primary display system, ushering in the next generation of cockpit interfaces. This innovative technology allows pilots to see through the bottom of the fuselage or directly at a target, providing an uninterrupted display of flight information and sensor data. The result is extreme spatial orientation, superior weapons targeting, and tactical superiority, whether it's day or night.

One of the standout features of this system is the seamless integration of the head-up display (HUD), helmet-mounted display, and visor-projected night vision. This integration empowers pilots with unparalleled capabilities inside the fighter cockpit. They can effectively target their weapons while maintaining advanced spatial awareness, all while continually monitoring crucial flight information.

The F-35 Gen III HMDS boasts an advanced bi-ocular display system with an expansive 30-by-40-degree field-of-view and a remarkable 100 per cent overlap. This feature becomes especially valuable during night missions, as the HMDS projects directly onto the visor, eliminating the need for separate night-vision goggles. Pilots can now seamlessly transition between day and night operations, further enhancing their flexibility and effectiveness.

Visual Targeting at Its Finest

One of the system's standout capabilities is the pilot's ability to target weapons simply by looking at and designating their intended targets. This innovative approach to targeting, combined with target verification through onboard sensors or datalink cues, streamlines the engagement process. It ensures that pilots can respond rapidly and accurately to threats, a critical factor in modern aerial combat.

Design and Comfort

Beyond its technical prowess, the F-35 Gen III HMDS also prioritizes the pilot's comfort and well-being. Its lightweight design maintains an optimal centre of gravity, enhancing overall manoeuvrability and reducing fatigue during extended missions. Additionally, the custom helmet liner ensures a precise fit, offering unmatched comfort that is essential for pilots operating under high-stress conditions.

Conclusion

In the ever-evolving landscape of aerial combat, the F-35 Gen III Helmet Mounted Display System stands as a testament to human ingenuity and innovation. It equips pilots with the tools they need to make split-second decisions, enhancing their situational awareness, precision, and safety to unprecedented levels. As we move forward into an era of advanced technology, this system serves as a beacon of hope for the brave men and women who protect our skies.

FAQs

How does the F-35 Gen III HMDS improve situational awareness?

The F-35 Gen III HMDS offers an uninterrupted display of flight information and sensor data, providing extreme spatial orientation, superior weapons targeting, and tactical superiority to pilots, day or night.

Can pilots switch between day and night operations seamlessly?

Yes, thanks to the advanced bi-ocular display system and visor-projected night vision, pilots can transition between day and night missions without the need for separate night-vision goggles.

How does visual targeting work with the HMDS?

Pilots can target weapons by simply looking at and designating their intended targets. Target verification is achieved through onboard sensors or datalink cues, ensuring accurate engagement.

Is the F-35 Gen III HMDS comfortable for pilots?

Yes, the system features a lightweight design with an optimal centre of gravity and a custom helmet liner for a precise fit, reducing pilot fatigue and increasing comfort.

What role does the F-35 Gen III HMDS play in modern aerial combat?

This system plays a crucial role by equipping pilots with the tools they need for split-second decision-making, enhancing situational awareness, precision, and safety in the ever-evolving landscape of aerial combat.

F-35 Gen III Helmet Mounted Display System (HMDS)

Unprecedented capability for the world's most advanced tactical aircraft

- Helmet Mounted Displays (HMD)/
- F-35 Gen III Helmet Mounted Display System

To the multi-role tactical aircraft pilot, split-second decision-making can be a matter of life or death. The F-35 Gen III Helmet Mounted Display System's next generation interface provides pilots with intuitive access to vast quantities of flight, tactical, and sensor information for advanced situational awareness, precision and safety.

Collins Aerospace CEVS JSF Helmet Mounted Display

Revolutionary Situational Awareness

The next-generation user interface serves as the pilot's primary display system, and virtual capabilities enable them to see through the bottom of the fuselage or directly at a target. With an uninterrupted display of flight information and sensor data, the pilot experiences extreme spatial orientation, superior weapons targeting, and tactical superiority–both day and night.

Integrated HUD, display and night vision

The head-up display (HUD), helmet-mounted display, and visor-projected night vision are fully integrated to provide pilots with unprecedented capability in the fighter cockpit. They can target their weapons and maintain advanced spatial orientation while continually monitoring critical flight information.

Bi-ocular display system with full day and night vision

Advanced bi-ocular, 30-by-40-degree-wide field-of-view has 100 percent overlap. For night missions, the HMDS projects directly onto the visor, eliminating the need for separate night-vision goggles

Visual targeting

The HMDS enables the pilot to target weapons by looking at and designating targets, and target verification when receiving steering cues from onboard sensors or via datalink.

High performance design with optimal center of gravity

The lightweight design has an optimal center of gravity and Active Noise Reduction (ANR). The custom helmet liner ensures precise fit and comfort for reduced pilot fatigue.

THE MODERN BATTLESPACE

BROUGHT TO YOU BY COLLINS AEROSPACE

The F-35 Helmet – a Modern Marvel That Creates a Unique Maintenance Challenge

"We get pilots from a wide range of backgrounds, including fighter and helicopter pilots. Many of them have reported to us that this helmet system is the lightest, best-fitting and most stable they've ever experienced."
For the military pilot, the ability to perceive threats around their aircraft is the difference between life and death. To give military aviators immediate access and visualization of the data and intelligence they need to increase survivability and accomplish their missions, companies like Collins Aerospace have worked to display data in the most effective place for the pilot –in front of their eyes.

The personal-fit headgear display system utilized by the aviators flying America's next-generation F-35 joint strike fighter, offers unparalleled situational analysis, visual accuracy, and flight safety. To do so effectively, it needs to be custom-fit to the pilot, and any wear and tear that compromises that fit can have negative impacts on the wearer's ability to fly their mission.

The Modern Battlespace recently talked with Arthur De Ruiter and Dustin Vagedes of Collins Aerospace, about how the F-35 headgear outperforms helmets from the past. They also explained why wear and tear can be detrimental, and why maintaining these personalized fit helmets can be challenging.

The Modern Battlespace (TMB): *How are F-35 helmets and visors superior to prior models? What makes them unique?*

Arthur De Ruiter: The F-35 helmet and visor system is truly an engineering marvel that represents today's fifth-generation warfighter. The key difference between the F-35 helmet and a traditional fourth-generation warfighter helmet used on the F-16 is that all the flight and mission data is presented to the pilot on a display, mounted to the helmet.

"IF THE PILOT LOOKS AROUND IN CERTAIN CONDITIONS, THEY DON'T SEE THE COCKPIT OR EVEN THEIR LEGS… ALL THEY SEE ARE THEIR SURROUNDINGS LIKE TERRAIN" – ARTHUR DE RUITER

In addition, the helmet is connected to six infrared cameras located around the aircraft, providing a 360-degree view and unprecedented situational awareness. If the pilot looks around in certain conditions, they don't see the cockpit or even their legs. All they see are their surroundings like terrain, with the flight critical and mission data projected inside the helmet.

Dustin Vagedes: Indeed — the F-35 helmet is unlike any other in history. The Collins Aerospace F-35 Helmet Mounted Display System (HMDS) was designed to realize and exploit a true pilot-to-machine union.

"THE CONNECTION OF THE HMD TO THE AIRCRAFT IS UNIQUE FOR EACH PILOT… TO ACCOMMODATE TORSO LENGTH AND RANGE OF MOTION CHARACTERISTICS." – DUSTIN VAGADES

Weighing in at around five pounds, this system hosts an on-visor, bi-optical Heads-Up Display (HUD) to include digital night vision and imagery overlay from the aircraft's Distributed Aperture System (DAS), set to each pilot's interpupillary distance for optimal display quality. The connection of the HMD to the aircraft is unique for each pilot through different length interface cables to accommodate torso length and range of motion characteristics.

TMB: *Obviously, all equipment requires maintenance. How does wear-and-tear affect an F-35 pilot's helmet and visor? Does this headgear last a long time, or will it eventually deteriorate after a few years?*

Arthur De Ruiter: Inside the helmet shell are custom-milled pads that generally experience normal wear and tear. Other than being exposed to sweat or hair grease, they usually last a long time if the helmet is well fitted. Visors typically get scratched by frequent handling and need to be replaced more often. That can be a challenge because they must be custom-trimmed to fit the oxygen mask.

"ANYTHING THAT CREATES MINIMAL SPACE BETWEEN THE CRANIUM AND THE CUSTOM MILLED PADS CAN CREATE A PROBLEM OVER TIME, POTENTIALLY REQUIRING A HELMET REFIT AND UPDATED OPTICAL CALIBRATION." – ARTHUR DE RUITER

The need for helmet refitting becomes really important when physical changes are happening with the pilot, such as weight or hairstyle changes. Anything that creates minimal space between the cranium and the custom milled pads can create a problem over time, potentially requiring a helmet refit and updated optical calibration.

Over time, the pilot will notice if there are any issues by feeling uncomfortable "hot spots" or even double vision, which can lead to fatigue, headaches, and long-term neck injuries. It is important that pilots immediately report any of these issues to their life safety equipment teams, so they can contact Collins Aerospace to solve any fit issues.

Dustin Vagedes: These helmets have proven to be quite resilient. The F-35 has now logged over 400,000 flight hours to date and our 2,000-plus HMDs custom fit and delivered to date have held up well. The HMD system was designed to be operated and maintained in the most austere conditions our warfighters may be operating within. With this in mind, the HMD was designed with seven-line replaceable units (LRUs), that can be serviced or replaced in the field as necessary.

"THE HELMETS GO THROUGH A LOT DURING THEIR LIFETIME [WHICH WAS] CONSIDERED DURING THE DESIGN OF THE HELMET… TO REDUCE THE NEED FOR RETURNS TO THE FACTORY FOR MAJOR REPAIRS" – DUSTIN VAGEDES

The helmets go through a lot during their lifetime. Between missions, they are stuffed in the pilots' helmet bags and stored in their flight lockers. Helmet maintenance and cleaning are often performed by schedule-saturated technicians, who may be stressed with meeting their assigned time-sensitive missions. Pilots can even bang the helmets against things in the cockpit while doing aggressive head turns while checking their "six". All these things were considered during the design of the helmet and factor into continuous design improvements to reduce the need for returns to the factory for major repairs — saving our customers and our end users money in the long run.

The helmets hold up quite well over time. It's the visors that are most likely to need replacement since they're supposed to be clean and clear but are exposed during use and storage. Any scratches on the surface of a visor might become an annoyance to a pilot even if they don't affect helmet functionality.

TMB: *What has the process traditionally involved for replacing a pilot's helmet and visor? Can they just use replacement parts, or is there a process that must be followed?*

Dustin Vagedes: The previous helmet-mounted display systems have typically been built around a fairly universal helmet shell and require extensive modifications to replace and/or reconfigure for their specified use and reuse.

The Collins Aerospace F-35 HMD's consistent configuration and integrated design provide a repeatable fit as replacement parts are installed.

The custom-milled liner and visor files are retained indefinitely and are provided to the end-user to further ensure continuity of the performance and fit. These replacements are typically provided by the services-life-support personnel who follow the OEM maintenance process to return a helmet to service, after being trained or re-trained by Collins Aerospace.

Arthur De Ruiter: In the current fitting process, pilot cadets will get their new helmet fit at a Pilot Fit Facility, typically at a US Air Force Base like Luke. This is a two-day process and after they have been fitted, they go straight into their extensive training program. Unless there is a major problem with the helmet seen during training flights, we typically do not see the pilot again.

"IF ANYTHING HAPPENS TO THE HELMET… THEY WOULD NEED TO GO THROUGH THE ENTIRE FITTING PROCEDURE AGAIN, WHICH MEANS RETURNING TO AT PILOT FIT FACILITY IN THE US." – ARTHUR DE RUITER

Once they become deployed at their home base and fly extensive hours, they are on their own to work with the services-life-support teams. If anything happens to the helmet that affects the perfect fit beyond what can be resolved with a simple replacement part, they would need to go through the entire fitting procedure again, which means returning to at Pilot Fit Facility in the US. Fortunately, Collins Aerospace has developed a technology that will get pilots back in the air sooner, by bringing the solution to the customer.

Designed to work with the F-35 Lightning II, the custom-fitted helmet serves to increase pilot responsiveness through enhanced situational awareness. Real-time imagery from the aircraft's six exterior cameras is streamed onto the helmet's display providing the pilot a view that would otherwise be obscured. (U.S. Air Force photo by Senior Airman Erica Webster)

An inside look at F-35 pilot helmet fittings

- Published Aug. 5, 2021
- By Senior Airman Erica Webster
- 419th Fighter Wing Public Affairs

HILL AIR FORCE BASE, Utah (AFNS) --

Reservists in the 419th Operations Support Squadron play a crucial role to ensure the safety of pilots assigned to the **419th Fighter Wing**, the **Air Force Reserve**'s only combat-capable **F-35 Lightning II** unit.

“We are responsible for maintaining and repairing pilot gear to ensure everything is in proper working condition,” said Staff Sgt. AJ Arteaga, 419th OSS aircrew flight equipment Reservist. “That also includes their helmet.”

Every helmet is custom-fitted to its pilot during a two-day process at a fit facility. To begin assembly of the helmet, pilots have their heads measured and scanned to secure the perfect fit.

Tech. Sgt. Anthony Farnsworth, 419th Operations Support Squadron, adjusts an F-35 Lightning II helmet during optical fit training at Hill Air Force Base, Utah, July 10, 2021. Each helmet is inspected every 105 days and has a 120-day fit check to ensure its functionality and safety. (U.S. Air Force photo by Senior Airman Erica Webster)

Staff Sgt. AJ Arteaga, 419th Operations Support Squadron, adjusts the head position of Tech. Sgt. Anthony Farnsworth, 419th OSS, during F-35 Lightning II helmet optical fit training at Hill Air Force Base, Utah, July 10, 2021. Reservists in the 419th OSS are responsible for maintaining and repairing pilot gear to ensure it is in proper working condition. (U.S. Air Force photo by Senior Airman Erica Webster)

Tech. Sgt. Anthony Farnsworth, 419th Operations Support Squadron, demonstrates the F-35 Generation III Helmet-Mounted Display at Hill Air Force Base, Utah, July 10, 2021. The display provides the pilot critical information, built-in night vision, and allows a 360-degree view of the aircraft's outside environment. (U.S. Air Force photo by Senior Airman Erica Webster)

Once assembled, pilots need to have the optics aligned using a pupilometer, which measures the distance between their pupils within two millimeters of its center, so pilots see a single image on the helmet-mounted display.

On the display, pilots are able to view mission-critical information and obtain enhanced situational awareness of the battlefield simply by moving their head. The helmet gives pilots a 360-degree view of the F-35's external environment without needing to tip the jet.

"The pilot can look down through a portion of their wing and see what's below," said Tech. Sgt. William Vass, 419th OSS. "When they look toward the cameras embedded on the F-35 that image projects onto their helmet display."

The helmet's innovative technology and precise fit require routine maintenance so pilots can complete their mission. In addition to pre- and post-flight fittings, the helmet is inspected every 105 days and has a 120-day fit check to ensure its functionality and safety.

"Pilots come in and put on all their gear so we can double-check to make sure everything fits properly and without issue," Arteaga said. "Small things such as a new haircut or a couple of pounds gained could cause the helmet to not fit correctly."

Mask adjustments are also included within the helmet fitting. Pilots are sent to an oxygen tester where aircrew flight equipment technicians can identify any leaks around the mask that could prevent adequate oxygen flow.

"The pilot can look down through a portion of their wing and see what's below. When they look toward the cameras embedded on the F-35 that image projects onto their helmet display."*Tech. Sgt. William Vass*

“The next part is to ensure there is a proper distance between the mask and the visor,” Arteaga said. “We have to make sure when the pilot moves or talks, the mask doesn't hit the visor. If it's too close, it will bend the visor and distort the display image.”

Reservists in the AFE shop are an integral part of the helmet-fitting process and maintenance intervals. They verify it remains as precise as possible to guarantee the safety of the 27 pilots in the 419th FW. The work is involved and in-depth, but essential to providing a seamless interaction between the helmets' advanced capabilities and the exacting skills of the pilot wearing it.

F-35 HELMET, AHEAD OF OUR TIME

When the DoD launched the acquisition process for the revolutionary multi-service, multi-role, single seat, single engine strike fighter aircraft known as the F-35 Lightning II, they envisioned a common platform across three variants that ultimately invigorated the defense industry world-wide, creating an influx of new technologies — notably the F-35 helmet.

A vital element of the F-35's unprecedented warfighter capability, the helmet's ground-breaking technology equips the pilot with mission-critical information on the helmet's visor; resolves well-documented fit, comfort, and convenience problems associated with helmets worn by pilots of legacy aircraft; and fuses together the F-35's cutting edge communications and sensor suite to form a clear picture of the operating environment — giving F-35 pilots unrivaled situational awareness and a decisive advantage over adversaries.

The latest iteration — known as the Generation III helmet — is also easily realigned and readjusted based on the individual pilot's needs, whereas previous legacy F/A-18 helmets are rigid, cumbersome, and require manual upgrades.

While onboard the amphibious assault ship USS America (LHA 6) during the third and final shipboard phase of F-35B Lightning II developmental test (DT-III), Marine Corps Sgt. Nicholas Voegeli and Desirée Smith, F-35 Lightning II Pilot Systems Integration-Human Systems engineer, demonstrated the advancements featured in the F-35's Gen III helmet.

Fabricated with its own Display Management Computer Hardware operating system the helmet enables pilots to toggle through different modes of data visualization. It also delivers a more efficient video feed than the F-35's Gen II helmets — equipping pilots with symbology correlated inside the cockpit as well as outside the aircraft with the use of the Distributed Aperture System (DAS). Using multiple DAS cameras installed peripherally around the aircraft, the pilot is able to display various modes of imagery such as thermal, night vision, and actual and achieve an unprecedented look-through-aircraft capability. All modes are beneficial to pilots as they deliver a clear 360-degree picture during daylight and lowlight settings. Thermal images portrayed through DAS enable pilots to view heat signatures emitted by various objects. For instance, a pilot can identify a ship running a hot engine against the vast darkness of the cold ocean. Night vision can also assist in magnifying low visibility objects against areas of very little to no light.

"The helmet mounted display (HMD) allows critical flight data to be viewable anywhere I look," added Marine Corps Major John "IKE" Dirk, a test pilot and the F-35B DT-III Officer-In-Charge (OIC) from the Pax River Integrated Test Force (ITF) assigned to Air Test & Evaluation Squadron (VX) 23 based at Naval Air Station Patuxent River, Maryland.

"In addition to the aircraft's flight symbology, I can display tactical data and even live night vision video. The helmet helps me find friendly and enemy aircraft, locate targets on the ground, and can even point out the ship. It is fully integrated into the aircraft systems and enables a seamless transition between tactical display and the outside world," he added.

Joint Helmet Mounted Cuing System (JHMCS) helmets worn by pilots of legacy jets such as F/A-18 Hornets, Super Hornets, and AV-8B Harriers, take a long time to install equipment enhancements while F-35 Gen III helmets are specially designed to facilitate the quick installation of equipment, thereby reducing the maintenance time required for each helmet.

Another problem with JHMCS legacy helmets is the graphics on the display visor, which block the pilot's ability to see through an overly bright image. Engineers worked to refine this imagery on previous iterations of the Gen III helmet and now the latest helmet enables pilots to toggle through several gradients of opacity. The pilot is also able to devote less time switching through different modes and doesn't have to physically install Night Vision Goggles before starting a night mission because the Night Vision Device (NVD) is built-in.

"Legacy systems are often limited to a fixed heads-up display or separated into several systems — targeting helmet, night vision goggles, heads up display, etc.," Dirk said. "The F-35 helmet integrates all of these capabilities and more into one balanced and comfortable helmet, complete with active noise reduction."

These technological advancements of the F-35 Gen III helmet will save military expenditures due to several new factors.

The use of laser scanning technology creates an exact replica of a pilot's skull, thereby fabricating a portable styrofoam helmet liner that is a break-through above and beyond the traditional custom-designed helmet for each pilot. This styrofoam cap fits into any size helmet, enabling a pilot to take the helmet liner from squadron to squadron for use throughout his or her career, optimizing the flexibility of the pilot flight equipment inventory, eliminating risk of damage to helmets during squadron transitions, and reducing investments in large inventories of helmets.

As the pilot dons the cap and helmet, two ocular cameras situated above the helmet's display visor are manually aligned to his or her interpupillary distance (IPD) settings for each eye to ensure the acuity of each pilot's vision and establish the proper fit of each helmet.

"The helmet is definitely well worth it considering what it brings to the fleet, the capability it brings to the warfighter who keeps us safe, and how it equips all of the pilots," said Smith, referring to the clear 360-degree picture of the battlespace that the helmet delivers.

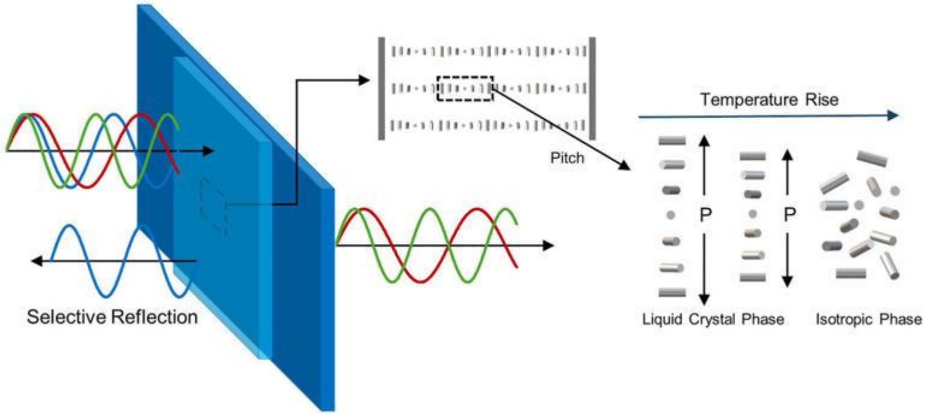
This unrivaled situational awareness equips the pilot with an unparalleled ability to dominate the tactical environment. Likewise, commanders at sea, in the air or on the ground immediately receive information collected by the F-35's sensors via data link — empowering them with an instantaneous, high-fidelity view of ongoing operations, making the F-35 a formidable force multiplier while enhancing coalition operations.

Additionally, legacy aircraft only displayed targets on screens installed inside the actual cockpit, creating a disadvantage because pilots would have to turn their heads away from their surroundings. Now, F-35 pilots can focus on their targets via the Gen III helmet display visor. This empowers them to keep track of adversaries farther than they could ever turn their heads.

"You can't put a price on the blanket of freedom that this aircraft will deliver," Voegeli added. "The threat of any adversary who wishes to bring us harm is ultimately the reason to test this next generation fighter jet. The moment this aircraft is put in the fight all questions will come to an end."

The quantity of specifications in this piece of revolutionary equipment showcases the DoD's integration of pilot equipment with its next generation strike fighter, its focus on warfighter performance and pilot safety, and its ability to inspire technological advancements that ensure U.S. air combat superiority for generations to come.

Prototype lenses can block epileptic-seizure causing wavelengths



Schematic diagram of a thermal-controlled CLC lens that can reflect certain wavelengths of light. Credit: Cell Reports Physical Science (2024). DOI: 10.1016/j.xcrp.2024.102158

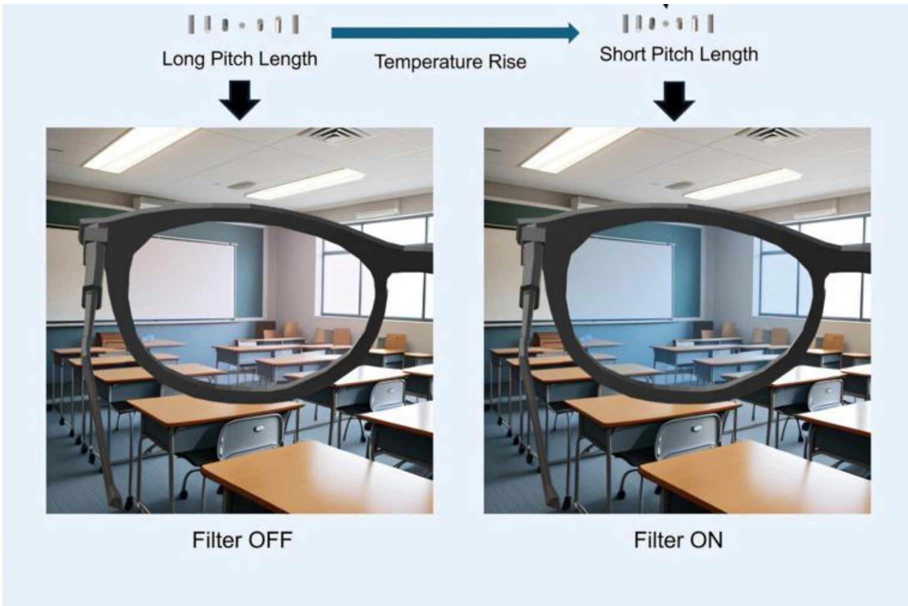
People with photosensitive epilepsy could benefit from a prototype pair of glasses with lenses that block out wavelengths that are known to cause seizures in some people.

In a study published in *Cell Reports Physical Science*, researchers from the University of Glasgow and University of Birmingham have developed a prototype of a liquid crystal lens that they believe could help photosensitive epilepsy sufferers.

The lenses are controlled by very small changes in temperature that can be built into the lens, and when activated can block more than 98% of light in the 660–720nm wavelength range, known to affect the greatest number of people suffering from photosensitive epilepsy.

Zubair Ahmed, Professor of Neuroscience at the University of Birmingham and co-author of the study said, "This is a hugely exciting project that felt like a science fiction project when we first started the work four years ago. This paper demonstrates the potential for the use of liquid crystal lenses that can be modulated to cut out specific wavelengths of light."

"The prototype shows how a discrete circuit installed in the frame of a pair of glasses can power these lenses and be used in situations where a certain wavelength of light is likely to trigger a seizure, such as while watching TV or playing computer games. The circuit heats up the lenses to a comfortable temperature for wearers that will also cut out more than 98% of light with a wavelength that can cause seizures."



Graphical abstract. Credit: Cell Reports Physical Science (2024). DOI: 10.1016/j.xcrp.2024.102158

Rami Ghannam, Professor of Electronics at the University of Glasgow and lead author of the study said, "The project shows how collaboration between different disciplines such as engineering, neuroscience and mathematics can bring about potential discoveries that could transform the lives of patients affected by various diseases."

"We are now developing this protype further to improve its performance before we take this into human studies."

The authors note that the current prototype was functional in rooms up to 26°C temperatures, and further tweaks to the technology would be needed to cater for uses in hotter environments. The team also note that the time taken for the prototype to heat and cool could be improved.

More information: Yuanjie Xia et al, Thermal-controlled cholesteric liquid crystal wavelength filter lens for photosensitive epilepsy treatment, *Cell Reports Physical Science* (2024). DOI: 10.1016/j.xcrp.2024.102158

Provided by University of Glasgow

Apple deepens dive into smart glasses with internal study

Apple has launched a comprehensive study of smart glasses, marking an initial move towards exploring the booming wearable technology category. The project, which insiders have dubbed "Atlas," started last week and aims to assess the user experience and functionality of current smart glasses on the market.

The initiative involves Apple's Product Systems Quality team, which works within Apple's hardware engineering division.

Apple studies the current market for smart glasses

As part of this project, Apple is gathering feedback from its employees on smart glasses available today. This feedback is essential as Apple studies current user expectations, preferences, and challenges associated with existing models. According to sources close to the study, Apple also plans additional focus groups in the coming weeks. These sessions aim to gather in-depth insights, providing data that could influence the design of any future Apple smart glasses, Bloomberg reported.

An internal email from the hardware team emphasized Apple's commitment to creating products that consumers will value and enjoy. "Testing and developing products that all can come to love is very important to what we do at Apple," stated the email, which invited employees at Apple's Cupertino headquarters to join Apple's study on smart glasses research.

Meta., a notable player in the smart glasses sector, has already entered the space with a partnership with Ray-Ban, launching glasses that allow users to take photos, make calls, and interact with an AI assistant. In contrast, Apple's study highlights a more cautious approach, suggesting Apple is looking to craft a unique path that could set its product apart from Meta's offerings. The ongoing

Apple study smart glasses project indicates the company may prioritize seamless integration with its ecosystem, similar to the appeal of its AirPods.

Apple's vision for lightweight wearables

Apple's recent research initiatives, including an app for tracking blood sugar levels, indicate its interest in health and lifestyle enhancements through wearable technology. However, while the Vision Pro headset introduced earlier this year offers advanced features, its bulk and high price limit mainstream appeal. Apple's current study may be a step toward developing lighter, more accessible smart glasses that could serve as an everyday device.

For now, it remains uncertain when or if Apple will officially introduce a smart glasses product. However, with fellow technology-driven competitors like Meta and Snap moving forward, Apple's continued exploration could pave the way for a competitive entry into the smart glasses market in the years to come.

Defining XR: What It Means and How It Works

Extended reality describes virtual, augmented, and mixed-reality technologies

Extended reality sounds cutting-edge and futuristic, and in a way it is. But you might be surprised to learn that you've probably used XR without knowing it. That's because it's really just a blanket term to refer to various types of reality.

What Does XR Mean?

XR stands for extended reality. It summarizes a group of technologies—VR, AR, MR—that let you experience and interact with virtual reality, augmented reality, and mixed reality environments.

This means XR is really just an umbrella term for those experiences. Whether you're talking about a virtual reality headset or an augmented reality mobile app, what you're referring to is *extended reality*.

How Does XR Work?

Here's an overview of these three technologies:

Virtual Reality

This is arguably the most well-known XR term. Virtual reality is just that: a *virtual* view of the world, meaning it's a fully simulated 3D environment that can be interacted with in a seemingly physical way. If you're after a truly immersive experience, VR is where you want to be.

Virtual reality is often used for gaming and entertainment, but its other applications include training, education, and design.

A headset is used for VR experiences. It interrupts your normal vision to display the virtual environment, tracks your head movement, and usually includes controllers or other input devices so you can interact with the virtual world much like you would the real world.

Augmented Reality

Augmented reality covers the real world with computer-generated images and other information. Unlike VR, these virtual elements don't take over your whole vision, so you can see and interact with both the real world and the virtual items simultaneously.

AR applications include education, training, entertainment, and marketing.

You can use AR through a smartphone or a headset.

Mixed Reality

Mixed reality blends the real and virtual world in a way that lets you interact with both simultaneously. It's similar to AR, but it allows for a greater level of immersion and interaction with the virtual environment.

MR systems typically use headsets to track movements and position in the real world and to display the appropriate virtual information.

Applications of XR

Extended reality has a wide range of applications, including:

- **Entertainment**: VR and AR are used in a variety of entertainment applications, such as video games, movies, and live events. Check out these VR travel experiences for some examples.
- **Education and training**: XR technologies are used to create immersive learning experiences that allow students to explore and interact with virtual environments and simulations. Think VR flight lessons before manning the cockpit.
- **Healthcare**: Extended reality can be used in the healthcare industry for training, surgical simulations, and therapy.
- **Manufacturing and design**: XR technologies are used in the manufacturing and design process to visualize and test products before they're built. Blueprints can be scaled down to the size of a table and examined by designers for inaccuracies before implementation.
- **Marketing and advertising**: AR is used to create interactive and immersive marketing and advertising experiences. For example, a brand could use AR to let customers "try on" a new line of clothing or makeup, or visualize how furniture would look in their room next to their other décor.

Are Smart Glasses XR?

VR, MR, and AR are related terms like headsets and smart glasses. VR, and often MR and AR, are experienced through a headset. Smart glasses (at least some models) can fall into the AR category because they display virtual information next to real-world information, similar to AR smartphone apps. This makes smart glasses a form of extended reality.

Frequently asked Questions

When was virtual reality invented?

The technology surrounding the ideas mentioned above began to emerge from research started in the 1960s and 1970s. As progress on miniaturing components continues, the hope is these devices will be lighter for when you wear them over your head (VR headsets) and smaller for when you wear them on your face (augmented reality glasses). New models of headsets are coming out each year with improvements.

How does virtual reality work?

While each device will have different capabilities, they consist of sensors and screens working in conjunction to display images to your eyes based on your body's position and where you're looking. The sensors include motion detection and accelerometers, and the screens use high-resolution displays and stereo projection so the correct image is displayed to the correct eye, giving a 3D effect.

AR vs. VR vs. MR vs. XR: What's the Difference?

All augmented, virtual, and mixed reality experiences are called 'extended reality,' but each is different in very specific ways

If you've heard of immersive video games, virtual travel, or AR shopping, then you've no doubt run into labels like augmented reality (AR), virtual reality (VR), mixed reality (MR), and extended reality (XR). We've reviewed these terms in depth to learn what they mean and how they differ so you can have some clarity about which one is right for you.

LIFEWIRE

Overall Findings

AR	VR	MR	XR
Virtual elements overlayed on the real world.	Fully virtual experience.	Anchored virtual elements that can interact with the real world.	Umbrella term for AR, VR, and MR.
Works through a headset or smartphone.	Works through a headset.	Usually works through a headset.	
View your physical surroundings at the same time.	View only the virtual world.	View your physical surroundings at the same time.	
Can be used for free through mobile apps.	There are free apps, but they require a headset.	Can be used for free through mobile apps.	

Extended reality is a blanket term that refers to a group of technologies: augmented reality, virtual reality, and mixed reality. Therefore, a virtual reality headset and an augmented reality headset, for example, while different, are both considered extended reality technologies.

These perception-changing technologies deal with virtual elements, meaning an onboard computer generates all the objects. In VR, the CGI fully covers your vision, so you're immersed in a totally fake world. AR and MR use computer-generated images, too, but since the point is to also see your surroundings, those elements don't take over your whole vision. Instead, your physical environment is enhanced or changed in some way.

You can use some AR and MR implementations from a standard smartphone without needing headgear, but VR requires a full headset.

The rest of this article doesn't include XR in the comparison tables because it's a term used to describe the other three. It's akin to comparing computer hardware with a mouse, keyboard, and webcam.

Technology: VR Blocks Your Vision, AR/MR Doesn't

AR	VR	MR
Superimposes virtual elements on real world items.	Shows only virtual elements.	Superimposes virtual elements on real world items.

Before digging into these XR technologies, we first need to make a clear distinction between how they work. The links at the beginning of this article provide an in-depth look, but for now, you need to know that there's a single factor that separates AR and MR from VR, and that's the fact that VR totally blocks your vision.

Virtual reality is built to hide everything but computer-generated images. Augmented reality and mixed reality are built to show you the real world *and* the virtual world.

It works this way because AR and MR, as you'll read below, are designed to enhance and change what you're already doing and seeing around you, while VR is designed to replace reality with something completely fake.

Availability: AR Can Run Straight From a Phone

AR	VR	MR
Can work through a smartphone.	Requires a headset.	Usually requires a headset.
Often free when used from a phone.	There are free apps, but only after you have the hardware.	Most useful after purchasing a headset, but it's not always necessary.

In terms of widespread availability, AR (and sometimes MR) is already in use on smartphones all over the world. By just holding your phone in front of you, you can experience things like live language translations, filters that change how your face looks in real time, and 3D models anchored in space.

Contrast this with virtual reality that's available only through a headset, and it's clear how easily accessible AR and some MR implementations are with nothing more than a smartphone. Most mixed reality experiences are accomplished through a headset, too, but with the line blurred so much between these terms, you could say some form of MR is also possible with just a phone.

Furthermore, there are plenty of free AR/MR apps, so no additional investment is needed to experience those XR types, which can't be said for virtual reality.

Immersion: VR Is the Clear Winner, MR Is Close

AR	VR	MR
You see both real and virtual elements.	Everything you see is virtual.	You see both real and virtual elements.
View simulated elements in the real world.	View and interact with fully simulated objects in a fake world.	View and interact with fully simulated objects in the real world.

An immersive experience is meant to simulate a different reality, ideally making you forget that you're even in it. VR is the only extended reality method of achieving that because you're completely engrossed in the simulated world. If you walk around in the room with your real legs, you won't know where you're going because you can't see anything but what the computer is generating (though, some VR experiences digitize real obstacles for safety reasons).

However, if you think of immersion as an altered perception where your environment is simply different from what it is usually, then MR is a close second because there's a level of interaction between the virtual and real elements, something that AR doesn't permit.

Mixed reality objects can be anchored in real space, meaning you can physically walk around them and often interact with them as if they were real. It creates a solid bridge between a completely real and a completely virtual environment.

Applications: VR/MR Excel in Education, VR in Entertainment

AR	VR	MR
Guided navigation.	Fully immersive gameplay.	3D asset collaboration.
Training exercises.	Training exercises.	Training exercises.
Real-time diagnostics.	Real-time, avatar-based socializing.	Semi-immersive gameplay.
Gaming and shopping.	Virtual movie theater and other entertainment.	Enhanced marketing.

There are lots of applications for all three XR types, and many of them bleed into the others.

AR includes your real surroundings, so it's useful for critical information in the real world, like overlaying on a body a hospital patient's vitals or X-ray details for precision surgery. Similar is MR, which isn't as helpful for a scenario like that but instead more beneficial for 'performing' the surgery with virtual objects, something that might be set up during an unqualified surgeon's training phase.

Arguably more relevant to the masses are entertainment and gaming. AR, VR, and MR create fun experiences in their own unique ways, but the deepest immersion level can be achieved only through virtual reality. With VR, an entire movie theater can be erected just for you, and realistic first-person shooter video games and virtual tourism are best enjoyed with a headset and no distractions from the outside world.

AR and MR can drastically change how we shop by letting us do all sorts of neat reality-bending tasks, like trying on clothes, testing how furniture will fit in a room, and viewing customer ratings on top of in-store products. Even VR can provide a fully simulated shopping mall for you to browse through with just a headset.

Final Verdict: They All Have Their Place

All three of these extended reality types are useful, so the one you choose depends entirely on what you want to accomplish. AR and MR are built for truly mixing real and imaginary elements, with the latter having an edge over the former by leaning deeper into the actual *mixing* of realities. VR doesn't let you view the real world around you, but that's the whole point; it excels in that you're fully immersed in a digital reality that you can enjoy alone or with friends.

If escapism and rich, life-like experiences like gaming are what you're after, you can't go wrong with VR. While MR is nearly synonymous with AR, its advantage is that it feels more real than augmented reality because you can interact with virtual elements that stay where they are regardless of how you view them. AR, however, is much more ubiquitous, available in some form on nearly all modern smartphones, often for free.

- What is Windows Mixed Reality?

Windows Mixed Reality is a virtual- and augmented-reality framework built into Windows 10 and 11. The main hardware it uses is HoloLens 2, a set of AR glasses. WMR also runs Windows-compatible VR games like Beat Saber.

- How is augmented reality used in businesses?

  The most common way you'll see businesses use augmented reality is in mobile shopping apps. For example, you might be able to use AR to see how a piece of furniture or art will look in your home. Businesses may also use AR internally for training (e.g., projecting assembly instructions onto a workspace or identifying different work tools).

What Is Augmented Reality?

AR enriches perception with virtual elements in the physical world

The word "augment" means to increase, extend, or make better. Augmented reality (AR) can be understood as a type of extended reality (XR) where the real world is expanded or enhanced through the use of virtual elements, usually overlaying those elements on the view of the real world through the use of a visual device.

AR can work in several different ways and is used for many different reasons, but in most cases augmented reality virtual objects are overlaid on and tracked in a view of the real world, creating the illusion that they occupy the same space.

Augmented reality devices have a display, input device, sensor, and processor. These devices can be monitors, head-mounted displays, eyeglasses, contact lenses, gaming consoles, and even smartphones, among others. Sound and touch feedback can be included in an AR system, as well as through other non-visual methods and devices.

Although augmented reality is somewhat similar to other forms of XR, like virtual reality (VR), it's distinctly different. Virtual reality is an experience that's entirely simulated—both the view of "reality" and the objects in it—while AR only uses some virtual aspects, which are mixed into reality to form something different.

The term "augmented reality" was coined by researcher Tom Caudell in 1990, who helped develop the first industrial augmented reality (IAR) at Boeing.

How Augmented Reality Works

Augmented reality is live. For it to work, the user must be able to see the real world as it is right now. AR manipulates the real world space the user sees, altering their perception of reality.

In one form of AR, the user watches a live recording of the real world with virtual elements imposed on top of it. Lots of sporting events utilize this type of AR; the viewer can watch the game live from their own TV, but also see the scores overlaid on the game field.

Another type of AR allows the user to look around their environment normally and in real time, but through a display that overlays information to create the augmented experience. An example might be a headset that appears much like a regular pair of glasses, but through the screen, the user can see GPS directions on the road or sidewalk as they drive or walk, or see the current temperature in the sky when they look up.

When a virtual object is placed between the user and the real world, object recognition and computer vision can be used to allow the object to be manipulated by actual physical objects, and allow the user to interact with the virtual elements.

For example, some retailer mobile apps let shoppers select a virtual version of something they're considering purchasing, such as a piece of furniture, and view it in the real space of their home through their phone. They can see their actual living room, for example, but the virtual couch they've chosen is now visible to them through their screen, letting them decide if it will fit in that room and if they like the look of it within that room.

Another example allows customers to scan products or special codes (such as UPC symbols) that use augmented reality to show the customer more information about a physical product before they buy it, see reviews from other buyers, or check what's inside their unopened package.

Marker and Markerless AR

When object recognition is used with augmented reality, the system recognizes what's being seen and then uses that information to engage the AR device. It's only when a specific marker is visible to the device that the user can interact with it to complete the AR experience.

These markers might be QR codes, serial numbers, or any other object that can be isolated from its environment for the camera to see. Once registered, the augmented reality device might overlay information from that marker directly on the screen or open a link, play a sound, etc.

Markerless augmented reality allows a system to use a location or position-based anchor points, like the compass, GPS, or accelerometer. These types of AR systems are implemented when the location is key, such as with navigation.

Layered AR

This type of AR uses a device to recognize a physical space and then overlay virtual information on top of it. It's how you can try on virtual clothes, display navigation steps in front of you, check whether a new piece of furniture will fit in your house, put on fun tattoos, and more.

Projection AR

This might seem at first to be the same as layered or superimposed augmented reality, but it's different in one specific way: actual light is projected onto a surface to simulate a physical object. Another way to think of projection AR is a hologram.

One specific use for this kind of augmented reality might be to project a keypad or keyboard directly onto a surface, allowing a user to type using the virtual keyboard.

There are many advantages to using augmented reality in areas like medicine, tourism, the workplace, maintenance, advertising, the military, and others.

AR in Education and The Workplace

In some senses, it can be easier and more fun to learn with augmented reality, and there are tons of AR apps that can facilitate that. A pair of glasses or a smartphone can be all you need to learn more about physical objects around you, like paintings or books.

One example of a free augmented reality app is SkyView, which lets you point your phone at the sky or the ground and see where stars, satellites, planets, and constellations are located at that exact moment, both during the day, at night, and from the opposite side of the planet.

SkyView is considered a layered augmented reality app that uses GPS. It shows you the real world around you, like trees and other people, but also uses your location and the current time to teach you where these objects are located and give you more information about each of them.

Google Translate is another example of an AR app useful for learning. With it, you can scan text in a language you don't understand, and it will translate it for you in real time. When viewed through the app on a phone, it looks like the physical space that occupies that text has changed to the target language.

Job education, too, is changing due to AR. Doug Stephen, president of CGS Enterprise Learning division, says it's becoming part of on-the-job training options.

"Often considered an emerging and disruptive technology, [AR] provides learners with an immersive format," he says. "An example of how to use consumer-focused AR for education is use of mesh modems that homeowners install to extend their internet reach. By using AR, the person can visualize the internet strengths throughout the home on a tablet or mobile device. This can alleviate in-home service (because) customer support is better enabled to see what the customer sees.

"It can also offer immediate education on set up and installation as well as help the user determine more-effective modem placements to optimize the range of the internet connections. This will ultimately help the consumer save time, effort, money and potential frustration from waiting for a technician to do in-home service."

AR in Navigation

Displaying navigation routes against a windshield or through a headset delivers augmented instructions for drivers, bicyclists, and other travelers so that they don’t have to look down at their GPS device or smartphone just to see which road to take ahead. Pilots might use an AR system to display transparent speed and altitude markers directly within their line of sight for much the same reason.

Another use for an augmented reality navigation app might be to overlay a restaurant’s ratings, customer comments, or menu items right on top of the building before you go inside. It might also show you the quickest route to the nearest Italian restaurant as you walk through an unfamiliar city.

GPS AR apps like Find Your Car with AR can be used to find your parked car, or a holographic GPS system like WayRay might overlay directions right on the road in front of you.

AR in Games

There are lots of augmented reality games and toys that can merge the physical and virtual world, and they come in many different forms for lots of devices. One well-known example is Snapchat, which lets users overlay fun masks and designs on their faces before sending a message. The app uses a live version of your face to put a virtual image on top of it.

Other examples of augmented reality games include Pokemon GO!, INKHUNTER, Sharks in the Park, Sketchar, Temple Treasure Hunt Game, and Quiver.

AR vs MR

Mixed reality (MR), as the name suggests, mixes real and virtual environments to form a hybrid reality. MR uses elements of both virtual reality and augmented reality to create something new. It's tough to categorize MR as anything but AR because it works similarly, by overlaying virtual elements directly onto the real world and letting you see both at the same time.

However, one primary focus with mixed reality is that the objects are anchored to real, physical objects that may be interacted with in real time. This means that MR could allow virtual characters to sit in the actual chairs in a room, or for the virtual rain to fall and hit the actual ground with life-like physics.

Mixed reality lets the user seamlessly exist in both a real state with the real objects around them and the virtual world with software-rendered objects interacting with real-world objects to create a fully immersive experience. One good example of what's meant by mixed reality is Microsoft HoloLens.

- What's the difference between AR and VR?

  Augmented reality fundamentally works and exists in the real world, adding layers of interactivity on top, like Pokémon GO.

Virtual reality is full immersion in a completely virtual world, such as the survival game *Half-Life: Alyx* on the Valve Index.

- When was augmented reality invented?

  The technology that powers AR experiences was invented decades ago, but AR technology first entered the mainstream in the 1990s. AR became more popular in the 2010s due to the various AR games and products released.

Are we on the verge of an XR wearable breakthrough?

Are we on the verge of an XR wearable breakthrough?© Shutterstock

Many popular technologies today are the product of several technological and economic factors converging at the right time. A recent example is the rise of generative AI, which rapidly transitioned from an emerging technology to mainstream phenomenon, sparking revolutionary changes across various industries and societies.

Similarly, extended reality (XR), which includes augmented reality (AR), virtual reality (VR), and mixed reality (MR), has long been touted to transform immersive experiences on devices. While adoption among consumers is steadily increasing, the true impact of XR to date has been seen across a variety of business use cases, including training, manufacturing, communication, content creation and retail.

According to the PWC "Seeing is Believing Report", the growing adoption of XR technologies across businesses could boost global GDP by US$1.5 trillion, which is nearly 2 percent of overall GDP. Through integrating XR into their processes, businesses will see significant productivity and efficiency improvements, along with substantial time and cost savings.

While challenges around wider XR adoption still exist, the tech industry is making great strides to address them, paving the way for XR to become a more mainstream technology, not just for businesses but for consumers too.

The XR challenges and how the industry is addressing them

One of the primary computing challenges with XR has always been meeting the power efficiency requirements of small wearable devices that need to be always-on. Some early XR wearable devices suffered from short battery life while untethered, limiting their practicality for extended use. The industry has responded by investing in advanced battery technologies and power management systems, leading to more efficient, longer-lasting XR wearables.

Early XR wearable devices also faced security and privacy challenges. Initially, businesses were hesitant to adopt the devices due to potential vulnerabilities in data handling and encryption. However, with the integration of enhanced encryption protocols and secure data management practices, XR devices are now far safer and more secure. The security improvements allow companies to integrate XR technologies into their operations with greater confidence, knowing that sensitive information is well-protected.

The final challenge was the lack of ecosystem support for XR technologies. Developing quality applications that met business expectations was both expensive and complex, hindering widespread adoption. Today, the industry is addressing this by creating more accessible development tools and platforms. These simplify the process of developing and deploying XR applications, enabling businesses to create tailored solutions that meet their specific needs.

Ongoing technological breakthroughs in XR

Beyond these challenges, companies are investing heavily in research and development to improve XR wearable devices and elevate the user experience. Hardware advancements, including touch screens and camera miniaturization, as well as software improvements in applications and operating systems, have created significant opportunities for XR wearable devices to become more mainstream.

AR smart glasses are one device type where there has been plenty of interesting technology innovation during the past year. For instance, Snap's fifth-generation Spectacles, Meta's next-generation Ray-Ban smart glasses, and Meta's Orion smart glasses are all examples of how XR wearables are evolving to meet business and consumer needs, with features like advanced AR displays and real-time AI video processing. More specifically, Meta's Orion glasses now offer lightweight, immersive hands-free AR, with future versions expected to add social awareness features.

Wider innovations in lightweight materials and better batteries are making XR wearable devices easier to use and wear. New AR smart glasses entering the market are now adopting ultra-thin silicon carbide waveguide technologies that not only enable high-definition displays, but also dramatically reducing the thickness and weight of the devices. This marks a significant breakthrough in AR technology. AI features are also enhancing the XR wearable device experience, making them more personalized and context aware.

How AI will transform XR Technology

In fact, new compact language models are becoming highly influential across XR wearable technologies. These models, designed to run efficiently on smaller devices, enable real-time natural language processing and interaction, allowing users to interact with XR applications using real-time voice commands. For example, in manufacturing, workers can use a voice command to get information about assembly instructions or safety protocols without taking off their XR headsets.

Compact language models are also transforming XR experiences for consumers, businesses and healthcare, making them more immersive and interactive. For consumers, this is enabling them to create and consume new types of content via XR wearables. Meanwhile for businesses, XR wearable devices are providing employees with highly interactive real-time feedback and guidance during training. This feedback helps improve training outcomes and reduce errors, especially in manufacturing and medical sectors, leading to higher levels of efficiency and safety. Finally, in healthcare, clinicians can use XR to augment different treatments during medical procedures, reviews and training, leading to improved patient outcomes.

The next wave of digital transformation

Looking ahead, the combination of XR and AI will continue to unlock new possibilities, driving innovation across a variety of industries. With ongoing improvements in power efficiency, security and software support, and advancing technology capabilities, XR wearable devices are likely to see rising adoption among businesses and consumers. While we have yet to hit the XR tipping point, the journey ahead appears to be promising, as more consumers and businesses embark on the next wave of digital transformation.

The new XREAL AR glasses are what Microsoft HoloLens should've been: on-board spatial computing takes the new 'XREAL AR One' and 'One Pro' to the next level

What you need to know

- XREAL is an augmented reality glasses company that is at the forefront of miniaturising the tech.
- Up until now, XREAL relied on external computing solutions to add spatial anchors to its insanely sharp hologrammatic screens, but not anymore.
- The XREAL One series (One and One Pro) have a new XR chip baked straight into them, side-stepping the need for apps and external add-ons.
- The XREAL One and One Pro are available now in the United States, United Kingdom, and Europe, starting at $499 USD, £449 GBP, and €549 EUR.

XREAL is back, and this time, they're even better.

I'm a big fan of XREAL. In my XREAL Air review, I detailed how the subtle lenses do all the things I wish HoloLens would've ended up doing, albeit with a key concession: they have no on-board compute. The worst thing about the XREAL glasses previously was underbaked software and integration with Windows and Android, although the app situation has improved immeasurably over time. XREAL even launched its own compute module for their glasses called the XREAL Beam, although it was a bit like carrying an extra phone around in your pocket, and not exactly ideal.

XREAL agreed, which is why their shiny new XREAL One and XREAL One Pro now have on-board computing for the first time, completing the augmented reality circle HoloLens failed to accomplish.

XREAL describes its new One series as the "biggest least forward" for consumer AR, owing to its independently-designed X1 processor platform. Previously, without a connected XREAL Beam, Android app, or Windows app, the XREAL was unable to independently reconfigure its virtual 3D display. You basically got an external monitor in glasses form, which while admittedly a very *good* external virtual reality monitor, the lack of configuration options was always a bit of a drag. Now, however, the X1 chip and the new XREAL SDK should enable an entire universe of new possibilities without having to rely on additional devices and apps to do the heavy lifting.

"*Using XREAL's brand new, in-house designed X1 independent spatial computing co-processor, XREAL One Series creates a spatial display from nearly any device and for anything the wearer sees, leaping beyond the limits of today's AR and VR devices by introducing a fully customizable cinematic virtual screen that is for the first time spatially controlled by the glasses themselves.*"

The new glasses feature a variety of other tweaks and improvements over their predecessors. We now have speakers by BOSE, alongside official eye health certifications and even an AI-powered optional modular camera for added tracking and spatial awareness features. The new glasses have dynamic interpupillary distance control as well for the first time, which should make for a more comfortable experience and easier positioning. There are also options for prescription lenses as was the case with the previous glasses.

The XREAL glasses are compatible with a huge range of devices, giving them broad applications for all kinds of use-case scenarios. Connect them to a Steam Deck or ASUS ROG Ally for large display gaming. Connect them to a Windows PC as a second virtual monitor. Expand your Samsung S24 with Samsung DeX, and so on.

XREAL is what HoloLens could've been

The XREAL One glasses have boosted 57-degree field of view, incredibly sharp 1080p visuals, clocking in at 84 grams and 87 grams for the Pro respectively. This is orders of magnitude more usable and convenient than HoloLens, or even devices like the Meta Quest 3.

I think therein lies the big gap between what some platforms want to push vs. what consumers will actually want in reality. Yes, the XREAL aren't cheap, but they're also something I use regularly as someone who travels frequently. I watched Cyberpunk Edgerunners while travelling exclusively on the XREAL devices connected to my phone. They're great for playing Xbox Cloud Gaming titles, and also adding a bigger display to the Lenovo Legion Go and so on.

The downside was always that you couldn't resize the monitors or anchor them without extra steps. The new X1 computing platform should help resolve that situation. We'll be back with a full review soon.

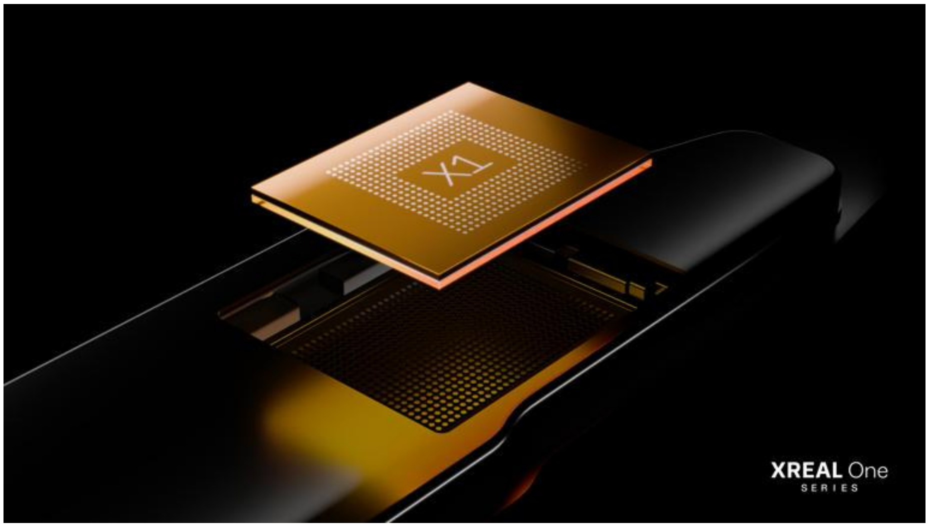
I just tried Xreal's new smart glasses and they're a leap forward for AR

Xreal already offers some of the best smart glasses in the Xreal Air 2 and today, the company announced two new smart glasses that may knock the Air 2s off the proverbial throne.

The Xreal One Series introduces a number of upgrades to it's glasses lineup, including a newly developed X1 chip that powers "independent spatial computing." The X1 enables the glasses to connect to any USB-C device creating a spatial display for gaming, work, apps and websites.

I got to give the new Xreal One and Xreal One Pro a test run a couple of weeks ago and they are impressive. We'll have a full review in the coming weeks, but here's what's new and more of my thoughts.

X1 Chip



((Image credit: Xreal))

Previously, Xreal smart glasses the like Air 2 need an accessory like the expensive Xreal Beam Pro that lets them access and create spatial displays for devices, especially ones that feature USB-C connectors with video out.

The X1 essentially takes that capability and puts it in the glasses themselves. Surprisingly, the addition of the chip doesn't really alter the way the glasses look.

"X1 powers the kind of spatial computing we’ve always envisioned and that customers have been eagerly waiting for," said Chi Xu, CEO and co-founder of Xreal.

((Image credit: Xreal))

During my test run of the One series, I was able to see the glasses connected to an iPhone 16, a Steam Deck and a MacBook. These were curated experiences but I was able to comfortably watch a YouTube video via the glasses that was outputting directly from the phone. Connecting to the MacBook enabled me to see three spatial monitors in a virtual workspace.

Both work well, with improvements to the fluidity afforded by the X1 chip and a lower latency helping especially when running a few laps in DiRT 5 on the Steam Deck. It felt very intuitive and I didn't notice any lag between the glasses and Valve's machine as I played.

Xreal says that X1 enables a "low motion-to-photon" latency of 3ms at 120Hz which is far lower than the 20ms on the currently available Air 2. And in our experience, that is especially noticeable.

Display and Design

((Image credit: Future))

Xreal has improved the display for the One and One Pro. Where the Air 2s offer 1080p per eye and 46-degree-field-of-view (FOV), the One features the same resolution with a 50-degree FOV with a larger display.

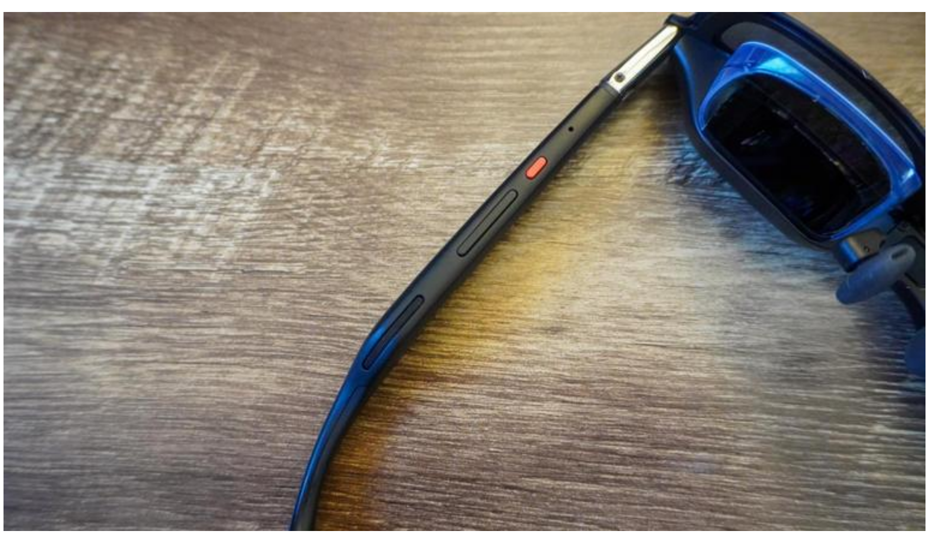
The One Pros have a 57-degree FOV, which Xreal says is the largest in the industry. They achieved this through a "flat-prism lens" that is different from the triangular birdbath design in the One and older Xreal glasses.

The new glasses are certainly more sleek than older Xreal glasses too, with silver banding at the temples and an interchangeable front frame for a customizable look. Alongside this, its dimensions are certainly a lot more low-profile, with the front of the glasses themselves being thinner too when compared to Air 2.

((Image credit: Future))

But one thing Xreal has been good to not compromise is the comfort. The Air 2 sit nicely on your face, and the One and One Pro follow suit.

The One and One Pro are listed at 84 and 87 grams (slightly heavier than the current specs). But in wearing them, I didn't feel uncomfortable with the weight, but this was only a short viewing. They did feel nicely balanced and I wasn't annoyingly aware of them like some wearable tech.



((Image credit: Future))

One cool feature that I got to hear was the new Bose speakers that are integrated into the arms of the glasses. The revs of the engine in DiRT 5 reverberate through the specs with impressive clarity, and the higher volume capability does mean you could listen to these on louder public transport with relative ease.

"Our audio tuning expertise creates a powerful and distinguished sound experience for the XREAL One Series. Content is more vibrant and lifelike, and we know consumers will hear the difference," Nick Smith, Senior VP of Strategy and Business Development for Bose said in the press release.

Xreal is also introducing a new RGB camera called the Xreal Eye that attaches to the bridge of the glasses. During my brief time with the glasses I tried on a pair with the camera attached and it didn't feel noticeably different. Though, I did not get to test out how the camera work with the One or One Pro.

Xreal says that the camera can capture "real-time" 12MP photos and record video up to 1080p at 60fps. Down the line, the camera will get multimodal AI features "including image recognition and communication via voice commands in unison with an AI or voice assistant coming from the glasses' host device."

It can be paired with the Xreal Beam Pro for augmented reality displays.

Availablity and price

((Image credit: Xreal))

Starting today, the Xreal One and One Pro are available for pre-order via the Xreal website.. The One will set you back $499/£449/€549 while the Pro One adds $100 starting at $599/£549/€649. There will also be bundles with the Xreal Beam Pro available.

If you want to get your hands on one of these sets, the One is supposed to start shipping in "mid-December" while the One Pro won't release until "early 2025."

Alibaba-backed Xreal launches augmented reality glasses with new chip as Meta rivalry heats up

- Xreal on Wednesday launched its latest generation of augmented reality (AR) glasses as it looks to fend off competition from the likes of Meta and Snap.
- The Xreal One Series features the X1 chip which is the company's first self-designed processor for its glasses and marks a big step for the product's capabilities.
- Xreal is among the companies that is betting on glasses, rather than large headsets like Apple's Vision Pro or the Meta Quest, to be the mass-market winners in AR.

The Xreal One Series features the X1 chip which is the company's first self-designed processor for its glasses.

Xreal on Wednesday launched its latest generation of augmented reality (AR) glasses as it looks to fend off competition from the likes of Meta and Snap.

The company, which is backed by Chinese e-commerce giant Alibaba, is hoping to capitalize on the growing interest in AR glasses.

The Xreal One Series features the X1 chip which is the company's first self-designed processor for its glasses and marks a big step for the product's capabilities.

Xreal talks up the ability for wearers of its glasses to be able to connect to devices such as a phone, laptop or games console, and see their content on a huge digital screen in front of them. The previous generation of Xreal's product required a companion device called the Beam for connections to a device, but the latest chip means that the Beam is not required.

"I think that it's the biggest upgrade in Xreal history and probably the biggest upgrade for the entire consumer AR glasses [sector]," Chi Xu, CEO of Xreal, told CNBC in an interview.

The X1 chip was in the works for three years, Xu said, adding that he sees it as a way to increase the capabilities of the glasses to differentiate from the competition.

"We have to step up to define a chip that is really defining some of the new features for these types of glasses," Xu said.

Xreal is one of the biggest players in the AR glasses space, but it is facing intense competition from the likes of Snap, which unveiled a new set of its Spectacles in September, as well as Facebook parent Meta's continued efforts with the Meta Ray-Ban product. Meanwhile, CNBC reported this year that Qualcomm is working on a set of glasses with Google and Samsung.

Xreal is among the companies that are betting on glasses — rather than large headsets like Apple's Vision Pro or the Meta Quest — to be the mass-market winners in AR.

"People have started to realize a headset doesn't make sense, we need to go to lighter form factors to the glasses category," Xu said. "But the challenge for glasses is can we push the limit to deliver a headset experience on a much smaller form factor?"

The Xreal One and Xreal One Pro start at $499 and $599 respectively.

AR, which refers to a technology that overlays digital content over the real world, has been hyped up over the last few years. However, the market had not exploded like many had predicted. Large headsets have proved too expensive or uncomfortable and firms including Xreal and Meta are focusing on how they can make the experience with glasses more compelling.

There is also still a lack of content and killer use cases for the product, an issue Xu said needs to change before the product category reaches a wider user base. The CEO added that this begins with good hardware.

"We need a platform, we need an ecosystem to improve the experience because we don't have any content yet. But in order to have the developers getting excited ... you need to have good hardware to begin with," Xu told CNBC.

Xu said the company is expecting to sell 500,000 units of its previous products in 2025, roughly doubling the figure of this year.

Will VR ever take off? 30 years since the first headset, it's still not there yet

Virtual reality has been close to mainstream adoption for decades, yet it remains a niche technology. While promising developments and incremental improvements continue, the game-changing app that will propel VR into every home remains elusive despite the efforts of tech giants like Meta, Google, and Apple.

History is littered with VR failures, from the early Nintendo Virtual Boy to the pricey Apple Vision Pro, but the promise of immersive digital worlds keeps companies investing billions. The stakes are high, as whoever unlocks mass-market VR will shape the future of the user experience across gaming, fitness, productivity, and beyond.

Google has been innovating in augmented reality and virtual reality for much longer than Apple

A roller coaster of hype and disappointment

VR's journey has been a roller coaster of hype and disappointment. Early attempts, like the vaporware Sega VR headset and Nintendo's ill-fated Virtual Boy, were hampered by technical limitations, high costs, and a lack of compelling content. What's worse, early VR users complained of vertigo-like symptoms.

VR didn't take off, even with the advent of more capable headsets like the Oculus Rift and HTC Vive. Google's forays into the market with Cardboard, Glass, and Daydream fizzled out, while Apple's Vision Pro stumbled with a hefty price tag and limited functionality. Meanwhile, Facebook keeps doubling down, and Samsung appears poised to re-enter the VR market. This makes us wonder who and what can succeed where capable tech companies fail.

The quest for VR's game-changing app spans three decades

VR's biggest challenge is the lack of a must-have experience that compels users to embrace the technology. While VR has shown promise in gaming, entertainment, and perhaps productivity, nothing has taken off after decades of trying.

Source:gamehistory.org
My first VR experience was in the early 90s in San Francisco. I remember donning a heavy headset and exploring an 8-bit, 3D world. It was exciting and felt innovative, but the experience didn't make me need VR in my daily life. As

illustrated by the timeline below, VR's "gotta have it" application has eluded many companies in a cycle that continues to this day.

VR reached numerous milestones but never thrived

The following timeline does not capture every event or product launch in VR's history. Still, it paints a lengthy history of false starts in the seemingly forever-nascent category.

1991: Virtuality Group launches VR arcade machines. Sega announces the Sega VR headset, but it is never released.

1995: Nintendo releases the Virtual Boy, a commercial flop.

2010: Palmer Luckey creates the first prototype of the Oculus Rift.

2014: Facebook acquires Oculus for $2 billion. Sony announces Project Morpheus (later PlayStation VR). Google releases the $15 Google Cardboard.

2015: Samsung launches the Gear VR series for its Galaxy phones.

2016: The Oculus Rift and HTC Vive hit the market, marking the beginning of modern consumer VR. Google extends its VR line with the Daydream View, a sub-$100 headset that, like the Cardboard, leverages a smartphone as its brain and display. The new model incorporates fabric into the design to address comfort.

2017: Facebook launches the Oculus Go VR headset, a self-contained headset for less than $250.

2019: Google discontinues Cardboard after it fails to scale the VR market. Facebook launches the standalone Oculus Quest and updates the Oculus Rift.

2020: Google officially ends support for Daydream VR, hampered by soft demand and limited content. Facebook launches the freestanding Oculus Quest

2, which becomes a category leader at $300. Samsung ends support for its Gear VR devices and services.

2021: Facebook changes its name to Meta and promotes its metaverse to mixed reception.

2022: Meta unveils the Meta Quest Pro at $1,500. It's still available for around $1,000.

2023: Apple jumps into VR/augmented reality with the $3,500 Vision Pro headset. Meta releases its Quest 3, focusing on gaming and productivity at a more affordable $500. According to multiple sources, Mark Zuckerberg claims it's "better than the Vision Pro."

2024: Reports surface of Apple scaling back or ending Vision Pro production due to disappointing sales. No surprise there, given its eye-popping price tag.

2025: Samsung, in partnership with Google and Qualcomm, is expected to launch a new mixed-reality headset.

After a relatively dormant period in the early 2000s, the 2010s brought a resurgence of interest in VR, fueled mainly by Palmer Luckey's Oculus. Facebook's acquisition of Oculus in 2014 and Mark Zuckerberg's interest in VR amplified this excitement. This period saw the launch of high-end consumer VR headsets such as the Oculus Rift and HTC Vive. Google tried the budget angle with its $15 Cardboard, and Samsung offered its Gear VR. Since then, we've seen numerous fully standalone headsets at various price points. Despite initial buzz, these devices failed to gain widespread consumer acceptance.

Overcoming the VR content hurdle

Source: Steam
Compelling VR content is crucial to scaling the category but has been in short supply. To address this, companies adopted multiple approaches. For example, centralized platforms like the Meta Quest Store and SteamVR were created as hubs for content discovery. To expand VR's appeal to wider audiences, companies also championed the development of non-gaming experiences,

spanning genres such as education, fitness, social interaction, and cinematic immersion. These efforts haven't solved the chicken-and-egg dilemma of hardware adoption and content availability.

Google keeps trying to crack the VR code

Google's attempts to conquer the VR market have been unsuccessful. Google Cardboard and Daydream View were discontinued due to low consumer adoption. On the augmented reality (AR) side, Google Glass was massively hyped and massively flopped. The company seems to have adapted its approach via its partnership with Samsung on an extended reality (an umbrella term for VR and AR) headset. The Google Play Store is rumored to be preparing to support apps for XR (extended reality) devices, indicating the growing anticipation for this technology.

Samsung takes another swing at VR

As numerous outlets have reported, Samsung is preparing to re-enter the VR market with a headset and potentially AR glasses. Samsung's platform is being developed in collaboration with Google and Qualcomm. A Samsung patent suggests the platform could reveal hidden objects in the user's field of view by overlaying digital information. Although initially expected in 2024, the launch has been delayed until 2025, and it might coincide with the Samsung Galaxy S25 debut.

Is Apple's Vision Pro heading for an exit?

Apple Vision Pro VR headset

Source: Apple
Apple launched the Vision Pro headset in 2023, positioning it as a spatial computer. Despite its advanced technology, including high-resolution displays and a powerful processor, the steep price of $3,500 put it out of reach for many consumers. Furthermore, the Vision Pro doesn't support motion controllers, a key feature for many popular VR games and applications. The high cost and limited functionality proved to be significant hurdles in attracting a wider consumer base, leading to scaled-back production and what may become the device's sunset in 2025.

Meta doubles down on VR again

Meta has long been devoted to VR and released the Quest 3 headset in 2024. The Quest 3 distinguishes itself by integrating with Windows 11. This feature positions the Quest 3 as a potential productivity tool. It will be interesting to see if this angle finds a market. Meta is also betting big on the metaverse and social experiences.

VR hurdles remain

Even if a game-changing app materializes, VR must overcome a few other barriers. Issues like the screen door effect, latency, and high component costs have improved but continue to exist.

Meta Quest 3s VR headset

Source: Meta
Let's not forget about comfort. VR headsets can feel bulky and hot and may cause eye strain for some. While motion sickness is less of an issue than it used to be, it still affects some users. Until these concerns are addressed, widespread adoption might remain out of reach.

Hope for a brighter VR future

Despite these challenges, VR isn't going away anytime soon. Companies like Meta, Google, and Samsung continue to invest heavily in VR and AR. Advancements in AI and hardware offer hope for a brighter future. However, until VR delivers compelling experiences that resonate with a wider audience, it seems destined to remain on the cusp of mainstream acceptance.

Perhaps the key to unlocking VR's potential lies in finding that elusive game-changing app, or maybe it will be a convergence of factors: compelling content that goes beyond gaming, relatively inexpensive AI-powered hardware, and comfortable, lightweight designs. Whatever the solution, one thing is clear: VR's journey to mainstream adoption continues.

LG's bizarre but impressive stretchable prototype display has the 'highest rate of elongation in the industry,' a measurement I had no idea existed

LG's bizarre but impressive stretchable prototype display has the 'highest rate of elongation in the industry,' a measurement I had no idea existed© LG Display

Flexibility could be the next bleeding edge for hardware to thread. Besides the bendy CPU whose performance leaves much to be desired outside its one party trick, monitor manufacturers are experimenting with pliable projects.

LG Display is the latest name to explore something with this technical twist, unveiling a stretchy screen prototype that can be expanded by up to 50% with a good tug (via Tom's Hardware). A prototype demonstration took place in Seoul at LG Science Park as part of a stretchable display national project during an event involving around 100 other South Korean tech stakeholders on November 8th.

This is far from the first bendy screen we've seen, with American company Corsair releasing the Xeneon Flex OLED Monitor a few years back. The big difference with LG's prototype is that it does a bit more than stretch; you can scrunch it, pull it, and twist it (though there's no word yet on whether you can bop it).

Dated reference aside (does Gen Z know the crushing low of flicking it when you mean to bop it?) LG's prototype is also a darn sight smaller than that Corsair monitor. LG's flexible display first presents RGB colour and 100 PPI at 12 inches, but can then expand up to 18-inches—which LG is quick to note in their press release exceeds "the original national project’s target of 20% elongation," and is "the highest rate of elongation in the industry."

As impressive as all of that is, I just can't get past how wrong the idea of scrunching up expensive tech feels; monitors may be hardware but they're historically not the hardiest of wares in the face of, say, a flung controller. Furthermore, in the case of the Corsair monitor, it's not just the fact you've really got to give it some welly to expand the display, but also the horrible sounds of protestation made by the frame that all contribute to the feeling of 'there's something wrong with this picture.'

Besides that, isn't the pliability of LG's prototype and its array of potential form factors just introducing heaps of new points of failure?

On the subject of durability, LG's press release states, "By using a micro-LED light source of up to 40 µm (micrometers), the new prototype’s strengthened durability means it can be repeatedly stretched over 10,000 times, maintaining clear image quality even in extreme environments such as exposure to low or high temperatures and external shocks." That might be a bold claim but, if this prototype ever makes it to market in some form, it could mean cracked phone screens may one day be a thing of the past.

The LG Display prototype remains a ways off any kind of consumer environment, but the company also shared a handful of conceptual use cases. In a bid to further highlight both the prototype's durability and pliability, LG proposed a wearable application where a stretchable display panel attached to a firefighter's uniform could provide a real-time feed of information. While that could end up being a pipe dream, a wearable that actually achieves some real world good would certainly make a change.

Is this the world's first truly wearable spatial computer? Viture's Pro Neckband aims to augment AR glasses

Wearables come in many forms, from the well-established smartwatch to 2024's sleeper hit in smart rings. However, wearable computers are often limited in scope, be that due to usability or those pesky laws of physics. Yes, the Apple Watch is great, but it's still a far cry from the futuristic Pip-Boy 3000-like Sci-Fi dreams of what wearable computers could be.

However, I'd like to take this moment to welcome you to that future as today, AR Glasses maker Viture has revealed its all-new **Pro Neckband** — not just a wearable computer, but a wearable *spatial* computer that brings more of a standalone experience to the company's incredible Pro XR Glasses.

XR/AR glasses have been one of the most fascinating gadgets to track throughout 2024, especially as smart glasses increasingly find a home with mainstream audiences. These wearables bring simple mixed reality entertainment to the masses, transforming how many consume media along the way. But the Pro Neckband looks to be a major leap forward for Viture's glasses.

7 Best Black Friday smart glasses deals: Save on Ray-Ban Meta. Viture, XREAL, and RayNeo

Top-rated product

Excited about Viture's new Pro Neckband? Save $100 on the Viture Pro XR Glasses during Black Friday sales at Amazon and outfit yourself with the perfect companion to Viture's wearable wonder.

I gave these glasses a four-and-a-half star review earlier this year, and I routinely use them to play games and watch movies across their vivid 135" holographic display. It's IMAX in front of your eyes and works with mobile, tablets, Macs, and PCs to make play and productivity possible in an AR space.

Features: Built-in micro-OLED displays (1920 x 1080, 120Hz, equivalent of 135" screen at nine feet), Electrochromic dimming lenses, Harman-tuned speakers.View Deal

VITURE Pro Neckband: A very spatial wearable computer

Viture's Pro Neckband is the next step in that bold, mixed reality direction, taking the capabilities of the company's AR glasses and pairing them with the powerful backing of a portable spatial computer featuring its own AI assistant, gesture-based controls, 3DoF tracking, and some clever tech that takes advantage of the dual-screens of AR glasses to turn flat media into 3D.

Viture's Pro Neckband comes in two models: the $299 Classic, which offers 8GB of RAM and 128GB of storage, and the $399 Elite, featuring 12GB of RAM and 256GB of storage.

Both models offer the same core improvements, including a longer-lasting 3,280mAh battery, improved 6nm 8-Core CPU, Wi-Fi 6E, Bluetooth 5.2, and improvements to the Neckband's build, fans, and cooling to reduce noise, heat,


VITURE

VITURE Pro Neckband: Augmenting the AR experience

The new Viture Pro Neckband doesn't run on the same Google TV framework as Viture's original Neckband. Instead, it runs on Android and is officially certified with the Google Play Store — unlocking access to literally millions of Android apps and allowing them to run natively on-device.

Alongside this, the new Pro Neckband also features hand tracking to interact with the AR environment, which can now span multiple windows. Simple gestures can control the size of each window and the Pro Neckband also allows for similar operability as the Apple Vision Pro or Meta Quest 3/3S by using your hand to move a virtual cursor and tapping your fingers to click.

Taking things even further, the new Pro Neckband also features an AI agent, cutely dubbed Vizard — an LLM-like assistant that can answer questions, handle your schedule, and even take notes for you.

The power of AI extends beyond Vizard, and merges into your entertainment. Using AI, Viture has been able to develop a way of translating 2D media into 3D, elevating your favorite content and greatly improving the viewing experience for all. This feature is also expected to make its way to games in the future, granting you a new way to enjoy your classics.

Outlook

Alongside AR glasses makers XREAL, RayNeo, and Rokid, Viture has been paving the way for entertainment-focused smart glasses to take flight in the mainstream. While the company's AR glasses have been impressive (to say the least), the Pro Neckband aims to bring the Viture experience forward tenfold.

It's hard to get across how much of an impact something like the Pro Neckband can have on AR glasses, but a similar impact was made by XREAL with their recent Android-based Beam Pro device.

Viture's Pro Neckband looks to be taking the same steps into the next generation of wearable AR tech, stepping out even further into what's possible with the inclusion of the Vizard AI agent, creating 3D experiences from 2D media, and offering an intuitive hand-tracked method of interfacing with its AR elements.

Those interested in trying out Viture's latest Pro Neckband for themselves won't have to wait long. Pre-orders for the AR accessory are now available at the Viture Store for the $299 Classic and $399 Elite Neckband models. The Pro Neckband is expected to ship in two batches so far, with the first batch due toward the end of December, and the second batch in early January 2025.

Aside from celebrating the launch of its new Pro Neckband, Viture is also celebrating Black Friday by hosting a slew of discounts on its best AR-friendly tech. You can catch many of these sales on the Viture Amazon Storefront, and if you follow this page you'll also get a free Viture x 8BitDo Ultimate C game controller on any purchase of the Viture Pro XR glasses.

Viture's new Pro Neckband grants AR glasses extra superpowers

Viture already has some of the best smart glasses with displays currently available. However, the market is maturing, and accessories that expand capabilities are becoming important as well — which is where the company's newest release comes in: the Pro Neckband.

All The Level-ups You've Been Waiting For — Secure Your VITURE Pro Neckband on 11/26!

The Pro Neckband expands the features of Viture's smart glasses, while also adding extra battery life. The current way of using the Viture smart glasses is by using the Spacewalker app for iOS and Android, which lets Viture glasses display multiple virtual screens, browse the web, and view content, though it can't run any other apps. That limits what's possible.

The Pro Neckband changes that. It's a standalone Android device that Viture says can run "millions of apps" in a multi-window spatial computing environment. Viture describes it as "all the level-ups you have been waiting for."

Viture’s Pro Neckband is a hands-free wearable that can run Android apps. Viture

The Pro Neckband does a similar thing as Xreal’s Beam Pro, which adds advanced features found in Apple’s Vision Pro headset, as well as Rokid’s AR Lite, and includes a separate compute puck so you don’t need to connect your phone.

While VR headsets like the Meta Quest 3S borrowed AR features with advanced mixed-reality technology, Viture smart glasses paired with the Pro Neckband incorporate what was once a VR feature: hand-tracking.

To control the Pro Neckband, you simply use your hands. Viture added sensors that recognize hand gestures so you can move or resize windows and interact with apps by using wave and pinch motions.

If you’re familiar with the original Neckband, Viture says the Pro Neckband is seven times faster and has 40 times the GPU performance while being lighter and offering a longer battery life. The unnamed 6nm 8-core processor supports up to 12GB of memory, 256GB of storage, Bluetooth, and Wi-Fi 6E.

That’s plenty of RAM for its AI assistant Vizard, and enough space to load it up with your favorite games and movies. You can stream from YouTube, Netflix, and more, watching 3D movies or using Viture’s AI to turn 2D videos into 3D.


Viture

We’re eager to go hands-on with this new accessory that could make Viture One and Pro smart glasses into one of the best wearable AR devices.

Check back for our full review. In the meantime, you can learn more about the Pro Neckband and preorder it now on Viture’s website.

Meta Orion AR glasses could get these 3 incredible sci-fi tricks, according to new Project Aria update

- **Researchers have shared their impressive Meta Aria projects**
- **Aria is a research kit to help developers better understand AR and AI**
- **These projects could become Meta Orion features if we're lucky**

Meta has just shared an update on its Aria AR glasses research project collaborations, and they reveal some exciting potential ways that the publicly available versions of its Meta Orion AR Glasses could shape our real-world lives when they launch.

Project Aria’s goal is to help software developers and researchers “better understand how to build the software and hardware necessary for future AR and AI-powered glasses.” Initially an internal undertaking, Meta expanded Aria access to partners like BMW and various universities across the globe – and what they've created so far highlights some awesome use cases for AR glasses.

It's worth noting that all of these tools are still at the research stage, so we're likely still years from them being packaged into a consumer usable app – something which may not even happen with any of these projects. But they highlight some of the ways Orion could be used, and who knows? With Orion likely years away there's still plenty of time to turn these projects into the world's best AR apps before they launch.

1. Learning from the experts

The Matrix series is not a dystopian setting anyone wants to live in, but there's one aspect of that world I'm sure most of us would want to bring into our real one: the ability to download any skill we could need.

While the Orion glasses might not instantly make you a master of kung fu, or teach you how to fly a helicopter in seconds, they could help us gradually improve our skills with feedback it has learned from experts.

For its Project Aria research, the University of Bristol has been capturing data from highly skilled people – from chefs, to musicians, to athletes, to mechanics – tracking their movements and how they move objects to learn more about how they "interact with and change the world to achieve their goals."

With this understanding it's easy to see how Orion could offer AR lessons about how to repair a bike or cook a delicious meal, going so far as to highlight the real-world object you need to use and showing you how to use it in real-time.

2. Driving more safely

Researchers at IIIT Hyderabad have used Project Aria to develop its Driver Intent Prediction Project. Using the AI glasses' outward cameras, and their inward eye-tracking cams – as well as various other car sensors – the team is able to tell where drivers are looking and importantly where they aren't.

If a pedestrian mindlessly steps into the street while you're looking in your mirrors, the glasses can detect that you haven't seen them yet and warn you –

allowing you to take action. The project's goal is to reduce traffic accidents and it's easy to see how this tool could help make us safer drivers if Orion were to launch with a version of it.

3. Maximizing accessibility

The last two Aria projects demonstrate the glasses' accessibility credentials. University of Iowa researchers are using Aria to help people with hearing loss by using the specs' microphone array to help determine the direction sound is coming from. This could then be combined with prompts on an AR glasses' display, or used in conjunction with traditional hearing aids to improve its effectiveness.

Meanwhile, researchers at Carnegie Mellon University have used the glasses to help people with visual impairments. Using the glasses' sensors (and some external beacons) Aria could help people more easily navigate unfamiliar environments with real-time guidance.

These kinds of accessibility features and more are exactly how technological advancements like Meta Orion could (and should) be put to use.

As more people get their hands on Aria research kits I'm excited to see what other projects they work on, especially as that hopefully means that Orion will have some awesome tools when it eventually releases to the public.

"The most advanced pair of AR glasses ever made":Meta unveils Orion augmented reality glasses

A natural step in the progression of technology, or deeply concerning? Tech giant Meta, owner of Facebook, Instagram and more, has unveiled the first pair of what it calls "true" augmented reality (AR) glasses.

Called Orion, Meta describes the product as "the most advanced pair of AR glasses ever made." However, they are still a prototype at present.

One of the reasons they haven't been released to the public is not a fear that people will become even more insular than they currently are, but rather that they would cost a prohibitive $10,000 (approximately £7,900 / AU$15,600) a pair.

Orion's hardware consists of three individual parts: the actual glasses, a wireless mouse and a wristband for gesture control.

A "feat of miniaturization," according to Meta, Orion has the largest field of view in the smallest AR glasses form to date. "From multitasking windows and big screen entertainment to life-size holograms of people – all digital content that can seamlessly blend with your view of the physical world."

Embedded into the wristband are electromyography sensors that capture and process electric signals generated by physical movement, and the mouse's dual processors carry part of the computing load, including some artificial intelligence (AI), graphics rendering and machine perception.

The glasses contain custom chips that consume less power and are optimized for its functions. They're made from magnesium, a lightweight material that efficiently dissipates heat, and miniature cameras and sensors surrounding the frame rims help the eye in hand-tracking and identifying objects in the real world. Additionally, microLED projectors beam holographic displays through the holographic lenses.

Apparently the glasses enable you to open your fridge and ask for a recipe based on what's inside, or for some inexplicable reason "video call a friend while adjusting a digital family calendar as you wash the dishes."

If that rather stressful-sounding scenario feels like something you'd be interested in, it's probably best to mention how Orion looks.

Meta claims that "what makes Orion unique is that it is unmistakably a pair of glasses in both look and feel – complete with transparent lenses."

As you can see, this is clearly not the case. They're clunky, cartoonish, and resemble the ever-trendy 'Coke bottle' glasses style.

While just a prototype at the moment, Meta is hoping that its development team can "learn, iterate and build towards our consumer AR glasses product line, which we plan to begin shipping in the near future."

Take a look at our guides to the best AI image generators, the best 360 cameras, and the best cameras for professionals.

Meta Orion hands-on: if this is a prototype the finished product is going to be incredible.

(Image credit: Future / Lance Ulanoff)

I didn't want to love it. My plan for my first Meta Orion AR glasses experience was to dispassionately try them and quickly identify the highlights, shortcomings, and pitfalls of this not-ready-for-primetime mixed reality product. But I can't do that because I enjoyed every bit of it, almost to the point of giddiness.
Let's back up for a minute.

Meta Orion AR glasses made their global debut just weeks ago at the Meta Connect Conference on the face of company founder and CEO Mark Zuckerberg. The live demo raised eyebrows for its build, image quality, eye and gesture tracking, and smart Meta AI integration.
Orion looked like everything Google once hoped Google Glass could be and, honestly, everything Apple Vision Pro should be today.

The look like fat glasses (Image credit: Future / Lance Ulanoff)

I read some of the early hands-on' with interest and some jealousy. I've been trying AR, VR, and mixed-reality headsets, and smart glasses for well over a decade, and I sensed a tipping point in Orion. Even so, I assumed it couldn't be that good. If Meta wasn't ready to release it to the public, Orion had to be more experiment than product and the utility would be limited at best.

Meta invited me to its New York headquarters this week to wear and try Orion for myself. Since I first heard of them, it seemed like a long road to get to this moment, but to be fair, Meta's traveled far further.

You can bend some at the hinges, but I never fully collapsed them (Image credit: Future / Lance Ulanoff)

The Orion project started inauspiciously five years ago with a massive headset that was attached to a heavy backpack (see the progression below). Meta VP of Wearable Devices Ming Hua, who is also leading the Orion team, told me the joke at the time was that you had to be very strong to work on AI glasses.

Meta worked quickly in the intervening years to shrink the system. By 2022, the project, then known as Balboa, was a torn-down Quest Pro. It was only marginally smaller in 2023. It is almost miraculous that Orion made the leap from this massive and unwieldy headgear to a pair of almost fashionable magnesium glasses that weigh just under 100 grams.

This is how we got here. Yes, the guy on the left is wearing a backpack. (Image credit: Meta)

Figuring out how to shrink components, which often seems to involve building custom silicon and then spreading it throughout the body of Orion, is an achievement in and of itself. I saw an image of a see-through version of Orion, which showed virtually every square millimeter filled with circuitry, silicon, and components. Even so, Meta has yet to fit everything inside the frames.

Some supporting custom silicon lives in the wireless puck. While Meta has experimented with additional puck features like a six-degree of freedom thumb control and some cameras, during my demo, the puck sits nearby like a silent partner.

There are enough sensors built into the glasses to track eye and head movement, but Meta went a different route for Orion input. It developed an Electromyography (EMG) band that reads subtle electrical signals produced in the wrist when you perform various hand gestures. I've used some of the EMG bands in the past and they were bulky and uncomfortable. Orion's companion band is not much thicker than a sweatband and no less comfortable.

The puck has some vestigial technology that's not being used. During my demo, I never touched it. (Image credit: Future / Lance Ulanoff)

Orion's defining feature, though, may be its display system. The lenses appear mostly clear, but there's a complex interplay of tiny micro-LED projectors, silicon carbide, and waveform etching that creates a remarkably seamless AR experience.

The projectors live in the frame, sitting in stems and right next to lenses, which have a thin coating of silicon carbide, chosen for its high refraction and low image ghosting capabilities. The waveguide technology involves fine etchings on the silicon carbide surface that guide the light and imagery across the lens surfaces for a wider-than-it-sounds 70-degree field view. The resolution ends up being 13 pixels per degree (ppd).

The specs are fascinating, but the experience is what convinced me. I just got a glimpse of our AR glasses' future.

This band provides Electromyography input. If it'snot tight enough, it pickup receive the signals. (Image credit: Future / Lance Ulanoff)

Wearing tomorrow

The first thing I noticed when they handed me the black Orion frames was that they were much lighter than expected. Yes, they are a lot thicker than, say, my glasses, but they're not actually much bigger.

When I put them on first the first time, they don't feel much different than when I'm trying to pick out a new pair of glasses. The only adjustment Meta's team insists on is finding the right nose piece. I think this has a lot to do with making sure the cameras looking at my eyes for eye tracking are in the right place. I recall Ming Hua mentioning to me that the frames use magnesium for its lightness, but also for rigidity because even a hair-width shift in the frame could set the dual displays off-axis and result in double AR vision.

Owing to this being a work in progress, some of my demos are driven and managed by a guy behind a computer. He mostly troubleshoots and reboots from afar; otherwise, I get to drive Orion.

In addition to the smart glasses, I'm fitted with an EMG band. It's positioned high on my wrist and tight enough that it can pick up my finger movements, so I can feel the haptic feedback to let me know that I've successfully transmitted a gesture instruction.

The right nose guard is important. (Image credit: Future / Lance Ulanoff)

The setup and calibration are quite similar to Apple Vision Pro in that the system asks me to, using only my eyes, look at a series of floating dots that appear in a circle in front of me. I notice right away that it doesn't seem to matter where I look, I can always see Orion's AR display. Later, I learned how to find the edges of the 70-degree FOV, but it takes effort, and in normal wear and activity, the visuals fill my view (without ever blocking them).
The system also trains me on the few gestures I'll use to access and control menus and engage with apps. Mostly, it's a pinch of the index finger and thumb or a pinch with my middle finger and thumb. I had less success with a flicking gesture that was supposed to let me scroll. Throughout my lengthy demo, the EMG band slowly slips down my wrist and eventually hangs like a bracelet. Naturally, this means it can't read any of my gestures. If I keep it high and tight on the wrist and use slightly assertive gestures, it works consistently.

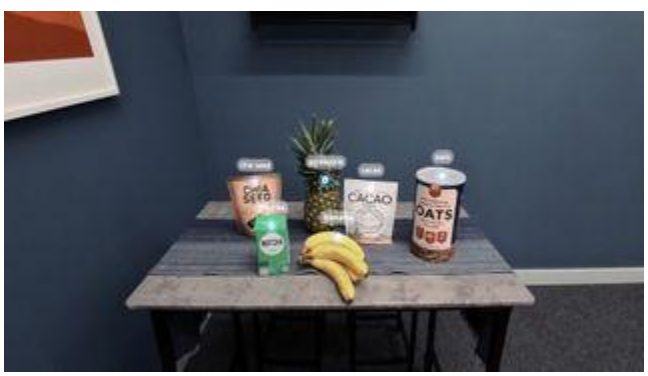
Home base

The home menu also reminds me of Vision Pro, and I reflexively pinch and grab a bar below it to bring the interface closer to me. Throughout the demo, I can't wear my glasses, which means some of the visuals are a little blurry, which is why I pulled them closer. I wondered how much better the experience would've been if I owned or had ever worn a pair of contacts.

I have several core Orion experiences, and each one was impressive in its own way.

Meta supplied mewith some b-roll images of the experiences. These images closely match what I saw. (Image credit: Meta)

When Ming Hua calls, and after I look at the call button and pinch to accept, her video call pops up in front of my face, looking much like a floating 42-inch screen. When I get up and move around, the screen stays in place. I can even look at it from the side. It really looks like part of my real world. I can see the home gesture to pull the interface in front of me. Not only is the video of decent quality, but the spatial audio, which sits near my ears, is clear. The six microphones mean I can talk in a normal tone of voice, and Hua can hear me perfectly.



Differnt room but the collection of ingredients is basically the same and, yes, I saw the labels appear right over the ingredients. (Image credit: Meta)

I stand up and walk over to a collection of ingredients, including a pineapple, cacao, bananas, whey, dates, and coconut flakes. There is a gesture to enable Meta AI, but it never works for me, so I look at the Meta AI icon and tap my fingers to access it that way.

Then I say, “Give me a recipe.” Meta AI understands this to mean that it should look at the ingredients in front of it and come up with a recipe. It’s something we do all the time without the assistance of AI.

In this instance, though, I watch as Orion identifies all the ingredients, putting little labels on each one. The 3D mapping here is spot on. Within a few moments, I have a usable recipe that I could page through. When I remove an ingredient from the table and ask for another recipe, Meta AI adjusts and gives me a coconut-encrusted banana. Yummy.

"Give me a recipe" (Image credit: Future / Lance Ulanoff)

I open Instagram, which is naturally part of the main menu, and then use a pinch and sweep-up gesture to scroll. The flick gesture doesn't work here, either. Someone messages me in another window, and when a call comes in, I look up at the call answer option, pinch my fingers, and a third window appears with a slightly unsettling-looking VR avatar of the caller. He is wearing a Quest 3s headset on his end but says that it would be two people wearing Orion glasses talking to each other with their VR avatars in the future.

Multitasking in AR is a thing. (Image credit: Meta)

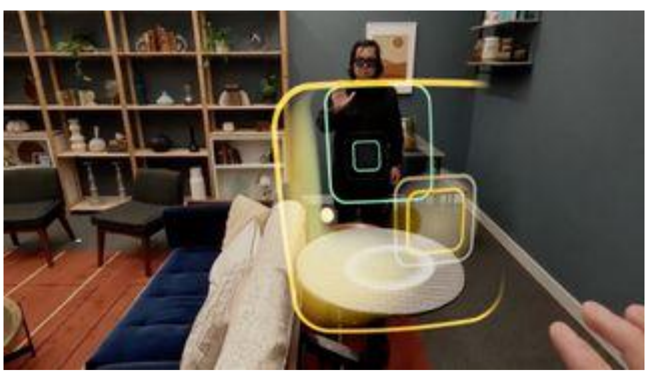
As we talk, I look around at the three screens. It’s hard to assess the image quality at the edges because, well, I’m not looking there. When I do, everything is in focus. Hua told me the system not only tracks your gaze but uses something called pupil replication, which ensures that wherever you’re looking, you still see the same image.

Put another way, the image doesn’t distort if you look at it incorrectly. I think this is what helps with the casually immersive feel of the Orion experience. I have none-too-fond memories of using Google Glass and always having to glance up and to the right to see the tiny screen. If the headset wasn’t on right, things looked weird.

I get very serious when I'm playing AR games. (Image credit: Future / Lance Ulanoff)
Orion can play games. My first experience is a space game where I steer a ship with my gaze and head movements and shoot by tapping my thumb and index finger. The game fills my field of view and is so entertaining I play all five levels and end up with a respectable 6,000+ score.

My only complaint is that I keep doing something to dump myself out of the game and into the Meta AI. I don’t know why it's happening, but I quickly return to gameplay by using the home gesture.

This multiplayer game was a lot more fun than it looks. (Image credit: Future / Lance Ulanoff)
After that, we play a multiplayer game. My opponent wears a pair of Orion glasses and stands 8 feet away from me as we play virtual ping pong. I move my virtual paddle with my open palm and bounce the translucent green ball off the walls and into his space. I don't fare as well here, though, and lose both rounds. After we play, they encourage me to step around the play area to see it from the side. My losing playfield is aglow; I reach out to touch…nothing.



Yup, this accurately represents what I saw. (Image credit: Meta)
I’ve had some concerns about the viability of Orion, especially after I heard that Meta thought they might not be able to source and scale up the manufacturer of enough silicon carbide to support mass distribution. Hua, though, seemed less sure that is the case, telling me they’d had many people in the silicon carbide manufacturing industry reach out after the reveal. The material remains very much on the list of display technology possibilities.

That’s good news because I have a sense that silicon carbide plays a significant role in the wide and relatively immersive field of view. Interestingly, the base experience I just had turns out to be only one step on the way to even better Orion smart glasses in the future.

The screen resolution of the set I wore is 13ppd, but Meta already has a pair of Orion prototypes running at 26ppd, double the resolution of the first frames. They had the pair in the room and offered to let me try them out.

(Image credit: Future / Lance Ulanoff)

In one of my earlier demos, I’d opened a browser window and watched a clip from the recent Mets versus Phillies MLB division series. It looked pretty good. Now, though, on the 26ppd Orion smart glasses, there was a noticeable difference in image quality. The player’s faces and the ballpark were all clearly sharper.

I realized that while everyone is talking about wearing the future, Meta is moving apace, quickly swapping and trying new components and features. Orion smart glasses that are thinner, lighter, more efficient, with a better resolution, and that cost as much (or as little) as a high-end smartphone might arrive much sooner than we think.

When I finally took off the Orion AR smart glasses after almost an hour of wearing them (they finally asked to recharge them), I was struck by how no part of my face ached. I loved my Vision Pro and Quest 3s experiences, but after 15 minutes, you know you’re wearing a pound of silicon and plastic on your face. Orion felt like glasses, very, very smart and AR-capable glasses.

What if the future is almost now?

Ray-Ban Meta Smart Glasses are getting even more AI features, like live language translations and Meta AI for live video


(Image credit: Future)

The Ray-Ban Meta Smart Glasses might be the most popular smart glasses around, and that's likely thanks to their feature set and housing. Meta partnered with Ray-Ban to bring the iconic Wayfarers into the technological age with slightly thicker frames, two cameras, some speaker tech, microphones, and connectivity.
These smart glasses started out as a unique way to capture photos or videos, at times even more 'in the moment', given that you didn't need to take your phone out and launch the camera. In recent months, Meta has infused these smart glasses with Meta AI, enabling you to look at something and simply say, "Hey Meta, what's this?" and let it look, analyze it, and then provide you an answer. It's pretty neat.
Now, though, at Meta Connect 2024, the team working on the Smart Glasses wants to make these even smarter – and if you guessed that they're doing that with AI, you'd be correct.

Language translations and visual reminders

Kicking things off with what might be the most helpful new feature, the Ray-Ban Meta Smart Glasses will get live language translation later this year. Similar to what Samsung accomplished with the Galaxy Buds Pro 2 or Google with the Pixel Buds Pro 2, the Ray-Ban Metas will be able to translate languages near-live, initially between English and Spanish, Italian, and French.
This could prove pretty helpful, and more natural than attempting to do this with earbuds in, as it's baked into the smart glasses, which you might already be wearing daily if you've opted to install prescription lenses.

Furthermore, beyond asking Meta to set a reminder verbally, you can now set up reminders based on things that you see, and therefore Meta is viewing – so it could be as you're getting milk out of the fridge and realize you're almost out, or maybe a package that you left near your front door that you need to be sure you take with you. This feature should be rolling out sooner rather than later.

Similarly, you'll now be able to scan QR codes for events, phone numbers, and even full contact information. If a QR code is visible, you'll be able to ask Meta via the Ray-Ban Meta Smart Glasses to scan it – we imagine the information will then appear in the Android or iOS companion app.

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An ambitious video step

Likely the most ambitious forthcoming feature, also set to arrive later this year, Meta AI for video, meaning that Meta can view what you're looking at in real time, not just an image snapshot, and provide clarity or answer questions. This could be helpful for navigating around a city, cooking a meal, completing a math problem, or helping you finish a Lego set.

This is likely a big step and would raise some privacy concerns, as it's a live view from your glasses that's being processed immediately. You'll also need the Ray-Ban Meta Smart Glasses to be connected to the internet via an iPhone or Android for this to work, as it would need to process the information in real time.

Still, though, it does likely give us an idea of where Meta is headed with the smart glasses category, and it's great to see that Meta is continuing to roll out new features to the smart glasses. And that's the good news here – these updates don't, so far as we know, require new hardware. These are set to arrive as over-the-air updates for folks who already have the Ray-Ban Meta Smart Glasses, or who purchase them.
Another update that's on the way is integration with Amazon Music, Audible, iHeart, and Spotify integration, which will give you easier access to your favorite songs, artists, podcasts, and books hands-free. You'll also see new Transition lens options arriving from EssilorLuxottica, the eye giant behind brands ranging from Dolce & Gabbana to Oakley. So, if you haven't loved the available looks enough to get a pair yet, or want to freshen yours up, once those hit the scene it'll a good time to consider them again. We'll be going hands-on with these new features, from language translation to Meta AI for video, as soon as we can, so stay tuned to TechRadar.

Startup’s displays engineer light to generate immersive experiences without the headsets

“We are adding a new layer of control between the world of computers and what your eyes see,” says Barmak Heshmat, co-founder of Brelyon and a former MIT postdoc.

Zach Winn | MIT News

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“Wherever you want to increase visual efficiency with screens, Brelyon can help,” Barmak Heshmat says.

One of the biggest reasons virtual reality hasn’t taken off is the clunky headsets that users have to wear. But what if you could get the benefits of virtual reality without the headsets, using screens that computationally improve the images they display?

That's the goal of the startup Brelyon, which is commercializing a new kind of display and content-rendering approach that immerses users in virtual worlds without requiring them to strap goggles onto their heads.

The displays run light through a processing layer before it reaches users' eyes, recalculating the image to create ultrawide, visual experiences with depth. The company is also working on a new kind of content-rendering architecture to generate more visually efficient imagery. The result is a 120-inch screen that simulates the sensation of looking out a window into a virtual world, where content pops in and out of existence at different angles and depths, depending on what you feed the display.

"Our current displays use different properties of light, specifically the wavefront of the electric field," says Brelyon co-founder and CEO Barmak Heshmat, a former postdoc in the Media Lab. "In our newest architecture, the display uses a stack of shader programming empowered with inference microservices to modify and generate content on the fly, amplifying your immersion with the screens."

Customers are already using Brelyon's current displays in flight simulators, gaming, defense, and teleoperations, and Heshmat says the company is actively scaling its manufacturing capacity to meet growing demand.

"Wherever you want to increase visual efficiency with screens, Brelyon can help," Heshmat says. "Optically, these virtual displays allow us to craft a much larger, control-center-like experience without needing added space or wearing headsets, and at the compute level our rerendering architectures allow us to use every bit of that screen in most efficient way."

Of light and math

Heshmat came to MIT in 2013 as a postdoc in the Media Lab's Camera Culture group, which is directed by Associate Professor Ramesh Raskar. At the Media Lab, Heshmat worked on computational imaging, which he describes as "combining mathematics with the physics of light to do interesting things."

With Raskar, Heshmat worked on a new approach to improving ultrafast cameras that used time as an extra dimension in optical design.

"The system essentially sent light through an array of mirrors to make the photons bounce many times inside the camera," Heshmat explains. "It allowed us to capture the image at many different times."

Heshmat worked across campus, ultimately publishing papers with five different professors, and says his experience at MIT helped change the way he perceived himself.

"There were many things that I took from MIT," Heshmat says. "Beyond the technical expertise, I also got the confidence and belief that I could be a leader. That's what's different about MIT compared to other schools: It's a very vibrant, intellectually-triggering environment where everyone's very driven and everyone's creating their own universe, in a sense."

After graduating, Heshmat worked at a virtual reality company, where he noticed that people liked the idea of virtual reality but didn't like wearing headsets. The observation led him to explore ways of achieving immersion without strapping a device to his head.

The idea brought him back to his research with Raskar at MIT.

“There’s this relationship between imaging and displays; they’re kind of like a dual of each other,” Heshmat explains. “What you can do with imaging, the inverse of it is doable with displays. Since I’d worked on this imaging system at MIT, what’s called time-folded imaging, I thought to try the inverse of that in the world of displays. That was how Brelyon started.”

Brelyon’s first check came from the MIT-affiliated E14 Fund after Heshmat built a prototype of the first device in his living room.

Brelyon’s displays control the angles and focus of light to simulate wide, deep views and give the impression of looking through a window. Brelyon currently sells two displays, Ultra Reality and Ultra Reality Mini. The Ultra Reality display offers a 10-foot-wide display and a depth of around 3 feet. The displays are fully compatible with standard laptops and computers, so users can connect their devices via an HDMI cable and run their favorite simulation or gaming software right away, which Heshmat notes is a key benefit over traditional, headset-based virtual reality displays that require companies to create custom software.

“This is a plug-and-play solution that is much smaller than setting up a projection screen, doesn’t require a dedicated room, doesn’t require a special environment, doesn’t need alignment of projectors or any of that,” Heshmat says.

Processing light

Heshmat says Brelyon has sold displays to some of the largest simulation training companies in the world.

“In simulation training, you usually care about large visualizations and large peripheral fields of view, or situational awareness,” Heshmat says. “That allows you to look around in, say, the cockpit of the airplane. Brelyon allows you to do that in the size of a single desktop monitor.”

Brelyon has been focused on selling its displays to other businesses to date, but Heshmat hopes to eventually sell to individuals and believes the company’s displays hold huge potential for anyone who wants to improve the experience of looking at a monitor.

“Imagine you’re sitting in the backseat of a car, and instead of looking at a 12-inch tablet, you have this 14-inch or 12-inch aperture, but this aperture is looking into a much larger image, so you have a window to an IMAX theater,” Heshmat says.

Ultimately, Heshmat believes Brelyon is opening up a new platform to change the way we perceive the digital world.

“We are adding a new layer of control between the world of computers and what your eyes see,” Heshmat explains. “We have this new proton-processing layer on top of displays, and we think we’re bridging the gap between the experience that you see and the world of computers. We're trying to connect that programming all the way to the end processing of photons. There are some exciting opportunities that come from that. The displays of future won’t just let the light out just like an array of lamps. They’ll run light through these photon processors and allow you to do much more with light.”

Humans are increasingly engaging with wearable technology as it becomes more adaptable and interactive. One of the most intimate ways gaining acceptance is through augmented reality (AR) glasses.

Last week, Meta debuted a prototype of the most recent version of their AR glasses—Orion. They look like reading glasses and use holographic projection to allow users to see graphics projected through transparent lenses into their field of view.

Meta chief Mark Zuckerberg called Orion "the most advanced glasses the world has ever seen." He said they offer a "glimpse of the future" in which smart glasses will replace smartphones as the main mode of communication.

But is this true or just corporate hype? And will AR glasses actually benefit us in new ways?

Old technology, made new

The technology used to develop Orion glasses is not new.

In the 1960s, computer scientist Ivan Sutherland introduced the first augmented reality head-mounted display. Two decades later, Canadian engineer and inventor Stephen Mann developed the first glasses-like prototype.

Throughout the 1990s, researchers and technology companies developed the capability of this technology through head-worn displays and wearable computing devices. Like many technological developments, these were often initially focused on military and industry applications.

In 2013, after smartphone technology emerged, Google entered the AR glasses market. But consumers were disinterested, citing concerns about privacy, high cost, limited functionality and a lack of a clear purpose.

This did not discourage other companies—such as Microsoft, Apple and Meta—from developing similar technologies.

Looking inside

Meta cites a range of reasons for why Orion are the world's most advanced glasses, such as their miniaturized technology with large fields of view and holographic displays. It said these displays provide: "compelling AR experiences, creating new human-computer interaction paradigms [...] one of the most difficult challenges our industry has ever faced."

Orion also has an inbuilt smart assistant (Meta AI) to help with tasks through voice commands, eye and hand tracking, and a wristband for swiping, clicking and scrolling.

With these features, it is not difficult to agree that AR glasses are becoming more user-friendly for mass consumption. But gaining widespread consumer acceptance will be challenging.

A set of challenges

Meta will have to address four types of challenges:

1. ease of wearing, using and integrating AR glasses with other glasses
2. physiological aspects such as the heat the glasses generate, comfort and potential vertigo

3. operational factors such as battery life, data security and display quality
4. psychological factors such as social acceptance, trust in privacy and accessibility.

These factors are not unlike what we saw in the 2000s when smartphones gained acceptance. Just like then, there are early adopters who will see more benefits than risks in adopting AR glasses, creating a niche market that will gradually expand.

Similar to what Apple did with the iPhone, Meta will have to build a digital platform and ecosystem around Orion.

This will allow for broader applications in education (for example, virtual classrooms), remote work and enhanced collaboration tools. Already, Orion's holographic display allows users to overlay digital content and the real world, and because it is hands-free, communication will be more natural.

Creative destruction

Smart glasses are already being used in many industrial settings, such as logistics and health care. Meta plans to launch Orion for the general public in 2027.

By that time, AI will have likely advanced to the point where virtual assistants will be able to see what we see and the physical, virtual and artificial will co-exist. At this point, it is easy to see that the need for bulky smartphones may diminish and that through creative destruction, one industry may replace another.

This is supported by research indicating the virtual and augmented reality headset industry will be worth US$370 billion by 2034.

The remaining question is whether this will actually benefit us.

There is already much debate about the effect of smartphone technology on productivity and well-being. Some argue that it has benefited us, mainly through increased connectivity, access to information, and productivity applications.

But others say it has just created more work, distractions and mental fatigue.

If Meta has its way, AR glasses will solve this by enhancing productivity. Consulting firm Deloitte agrees, saying the technology will provide hands-free access to data, faster communication and collaboration through data-sharing.

It also claims smart glasses will reduce human errors, enable data visualization, and monitor the wearer's health and well-being. This will ensure a quality experience, social acceptance, and seamless integration with physical processes.

But whether or not that all comes true will depend on how well companies such as Meta address the many challenges associated with AR glasses.

From Google Glass to Magic Leap to Oculus Rift, there have been numerous attempts to get wearable computers in front of your eyes. But none have changed how we interact with technology in the way their promoters imagined. Qualcomm CEO Cristiano Amon has hinted that technology heavyweights aren't done trying, though. Amon says his firm is working with Samsung and Google on mysterious new mixed reality smart glasses—but don't expect an Apple Vision Pro competitor.

In an interview with CNBC, Amon noted that the companies had agreed to work together to develop smart glasses that he describes as "mixed reality" as opposed to virtual reality. That suggests it will superimpose data and visuals on top of the real world rather than enclosing users in a virtual environment with optional passthrough video. That's the approach currently in use at Apple and Meta, which makes the most popular wearable computers.

Meta and Apple have designed their headsets with powerful processors and sharp integrated displays, which make the hardware expensive and heavy but capable of standalone operation. Amon says its unnamed smart glasses project will take a different approach, acting as an accessory for your phone.

"It’s going to be a new product, it’s going to be new experiences," said Amon. "But what I really expect to come out of this partnership, I want everyone that has a phone to go buy companion glasses to go along with it."

Qualcomm CEO discusses AI on the 'edge'

Those "new experiences" will have to be compelling, though. Truly useful smart glasses have been slow to arrive. It's difficult to balance performance and battery life in wearable devices, particularly gadgets that are supposed to remain perched on your face all day. The simpler approach hasn't been great, either. The Meta Ray-Ban smart glasses barely do anything other than play music and take grainy photos—there isn't even a display.

Snapdragon AR2

Qualcomm has already developed chips for smart glasses. Credit: Qualcomm Amon says AI will be a key aspect of the glasses, and Google is investing heavily in that technology and developing the Android operating system for phones that the glasses will have to talk to. Samsung, meanwhile, is the largest manufacturer of Android phones and a major producer of OLED panels and similar display tech that will be essential for such a product. And then there's Qualcomm, which produces some of the most efficient mobile chipsets, including the Snapdragon AR2 Gen 1 for smart glasses.

Neither Google nor Samsung have commented directly on Amon's statements. Still, Samsung mobile chief TM Roh did mention several months ago his firm would announce a new mixed-reality platform within a year. There's no guarantee this partnership will bear fruit—we may never hear about it again, or the eventual product could be a mere blip on the radar. However, this group of companies theoretically has the expertise to make a go of it.

Of everything we've seen in 2024, smart glasses are proving to be a genuine hot property. While wearables such as Samsung's Galaxy Ring are making headlines and bringing the smart ring into the limelight, smart glasses — a wearable wonderkid a decade in the making — are also beginning to come into focus.

But how do you know that a product is likely to force its way into the mainstream and become one of the next must-have devices for years to come? Well, there's market speculation from well-established analysts or a growing buzz among tech outlets. However, there's also potentially the biggest nod towards the success of any given device, the news that Apple is making one too.

Apple once sneered and derided its competitor's initial efforts at bringing smart glasses to the consumer market, but, ten years removed from the ill-fated Google Glass, the company is currently committed to releasing its own smart glasses, and it could lead to the mainstream moment this wearable has been waiting for.

Apple smart glasses: What we know

While Apple is a company well known for having any number of irons in the fire at one time, we can never say for certain that its behind-closed-curtains collection of in-the-works projects will materialize into anything that lands on store shelves.

However, when it comes to smart glasses, things are looking ever more likely to progress with *Bloomberg*'s resident Apple auteur Mark Gurman highlighting Apple's commitment to the project in his latest Power On newsletter.

iPhone 14 and Planned Obsolescence

The long-standing "Apple Glass" rumors will seemingly take their first steps into realization as Apple's Vision group continues to expand on the company's new face-worn focus that kickstarted with this year's release of the Vision Pro.

However, while the Vision Pro immediately dove into the deep end of high-tech headsets, offering one of the most premium experiences we've seen so far, Apple's first venture into smart glasses could be a much more modest matter.

Apple smart glasses: What to expect

While it's long been the rumor that Apple is looking towards developing a pair of "true" AR smart glasses, Gurman states that "true augmented reality glasses has been tabled due to technical challenges," the company's first pair of smart glasses could more clearly resemble the Meta Ray-Ban Smart Glasses, which released in October last year.

Meta's frames refine the smart glass experience by offering a Bluetooth and Wi-Fi-enabled pair of Ray-Ban's iconic Wayfarer sunglasses that offer touch capacitive controls for handling calls and music playback through open-ear speakers, housed directly within the temples of the frames.

If Apple hopes to emulate Meta's success in this market, then it's more than capable of providing a similar, if not superior, experience.

Taking this another step further, the Meta Ray-Ban smart glasses also feature a built-in ultrawide 12-megapixel camera and multi-mic system for image and video capture from the first-person perspective.

However, the cherry on top of Meta's smart glasses came with the arrival of Meta AI, which allowed hands-free access to the company's premier multi-modal AI chatbot. Wearers can interact with Meta AI through natural language prompts in a similar way to smart home assistants. Simply saying "Hey Meta..." activates the onboard assistant allowing wearers to engage with the AI.

The AI can also access the glasses' camera to comment and respond based on real-world visual inputs such as translating foreign languages, helping to choose outfits, and giving you more information on landmarks or works of art.

If Apple hopes to emulate Meta's success in this market, then it's more than capable of providing a similar, if not superior, experience.

Apple's smart glasses could draw upon the tech housed a wide range of Apple products to emulate any number of features the Ray-Ban Meta Smart Glasses offer to complete one of the most well-rounded smart glasses offerings we've seen to date.

A concept image of Apple-branded "true" AR glasses imagines how the company's smart glasses ambitions could eventually be realized. (Image credit: Apple)

Apple smart glasses: What we'd like to see

The first generation of Apple smart glasses would do well to draw inspiration from the audio excellence of the AirPod together with the iPhone's quality camera offerings while making great use of the company's all-new Apple Intelligence AI — not to mention the long-awaited AI Siri overhaul expected to release next year.

Where Apple could go one further is to double up the camera offerings, allowing wearers to capture spatial images and video in full 3D, something already implemented into iPhone 15 models.

Smart glasses also allow for various health and lifestyle tracking capabilities like those features in the Solos AirGo 3, which offers step tracking, posture reminders and correction from its built-in gyroscope, and even an optical heart rate sensor hidden inside one of its temples.

With health and fitness tracking becoming one of Apple's major focuses with the Apple Watch, it's likely that we could see the company adopt a similar approach for its smart glasses.

This would not only expand on what its smart glasses could offer wearers but also help to set the foundations of a future "all-in-one" wearable that could viably replace the iPhone once Apple figures out how best to implement displays into this product.

Will Apple smart glasses replace the iPhone?

It was 2007 when Steve Jobs took to the stage to reveal the iPhone to the world for the first time. Since then, we've seen Apple's smartphone refined, reformed, and redesigned countless times through innovation and invention.

However, over fifteen years on from this landmark announcement, we're finally staring down the barrel of a product that could eventually see the smartphone dethroned as the everyday computing companion.

Likely, this first generation of Apple smart glasses won't be the one to complete such a Herculean task, but the company's "true" AR glasses could well be the ones that pave a new path ahead for personal tech.

Even Meta CEO Mark Zuckerberg believes the eventual release of "true" AR glasses is a "Holy grail" moment in tech, and that's something he and his company are being heavily linked with showcasing as early as later this year.

That being said, Apple's first-generation smart glasses may include a cellular and Wi-Fi option, similar to its iPad and Apple Watch offerings. Thanks to the sleuths at *Patently Apple*, we already know that Tim Cook and Co. are exploring how best to outfit its future glasses with cellular antennas.

While it's unlikely that anyone will be ditching their iPhone for this first-generation device, it seems highly likely that it will be available as a stand-alone device of its own, and not brought to market as an accessory that is iPhone dependent. As for how future iterations are adopted, especially "true" AR glasses, that remains to be seen.

When can we expect them?

With so much potential to be found in Apple's upcoming smart glasses, it's only natural to want to know when we can expect them to release.

While we can't say for certain they will, insiders and analysts believe they're on their way, with the reputable Ming-Chu Kuo believing that a 2026 release date is possible, with Metalens production likely allowing for Apple to chase its "true" AR glasses dream further down the line.

An even more positive prediction comes again from *Blomberg*'s Mark Gurman, who believes we could see Apple's smart glasses arrive by the end of 2025.

Of course, these dates should be taken with a healthy amount of salt, as Apple is no stranger to abandoning projects or delaying them until they're completely satisfied with the end result.

However, with a more stripped-back approach to its smart glasses on the cards, leaving AR out of the equation for the time being, it's very likely that Apple can follow through on its ambitions in a faster manner and capitalize on the growing popularity that this form of wearable has to offer.

What are smart glasses? Yesteryear's 'next big thing' is finally finding an audience

published July 10, 2024

An eyewear revolution you don't want to miss out on

(Image credit: Laptop Mag / Rael Hornby)

Wearable tech has become commonplace in the digital age as everything from watches to rings receive 'smart' overhauls that unlock a slew of new functions for familiar forms, from tracking health metrics to more conveniently interacting with other devices. However, while we can all recognize an Apple Watch, we may be less familiar with other forms of wearable — particularly, smart glasses.

There's good reason for such oversight too. On their initial release into the wilds of the commercial market, smart glasses were more prone to jeers and jibes than shock and awe.

As a glasses wearer, it's plainly obvious to me that my regular frames are bursting with untapped potential.

While the tech was impressive, they were often seen as little more than an expensive status symbol for the tech-obsessed, and a genuine threat to the privacy of anyone not positioned behind their lenses. However, as times have changed, so too have attitudes, and a smart glasses renaissance could be primed to explode in popularity in the very near future.

What makes smart glasses important? Well, when it comes to finding a wearable that can do it all, the answer for many of us is right in front of our faces. Literally. While glasses have helped correct vision for centuries, their form and position on the body make them ideal for providing visual and audio feedback in the most unobtrusive and accessible way possible.

I'm a huge proponent of smart glasses and have been for some time now. As a glasses wearer, it's plainly obvious to me that my regular frames are bursting with untapped potential — and several of my experiments with smart glasses have shown me that they're more than capable of housing all kinds of wonderful tech too.

So, let's take a deeper look at what smart glasses are and some of the frames we'd recommend you become familiar with.

Smart glasses like the XREAL Air 2 AR Glasses are face-worn displays that can project 100-inch virtual screens in front of users. (Image credit: Laptop Mag / Rael Hornby)

What are smart glasses?

Smart glasses, like regular glasses, are face-worn eyewear that can not only help correct vision but also offer additional functionality. They can interact with your other smart devices and computers or work stand-alone to provide media playback, activity tracking, and more.

Although they've been around since 2004, they're only truly beginning to make their presence known in the mainstream.

Why check your phone for notifications when you can be alerted through a heads-up display (HUD)? Why rely on physical screens when you can project content directly in front of your eyes and all around you with augmented reality (AR)? And why let a phone call interrupt you when you can use your smart glasses to receive calls completely hands-free?

Smart glasses offer a new way of being connected to your favorite tech. Although they've been around since 2004, they're only truly beginning to make their presence known in the mainstream. While Google tried its hand at the format in 2014, a generally negative reaction to its camera-adorning frames set the consumer viability of these devices back for some time.

However, consumer attitudes have started to shift. Despite several high-profile flops, wearables are now commonplace (remember, Google Glass was unveiled even before the very first Apple Watch launched), smart glasses sales are currently predicted to double year-over-year, Meta's latest smart glasses have proven to be a surprise success, and the growing popularity of AR and AI has given the smart glasses form factor rejuvenated use cases — even Apple is pondering making pair of smart glasses of its own according to one *Bloomberg* report.

The market is now more welcoming than ever to wearables of this sort, with smart glasses morphing into a much more attractive prospect due to the many useful features and capabilities they can offer.

Ray-Ban Meta's smart glasses are better suited to media capture and audio playback, syncing with a smartphone instead of housing its own display. (Image credit: Future)

What types of smart glasses are there?

While smart glasses aren't exactly commonplace, there are a considerable number of manufacturers dedicated to designing frames that offer all kinds of advanced functions.

Because of this, there's no universal example of what a pair of smart glasses must include to be considered as such. However, a majority of smart glasses fall within one or more of the following categories:

- **Smart glasses for media capture:** Mirroring the spy glasses of espionage novels, but hopefully not abused for creepshot potential, some devices like the Ray-Ban Meta smart glasses use built-in microphones and cameras to capture images and video from a first-person point of view.

These frames are great for those looking to capture some social media snaps, though you'll need a mirror handy if you're interested in taking the perfect selfie.

- **Smart glasses for communication:** One of the more basic smart glasses variants are those designed to replace hands-free headsets for inbound and outbound phone calls.

  While they lack any of the more fancy display or AR/XR capabilities of premium models, these smart glasses are generally much more affordable and offer built-in microphones and open-ear audio for music playback and call handling.

- **Smart glasses for AI:** Tech's latest craze is undoubtedly AI, and there's a push to infuse large language models (LLMs) into just about every product there is. However, when it comes to smart glasses, there may be no better home for a super-intelligent assistant.

  With multi-modal AI models now fairly common, smart glasses like the Solos AirGo 3 and AirGo Vision offer unique ways to use AI to interact with the world around you using contextual voice, text, and visual information.

- **Smart glasses for AR/XR:** Augmented (or mixed) reality glasses are among the more expensive options on the market. They provide a virtual display for mobile and desktop devices.

  AR smart glasses like the XREAL Air 2 and VITURE Pro XR are also equipped with head tracking sensors capable of providing 3DoF (Three Degrees of Freedom) to floating AR windows. With the right accessories, glasses like these can also offer 6DoF tracking similar to Meta Quest 3 and Apple Vision Pro headsets.

Frames like the Solos AirGo3 Smart Glasses allow for instant access to ChatGPT via a discrete action button linked to a mobile app. (Image credit: Laptop Mag / Rael Hornby)

Outlook: Are smart glasses the future?

Call me biased, but as I sit here wearing a pair of smart glasses myself, I can say with certainty that these devices are incredibly useful and packed with potential. A pair of lightweight AR glasses can turn a simple laptop into a multi-screen workstation, while others give you instant access to some of the most powerful AI models for real-time assistance.

While several of the more popular AR models excel at delivering compelling entertainment experiences in 2D and 3D media, the potential of smart glasses isn't limited to the living room.

Call me biased, but as I sit here wearing a pair of smart glasses myself, I can say with certainty that these devices are incredibly useful and packed with potential.

As the display tech evolves and software improves, smart glasses will offer more compelling visual aids for navigation, offer real-time visual translation of languages, and adopt hand tracking for more advanced interactions with richer interfaces and AR elements. We're already seeing the latter take shape with XREAL's latest Air 2 Ultra glasses. The potential for this tech is unrivaled among its wearable contemporaries, and we're even beginning to see screenless AR laptops outfitted with smart glasses enter the market — fully banking on the future of spatial computing.

Are smart glasses a guarantee to take the tech world by storm? Well, that's not so easy to say. Sometimes, even the best ideas don't catch on. However, as the buzz around these devices grows, along with their capabilities and performance, I'd personally say that spatial computing in all of its forms is here to stay, and smart glasses are the best and most obvious way for it to thrive.

Google Glass 2.0: A smart glasses comeback that's long overdue

published May 16, 2024

Is Google reviving a cult Glassic?

(Image credit: Google)

Remember Google Glass? It's OK if you don't. Despite promising to be the dawn of augmented reality and a grand leap forward for wearable tech, Google's smart glasses went out of fashion faster than the Vuvuzela (you'll likely have to Google that one).

However, Google's dream of delivering AR smart glasses to market might not be as dead in the water as we once thought — and the recently revealed Project Astra may be our best look to date at how it's looking to make that dream a reality.
A video released by Google to coincide with Google I/O titled *Project Astra: Our vision for the future of AI assistants*, showcases an AI agent, powered by Google's multimodal Gemini AI model, running on both a Pixel phone and a similar pair of prototype smart glasses to the ones last seen in a 2022 YouTube video titled *Breaking down language barriers with augmented reality*.
As a genuine backer of smart glasses, and someone who has been lucky enough to review several pairs of the best options on the market, my heart leapt into my mouth when this was revealed. Is there still hope for a Google Glass revival?

The untimely demise of Google Glass

The world of tech is a very strange place. As an industry ceaselessly in the process of invention, innovation, and something else beginning with "i" to follow the rule of three, the tech landscape is in a never-ending state of evolution.

New ideas are constantly being toyed with and tested behind closed doors, and sometimes, not often, but sometimes, a company will eagerly show the world what it's been hard at work on, only to find out that the world was not equipped to deal with what it had to show or was proposing.

Such a thing happened in 2013, and so begins the story of Google Glass.

While not the first to develop a pair of consumer smart glasses, Google's were among the most ambitious — offering hands-free control of a voice-activated augmented reality display for the startling price of $1,500 (~$2,000 in today's money adjusted for inflation).

Google Glass was so ahead of its time that I'm amazed the simple folk of 2013 didn't burn Google at the stake for witchcraft. (Image credit: Google)

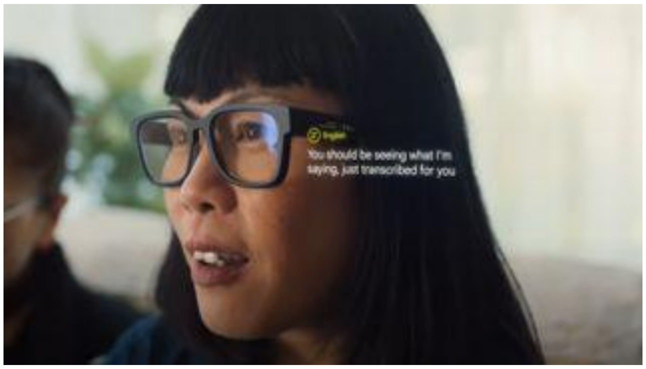
However, in a move that seems incredibly hard to fathom after adjusting to life in 2024, the quaint folk of 2013 were outraged over the fact that Google Glass was outfitted with a built-in camera. Many feared for their privacy (a fear we seem to have completely grown out of just over a decade later), believing it could be used to secretly record them. It was even banned from use in certain public spaces.

The outrage spawned the term "Glassholes," a pejorative used against anyone rude enough to wear Google's smart glasses out in public spaces. They were mercilessly shamed for adopting this tech, as was Google, who eventually pulled their futuristic frames from public sale in 2015 and repositioned them as enterprise devices until shutting up shop altogether last year.

Google Glass: A long-rumored return

Of course, within that time, humanity collectively stopped caring about its privacy. Now we're mostly a collective of extroverted lens lovers who wouldn't blink twice at an IRL streamer wandering the streets, waving their camera around with reckless abandon.

Even still, Google was once bitten and twice shy when potentially stepping back into the consumer market. The following years were a constant back and forth of will-they-won't-they rumors anticipating a Google Glass 2.0 follow-up — especially when more companies went down the smart glasses route without so much as a mild murmur in their direction.



When we saw Google Glass next, it was primarily showcased as a translation tool. (Image credit: Google)

It was 2022 before we saw anything concrete surrounding Google's continued smart glasses intentions with our first look at a prototype pair of next-gen smart glasses. But even then they'd dropped the built-in camera for an audio-only approach to its wearable. Then, after Apple announced the Vision Pro in June 2023 Google reportedly ditched its Glass plans again.

Even Google's Senior Director of Engineering for XR and AR projects at the time walked from the project and the company, taking to Twitter (now X) to state his key reasons for leaving being "recent changes in AR leadership and Google's unstable commitment and vision have weighed heavily on my decision."

At this stage, it was seemingly all over (again). That is, until October 2023, when code was spotted within the Google app for Android that pointed towards "Iris," one of the project names believed to be associated with a Google Glass follow-up.

This brings us right the way around to this year's Google I/O, and Project Astra.

Project Astra: The Glass is half full

So what are the chances that Google is giving us a hint at things to come with its Astra video? Well, not zero.

While there have been reports that Google was planning to focus solely on software, developing an AR platform for OEMs to make use of in their own hardware (something desperately needed for current smart glasses manufacturers to take the next step toward the mainstream) Google I/O did see co-founder Sergey Brin hinting at augmented-reality glasses making a return with the help of AI, which is exactly what the Project Astra video showcased.

Whether or not this means Google is officially back in the smart glasses business remains to be seen. But it does leave the doors wide open if it should decide to do so. As the now-dormant Google Glass website states: "The journey doesn't end here."

AR Smart glasses are everything the Vision Pro should have been

By Rael Hornby

published April 23, 2024

Mark my words, smart glasses are the future

When you purchase through links on our site, we may earn an affiliate commission. Here's how it works.

(Image credit: Laptop Mag / Rael Hornby)

Apple's Vision Pro was supposed to be a game changer, a harbinger of spatial computing. It housed the most cutting-edge tech, was made from the most premium of materials, and was designed to operate in total harmony with the wider Apple ecosystem. That's why it was such an overwhelming success, and, to this day, hailed as one of Apple's most successful product launches of all time.

Except it wasn't.

Apple Vision Pro: A fate sealed with a K.I.S.S.

Keep it simple, stupid (KISS) is a design principle and acronym that pushes for products and systems to avoid complexity wherever possible. This is an especially good design mentality to have when you want to introduce something new to a larger audience, as it gives them far less to have to adapt to.

Apple managed this pretty well for devices like the iPod, iPhone, and iPad. To use them, you simply turn them on and tap. Sure, further features require a little more know-how and these systems evolved in complexity over time, but the general usage is simple.

Seeking to introduce a new type of product to a wider audience, Apple designed its Vision Pro with the same ease of use in mind. Subtle finger gestures allow you to interact with the "spatial computing" environment around you, with the very direction of your pupils serving as a pointer of sorts.

The Apple Vision Pro's weight proved to be an issue for many users post-release. If only they'd have listened well in advance... (Image credit: Laptop Mag / Rael Hornby)

That's pretty simple and pretty intuitive. However, tack onto this the need to scan your face to build a digital clone of yourself, calibrate your own fingers to engage in awkward zero-feedback interactions, control everything via gesticulation that leaves you looking like you're attending the most low-energy rave mankind ever bore witness to, and then having to head on over to Reddit for medical opinions on how to strengthen your neck muscles enough to wear this behemoth without developing scoliosis, and you're beginning to push at the boundaries of how simple and intuitive things really are.

It's just a lot to throw at somebody at once. It's a whole new medium, method of interaction, and an entirely different type of wearable (that isn't all that wearable). By the time you get to the Vision Pro's weak selection of proprietary apps and its $3,500 price tag, it's very hard not to see this thing as a supremely over-specced stereoscopic View-Master.

Sadly, we're just a little too early on into this tech's life cycle and there's nothing else out there to provide a simpler, affordable, and more comfortable all-day AR experience.

Except there is.

Enter, eyewear 2.0: The smart glasses revolution you aren't paying attention to

If you haven't heard, smart glasses are the next big thing. Says who? Says me, dear reader. That's who. What do I know? Well, actually, a fair bit.

I've been wearing smart glasses of various forms for over six months now. While I can confirm I'm basically as cognitively defunct as I was before putting them on, I can say there's genuine promise when it comes to eyewear 2.0 technology.

They're lightweight, easy to use, stay completely cool, and (generally speaking) completely unobtrusive. Plus, you don't have to walk around with a pair of digital googly eyes plastered to the front of your face.

While many people were slowly coming to grips with the fact that I was right when I said that there's no way anyone is wearing the Vision Pro for a full day's work, I was busy saying my farewells to the flat screen and using AR Glasses to replace my monitors.

Solos' AirGo3 Smart Glasses have ChatGPT built-in, giving you one touch access to the world's most popular AI chatbot. (Image credit: Laptop Mag / Rael Hornby)

I even switched out my regular eyewear for a pair of Solos AirGo 3 Smart Glasses, and by switched out, I mean I've yet to return to my regular old spectacles 1.0 lifestyle. And why would I? Thanks to Solos' smart glasses I now have the power of ChatGPT perched atop my face at all times. I'm practically a demigod.

When it comes to entertainment I can always switch over to AR glasses, enjoying a 120-inch projection of a display anywhere at any time with impressive open-ear audio for more natural immersion. Typically all this requires is connecting a cable and I'm good to go.

While I might have eventually returned to monitors, I did so begrudgingly and only because I needed to perform a lot of multitasking that the software powering these augmented eyeglasses wasn't quite capable of yet. Sadly, this goes to show that even your favorite tech has its limitations, and I'm forced to twiddle my thumbs while I wait for a more ideal solution to present itself.

Except it has.

Rokid's AR Lite spatial computing suite: The smart glasses combo you didn't know you needed

I'll forgive Rokid for adopting the spatial computing Apple marketing slang, but only because it has just announced the smart glasses product I've been banking on.

Rokid's AR Lite is a bundle of two new products: the ultra-lightweight Rokid Max 2 AR smart glasses and the Rokid Station 2 host unit—an easy to operate touch interface that uses the proprietary YodaOS-Master spatial operating system to power expanded AR functions.

The Rokid AR Lite Suite offers multiscreen multitasking all in augmented reality across virtual screens up to 300-inches in size. (Image credit: Rokid)

It's those AR improvements that change everything for the Rokid Max 2, with the new AR lite suite combining to provide **multi-screen support for AR windows** up to **300-inches** in size, **picture stabilization** for use while on the go or in a moving vehicle, **wireless multi-platform screen casting** to spatial windows, and **expanded Bluetooth connectivity** for external peripherals alongside **100GB of free cloud storage** that unshackles you from the confines of your dreary desk throughout your 9-to-5 misery—especially when taking into account the host unit's **5,000mAh battery**.

Not only that, those "spatial computing" capabilities are backed by the Rokid Max 2 smart glasses already impressive features like **non-destructive Diopter adjustment** (0.00D to -6.00D), which sounds fancy, but is actually a set of in-frame dials to tune-in the display to suit near-sighted users without the need for prescription lenses.

The AR Lite Suite's Rokid Station 2 host unit can be controlled through simple touch gestures, or held in the hand and used as a controller-like pointer device. (Image credit: Rokid)

As a stand-alone set of smart glasses the lightweight (just 75 grams) Rokid Max 2 can also deliver a **300-inch**, **FHD**, **TÜV Rheinland-approved eye-friendly display** at **600 nits** of peak brightness, at 1200p resolution with a **90Hz refresh rate.** Then there's the built-in **HiFI-level open-ear audio** that leaves you free to engage with the environment around you in complete comfort without skipping out on immersion for your chosen media.

Outlook

As one of the latest and more promising wearable options, smart glasses are becoming better and better all of the time. Rokid's AR Lite Suite is just the most recent example of this, and highly unlikely to be the last.

This tech is destined for big things, and you can bet your bottom dollar that Apple, Meta, and more all have their sights set on condensing VR/AR headsets into this form factor as soon as it's humanly possible to do so.

In the meantime, Rokid's AR Lite Suite will be available direct from the Rokid website following the coming launch of its Kickstarter.

AI glasses could be the next big trend

AI glasses are expected to be the next big hit shortly with almost everyone wishing to own a pair of the set on the back of their abilities, reports say.

Combining capabilities ranging from AI voice assistant with AR holographic visuals and other features and functionalities of Bluetooth earbuds, having a pair of these glasses, according to Compute World, will make one feel special, like they know everything and are constantly aided by AI.

AI glasses to bring Sci-Fi to reality

In one of his movies, Mission Impossible Dead Reckoning 1, Tom Cruise, who plays the character of Ethan Hunt, wears augmented AI-powered glasses to aid his fight against the bad guys.

If global technology giants' plans materialize, similar devices may be part of our daily lives, as there is an emerging race of companies rushing to capture the AI-powered glasses market.

According to reports, Snap Incorporated, an American company that manufactures futuristic eyewear, and Meta, one of the biggest investors in the metaverse, are both preparing to launch AI-powered glasses soon.

Although both companies have kept any insights into the products under lock and key, it is suspected that these products may be a few weeks away and expected to be a hit.

Meta is expected to unveil their *Orion* glasses at the Connect Conference, scheduled for September 25 and 26.

Deep brain stimulation may provide immediate improvement in arm and hand strength and function weakened by traumatic brain injury or stroke, University of Pittsburgh School of Medicine researchers report today in *Nature Communications*.

Encouraging results from extensive tests in monkeys and humans open a path for a new clinical application of an already widely used brain stimulation technology and offer insights into neural mechanisms underlying movement deficits caused by brain injury.

"Arm and hand paralysis significantly impacts the quality of life of millions of people worldwide," said senior and corresponding author Elvira Pirondini, Ph.D., assistant professor of physical medicine and rehabilitation at Pitt. "Currently, we don't have effective solutions for patients who suffered a stroke or traumatic brain injury, but there is a growing interest in the use of neurotechnologies that stimulate the brain to improve upper-limb motor functions."

Brain lesions caused by serious brain trauma or stroke can disrupt neural connections between the motor cortex, a key brain region essential for controlling voluntary movement, and the muscles. Weakening of these connections prevents effective activation of muscles and results in movement deficits, including partial or complete arm and hand paralysis.

To boost the activation of existing but weakened connections, researchers proposed using deep brain stimulation (DBS), a surgical procedure that involves placing tiny electrodes in specific areas of the brain to deliver electrical impulses that regulate abnormal brain activity. Over the past several decades, DBS has revolutionized the treatment of neurological conditions such as Parkinson's disease by providing a way to control symptoms that were once difficult to manage with medication alone.

"DBS has been life-changing for many patients. Now, thanks to ongoing advancements in the safety and precision of these devices, DBS is being explored as a promising option for helping stroke survivors recover their motor functions," said senior author and surgical leader of the project, Jorge González-Martínez, M.D., Ph.D., professor and vice-chair of neurosurgery and director of the epilepsy and movement disorders program at Pitt. "It offers new hope to millions of people worldwide."

Taking cues from another successful Pitt project that used electrical stimulation of the spinal cord to restore arm function in individuals affected by stroke, scientists hypothesized that stimulating the motor thalamus—a structure nested deep in the brain that acts as a key relay hub of movement control—using DBS could help restore movements that are essential for tasks of daily living, such as object grasping.

However, because the theory has not been tested before, they first had to test it in monkeys, which are the only animals that have the same organization of the connections between the motor cortex and the muscles as humans.

To understand the mechanism of how DBS of the motor thalamus helps improve voluntary arm movement and to finesse the specific location of the implant and the optimal stimulation frequency, researchers implanted the FDA-approved stimulation device into monkeys that had brain lesions affecting how effectively they could use their hands.

As soon as the stimulation was turned on, it significantly improved activation of muscles and grip force. Importantly, no involuntary movement was observed.

To verify that the procedure could benefit humans, the same stimulation parameters were used in a patient who was set to undergo DBS implantation into the motor thalamus to help with arm tremors caused by brain injury from a serious motor vehicle accident that resulted in severe paralysis in both arms.

As soon as the stimulation was turned on again, the range and strength of arm motion was immediately improved. The participant was able to lift a moderately heavy weight and reach, grasp and lift a drinking cup more efficiently and smoothly than without the stimulation.

To help bring this technology to more patients in the clinic, researchers are now working to test the long-term effects of DBS and determine whether chronic stimulation could further improve arm and hand function in individuals affected by traumatic brain injury or stroke.

Other authors of this research are Jonathan Ho, B.S., Erinn Grigsby, Ph.D., Arianna Damiani, M.S., Lucy Liang, M.S., Josep-Maria Balaguer, M.S., Sridula Kallakuri, Lilly Tang, B.S., Jessica Barrios-Martinez, M.D., Vahagn Karapetyan, M.D., Ph.D., Daryl Fields, M.D., Ph.D., Peter Gerszten, M.D., T. Kevin Hitchens, Ph.D., M.B.A., Theodora Constantine, P.A.-C., Gregory Adams, B.S., Donald Crammond, Ph.D., and Marco Capogrosso, Ph.D., all of Pitt.

More information: *Nature Communications* (2024). DOI: 10.1038/s41467-024-52477-1. www.nature.com/articles/s41467-024-52477-1

Brain-Computer Interfaces©Image Credit: Kohji Asakawa from Pixabay

These devices let brains talk directly to computers. They could help paralyzed people move again or let us control machines with our thoughts. Some companies are already testing early versions. By 2030, they might be helping people with disabilities and changing how we all use technology.

Ever wish you could memorize every detail? Colleague's outfit? Neighborhood cat's meows? Newsflash: It's a memory meltdown waiting to happen!

Your brain, like a digital detoxing device, declutters by forgetting. Not a weakness, but a well-being weapon! Dive into the surprising science of remembering... less.

As Dubai-based neuropsychiatrist Nadia Khan explains, “Forgetting actually helps us focus on what matters now. We don’t carried away with every detail from the past. And so, with a little help from forgetting, we can actually adjust to different situations with agility. You can also see it as prioritising tasks on your list; you deal with the relevant ones first,” she says.

Neurological housekeeping

Research indicates that, at least in some cases, forgetting is due to “altered memory access” rather than memory loss. Image Credit: Shutterstock
As Khan explains, our brain is wired to optimise memory storage. It’s not intended to carry every detail. This complex, dynamic process of forgetting actually allows us to rid ourselves of outdated information. It makes room for learning and experiences. This kind of neurological housekeeping enhances our ability to process the present better. “As a result, we make healthier decisions that actually benefit our well-being,” she says.

Needless to say, forgetting usually comes at the cost of information, but research indicates that, at least in some cases, forgetting is due to “altered memory access” rather than memory loss.

So, how does this work? Well, it comes down to the neurons. The international journal, Nature Reviews Neuroscience, explained the complicated neuron activity that goes on, during the process of forgetting and recalling. In the study, the researchers examined the unique ensemble of neurons called “engram cells”. When we recall a memory, these cells fire collectively, and our memory surges. However, what happens when we forget?

As the researchers explain, forgetting doesn’t necessarily mean that the memory is gone. Instead, it proposes that these engram cells become inaccessible. However, this “inaccessibility”, is actually an active process.

It’s not a passive decay, as the researchers emphasise. In fact, our brain actively remodels the memory circuits, making specific engram cells harder to access based on the environmental factors. And so, in certain environments, it’s not completely essential to hold on to every detail. When we forget, we actually focus on what’s important.

The research highlights that while natural forgetting is generally a necessary process, it could potentially be reversed in certain situations. However, in the case of severe diseases like Alzheimer’s, the natural mechanisms are ‘hijacked’, leading to excessive forgetting and memory loss. These new findings could open up avenues for research into how to restore healthy forgetting processes and treat memory loss in diseases like Alzheimer’s.

Forgetting: An active part of learning

In order to update your memory, your brain does a little clever forgetting. It provides more clarity to decision-making. Image Credit: Shutterstock
Forgetting could just be an ally in learning and mastery, if done right.

According to the 2023 study published in the US-based scientific journal Cell Reports titled Adaptive expression of engrams by retroactive interference, researchers studied how forgetting things is actually an active part of learning and memory maintenance. In fact, it is actually an active process that involves neural plasticity. This helps in modulating the functionality of specific memories.

In simpler words, in order to update your memory, your brain does a little clever forgetting. It provides more clarity to decision-making.

Forgetting is an important part of the learning process, says Dubai-based neuropsychiatrist, Anne Thomas. It helps the brain to sort, separate crucial information from all the details. In this day and age of excessive information overload, this particular filtering process is essential, says Khan. In order to retrieve information that is relevant and appropriate, we forget the unwanted and irrelevant information.

How to revive dormant memories

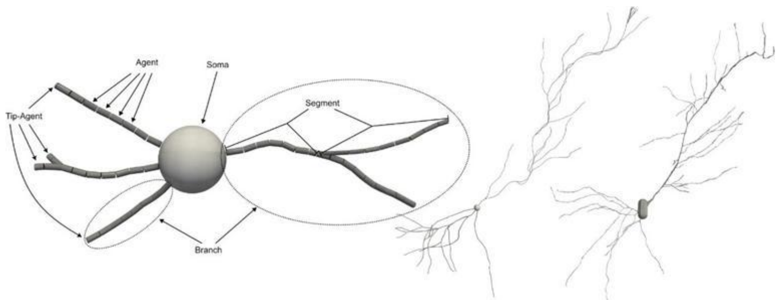
These forgotten memories still exist; they haven't been wiped out, as the Cell Reports study explains. They just become dormant. As Thomas explains with an example: For instance, you can't remember someone's name. Yet, when they re-introduce themselves, you realise that you knew it all along.

Your brain is playing a clever trick, there. "These forgotten memories aren't actually gone," explains Thomas, elaborating on the process of 'recognition' and 'recall'. So, when you see a familiar face, you recognise the familiarity, even if you're not able to recall the name. It's kind of like your brain getting a hint. You just take time to recall the name.

And so, in order to "revive" dormant memories, you need to review what you had previously learned, explains Thomas. For example, if you studied the previous night, and slept on time, the next morning, do a quick review of what you read. According to a 2016 study, titled Relearn Faster and Retain Longer published in US-based Academic journal Psychological Science, people who studied before bed, slept, and then later did review the next morning not only spent less time studying, they also increased their long-term retention memory by 50 percent. "A good rest does help your brain in filing away what you learned, and it also makes the information easier to access," explains Khan.

The brain needs to keep learning and adapting, she says. Learning and forgetting is a deeply inter-linked process. If you learn something, you need to keep reviewing it, to keep it in your memory. You need to keep revisiting it as well, so that the process of retrieval becomes easier.

This also helps you strengthen important memories through reviewing and tests, you make the important ones far more accessible, adds Khan. "Your brain needs to keep forging connections and building new pathways. 'Forgetting' old connections forces your brain to create new ones, keeping it flexible and adaptable," she says.



3D Mechanistic ABM for neuronal growth. Panel a shows the agent-based discretization and the early stage of a neuron simulation (pyramidal cell). The center is the spherical soma (cell body). The dendrites are discretized with small, cylindrical agents. Typically, the tips drive the growth (Shree et al. 2022); hence, we differentiate between the general and tip agents. The agents define a tree-like structure with different segments and branches. b Pyramidal cell at the end of the simulation. c Experimental pyramidal cell in the mouse hippocampus observed by Benavides-Piccione et al. (2019) (NMO_147071). Credit: Journal of Mathematical Biology (2024). DOI: 10.1007/s00285-024-02144-2

A new computer simulation of how our brains develop and grow neurons has been built by scientists from the University of Surrey. Along with improving our understanding of how the brain works, researchers hope that the models will contribute to neurodegenerative disease research and, someday, stem cell research that helps regenerate brain tissue.

The research has been published in the *Journal of Mathematical Biology*.

The research team used a technique called Approximate Bayesian Computation (ABC), which helps fine-tune the model by comparing the simulation with real neuron growth. This process ensures that the artificial brain accurately reflects how neurons grow and form connections in real life.

The simulation was tested using neurons from the hippocampus—a critical region of the brain involved in memory retention. The team found that their system successfully mimicked the growth patterns of real hippocampal neurons, showing the potential of this technology to simulate brain development in fine detail.

Dr. Roman Bauer from the University of Surrey's School of Computer Science and Electronic Engineering said, "How our brain works is still one of the greatest mysteries in science. With this simulation, and the rapid advancements in artificial intelligence, we're getting closer to understanding how neurons grow and communicate. We hope that one day this work could lead to better treatments for devastating diseases like Alzheimer's or Parkinson's—changing lives for millions."

The accuracy of the model is closely tied to the quality of the data used to calibrate it. If the real-life neuron data is limited or incomplete, the precision of the simulation may decrease. While the current model has shown impressive results in replicating the growth of specific neurons, such as hippocampal pyramidal cells, further adjustments may be needed to accurately simulate other types of neurons or regions of the brain.

The computer simulation is built from the BioDynaMo software, which Dr. Bauer co-developed. The software supports scientists to easily create, run, and visualize multi-dimensional agent-based simulations, be they biological, sociological, ecological or financial.

More information: Tobias Duswald et al, Calibration of stochastic, agent-based neuron growth models with approximate Bayesian computation, *Journal of Mathematical Biology* (2024). DOI: 10.1007/s00285-024-02144-2

Provided by University of Surrey

Potential breakthrough as scientists claim two people communicated in their DREAMS in world first

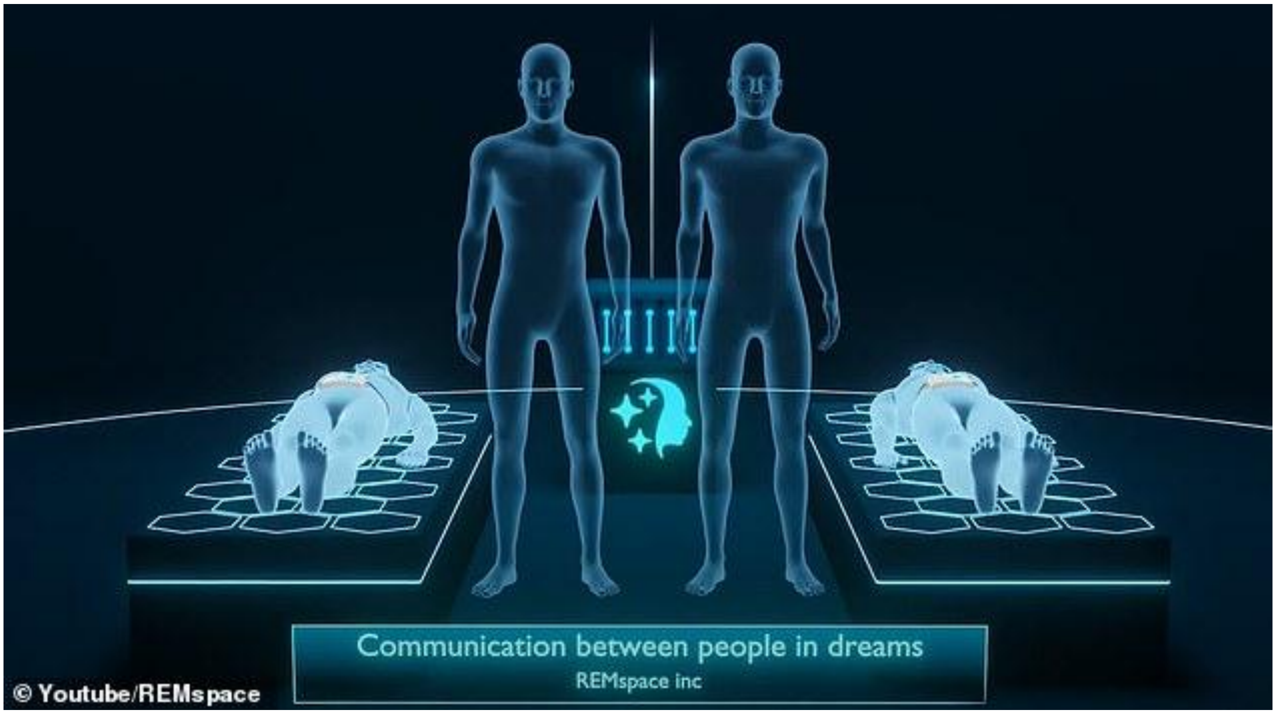
- **READ MORE: These three tricks could allow you to try lucid dreaming**

By ELLYN LAPOINTE FOR DAILYMAIL.COM

Scientists have brought science fiction one step closer to reality by achieving the first two-way communication between individuals during **lucid dreaming**.
In an experiment that sounds like a scene out of the movie 'Inception,' REMspace - a California-based startup that designs technology to enhance sleep and lucid dreaming - reportedly exchanged a message between two people who were asleep.

The company used 'specially designed equipment' which included a 'server,' an 'apparatus,' 'Wifi' and 'sensors,' but did not specify the exact technology they used.

The study participants were asleep in separate homes when REMspace researchers beamed a word created through a unique language between them.



A neurotech company claims to have achieved the first two-way communication between individuals during lucid dreaming

REMspace CEO and founder Michael Raduga said: 'Yesterday, communicating in dreams seemed like science fiction.

'Tomorrow, it will be so common we won't be able to imagine our lives without this technology.

'This opens the door to countless commercial applications, reshaping how we think about communication and interaction in the dream world.'

The technology has yet to be reviewed or replicated by scientists. But if validated, it would be a major milestone for sleep research and could provide applications for mental health treatment, skills training and more, REMspace said.

REMspace used 'specially designed equipment' to allow two individuals to successfully exchange a simple message while lucid dreaming, the company claimed.

Lucid dreaming is when a person is aware they are dreaming while still in the dream state.

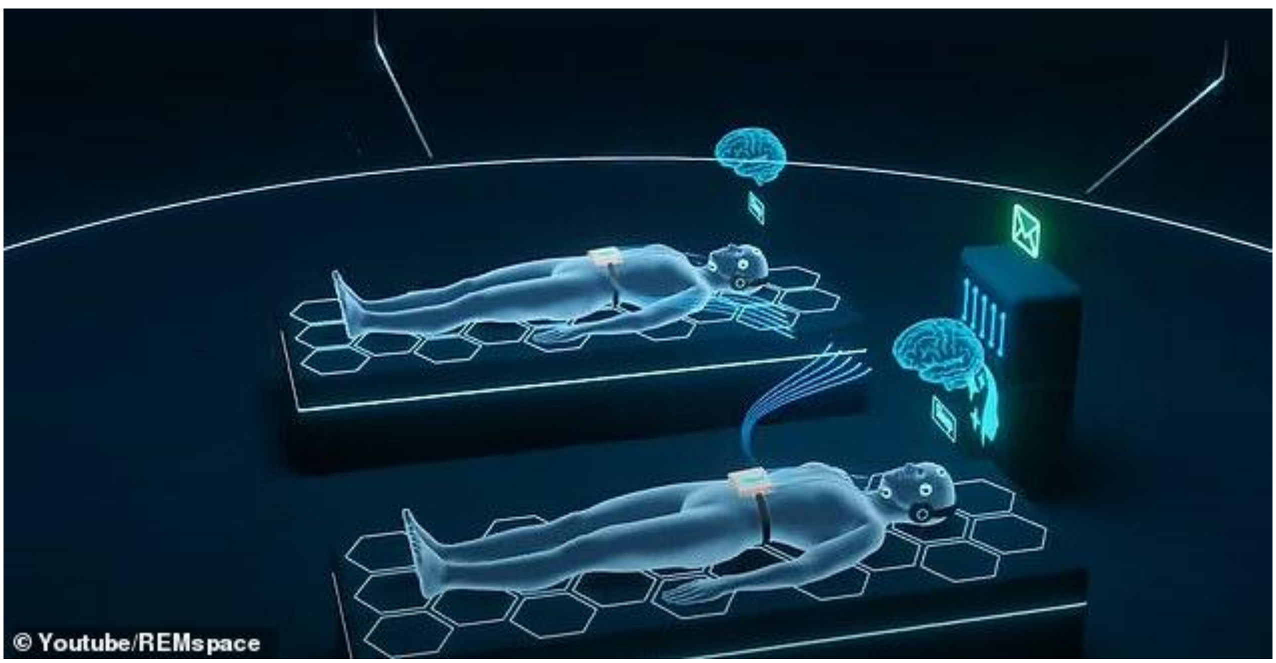
This allows them to perform self-directed actions in their dreams, rather than randomly interacting with the 'dream world' without any sense of control.

This phenomenon happens during REM sleep, or Rapid Eye Movement sleep, when dreaming typically occurs.

REMspace has not revealed exactly what equipment was used in their experiment, but said the experiment involved an 'apparatus' that tracked participants brain waves and other biological data during the experiment.

It also involved a 'server' that can detect when participants enter a lucid dream and generate messages that are transmitted to them.

Two study participants slept in separate homes while their brain waves were remotely tracked by the apparatus, which fed data into the server.



Two study participants slept in their homes while their brain waves were remotely tracked by the apparatus, which fed data into the server

Once the server detected that one participant had entered a lucid dream, it generated a random word and transmitted it to him via earbuds

Eight minutes later, the second participant entered a lucid dream. The server transmitted the stored message from the first participant to her, which she repeated upon awakening

Once the server detected that one participant had entered a lucid dream, it generated a random word from the special language and transmitted it to him via earbuds.

The participant then repeated this word in his dream, and that response was captured and stored in the server.

Eight minutes later, the second participant entered a lucid dream. The server transmitted the stored message from the first participant to her, which she repeated upon awakening.

REMspace was able to repeat this experiment with another pair of participants. But the study will need to undergo rigorous review before the company can definitively say that they achieved dream communication.

Raduga, who is confident about their results, is widely known for his ambitious - and sometimes bizarre - experiments.

Real-life Inception headband lets you control your dreams - but experts fear zapping the brain with $2,000 device could hinder cognitive abilities during waking hours

- **The Halo AI headband uses high-frequency sound to create lucid dreams**
- **Experts warn that lucid dreams could cause heightened stress**
- **READ MORE: The 10 most common dreams and what they mean**

By NIKKI MAIN SCIENCE REPORTER FOR DAILYMAIL.COM
PUBLISHED: 17:37 EDT, 5 February 2024 | **UPDATED:** 17:37 EDT, 5 February 2024

An **AI** tech startup wants you to trade in regular dreams for a headband that lets you control your nighttime wanderings in a lucid dreamlike state.

Prophetic is releasing the $2,000 Halo AI headband in 2025, which will give wearers unparalleled control over their dreams that could help users grapple with existing problems they're facing in their waking lives.

The headband uses electroencephalography (EEG), which records electrical activity in the brain, and functional magnetic resonance imaging (fMRI) which measures brain activity by measuring the blood flow.

The video player is currently playing an ad.
However, experts aren't yet sure what the long-term effects could be and warn that using high-frequency sounds to zap your brain, could hinder our cognitive ability to process short-term memories.

The Halo AI headband uses EEG and fMRI data to create lucid dreams while you sleep

Experts fear lucid dreams could have negative long-term effects including causing heightened levels of stress and anxiety

'We are very rarely lucid in our dreams. And not being lucid may be part of, or required, for any effective function of dreams,' Professor Mark Blagrove, a sleep and dream researcher based at the Swansea University Sleep Laboratory, told **Science Focus**.

The EEG and fMRI work together to create a detailed map of the brain to induce lucid dreams which is a state of dreaming where the person is aware they are in a dream while they are sleeping.

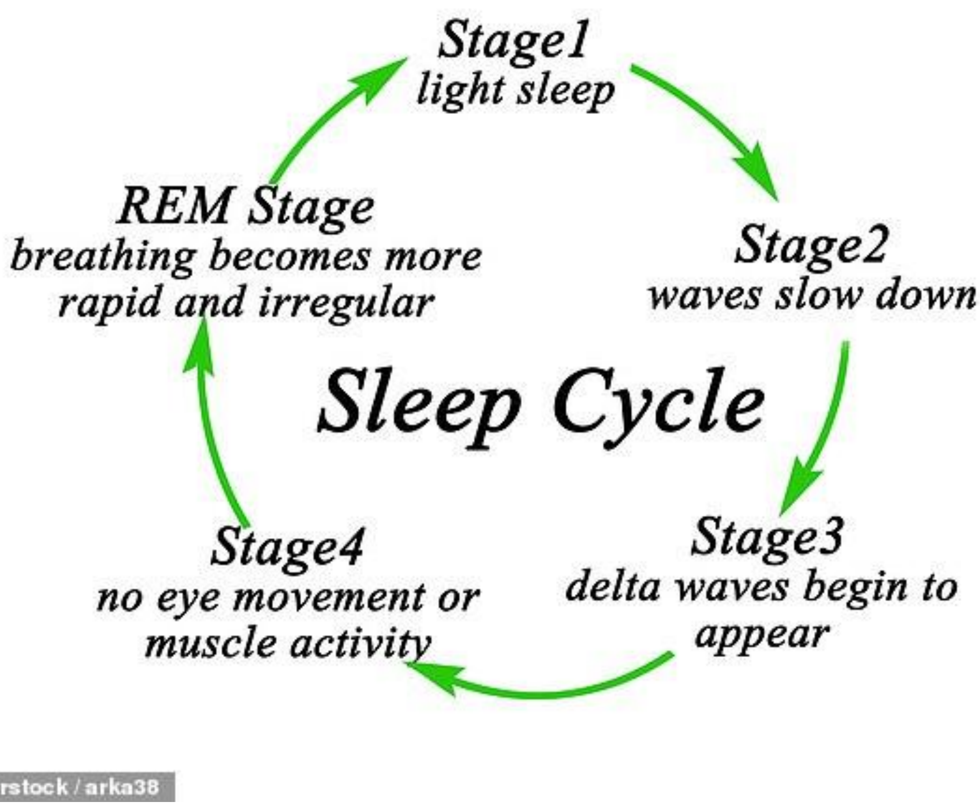
Prophetic uses the EEG data to determine when the wearer has entered REM sleep and then uses the fMRI to induce lucid dreams and 'pursue the answers to life's biggest questions,' according to its **site**.

REM, or rapid eye movement, is the state of deep sleep when a person starts dreaming, and the headband can deliver high-frequency sounds to stimulate brain activity so it induces, sustains, and influences lucid dreams.

'It is plausible that the sound stimulation could induce the high-frequency brain activity that is associated with lucidity,' said Professor Mark Blagrove, a sleep scientist based at Swansea University and the co-author of The Science of Art and Dreaming.

'Sound stimulation has been used to induce low-frequency slow waves in slow wave sleep, so the method proposed is credible.'

The wearer won't need to do anything to induce the lucid dreams, instead, 'it will be autonomously happening while you wear the headband,' Prophetic CEO and cofounder Eric Wollberg said in a **demo video** describing how the Halo works.
The caveat to the new AI technology is that scientists don't know what would happen to a person's brain if it is continuously zapped with high-frequency sounds.



REM sleep cycle is when you are in the deepest part of your sleep state and you begin to dream

The Halo AI headband will go on sale in the Fall of 2025 for an estimated $2,000

Scientists believe dreams have basic functions that are essential to our cognitive development including processing emotional experiences, and some fear if dreams are altered, it could interfere with the purpose of the dream.

Lucid dreams could also have detrimental effects on a person's reality, appearing similar to nightmares and sleep paralysis.

According to the **Sleep Foundation**, 'prolonged and intense lucid dreaming may overstimulate the dreamer, leading to heightened stress and worsened sleep.'
'In popular media, everyone talks about how lucid dreaming will change your life, and [how] it's so great…[But] almost no one talks about any dangers or caution,' Nirit Soffer-Dudek, a clinical psychology researcher at Ben-Gurion University of the Negev in Israel told **BBC**, speaking to the negative effects of lucid dreaming.
'I think that more carefulness is needed, in terms of thinking about who this is good for and who it isn't,' Soffer-Dudek added.

Prophetic opened up a beta-test application for its Halo headband last week but is prioritizing people who have already put down a pre-order deposit to receive the device.

- The two Harvard students who put facial recognition AI in Meta's Ray-Ban glasses have big ideas.
- The duo, AnhPhu Nguyen and Caine Ardayfio, are known for their innovative tech projects.
- They plan to apply AI advancements to construction, enhancing robotics with reasoning.

Two Harvard students spooked the world with their demonstration of facial recognition using Meta Ray-Bans. Now, the duo says they have big ideas for AI in the construction industry.

and Anthropic's Claude over the past year have allowed more rapid innovations "in a way that you haven't been able to before," Ardifiyo said.
For example, if an autonomous construction robot trying to dig a hole was blocked by a person standing in the way, it would previously have needed an engineer to hardcode every one of its movements to avoid the person, Ardifiyo said.

But a construction robot with LLM reasoning can say to itself, "I'm going to wait for this person for a couple seconds until they move, and then if they don't, then I'll do this, and you can have a very strong likelihood that whatever it does is pretty reasonable," Adifiyo said.

"That's actually, like, very incredible, and a capability that has only existed in the past six months, essentially," he added.

Privacy concerns have been raised after two Harvard students just demoed a proof-of-concept system called I-XRAY which uses smart glasses to access personal information about others.

The system combines the use of the glasses along with custom software to ID strangers and retrieve personal data about them. The system has been coined 'I-XRAY.'

The students, AnhPhu Nguyen and Caine Ardayfio, took to the social media platform X to share their experiment writing: "Are we ready for a world where our data is exposed at a glance?"

They tested I-XRAY on Harvard's campus and correctly identified random people, before taking it to the subway to test on non-students.

Five technologies have been used and integrated to make the system function. To use it, people simply put the glasses on, then as you walk by people the glasses will detect when somebody's face is in the frame.

synergy between LLMs and reverse face search allows for fully automatic and comprehensive data extraction that was previously not possible with traditional methods alone.
"From the LLM extracted name, a FastPeopleSearch lookup can identify the person's home address, phone number, and their relatives.

The two creators of the system say the tool "quickly highlighted significant privacy concerns."

In a document where they give people the know-how to remove their information from online sources, they write that the purpose of building the system isn't for misuse and will not be released.

"Our goal is to demonstrate the current capabilities of smart glasses, face search engines, LLMs, and public databases, raising awareness that extracting someone's home address and other personal details from just their face on the street is possible today."

While the duo won't be publicly releasing I-XRAY, the demo alone does expose the concerns for privacy and surveillance in the new AI age.

Meta’s glasses include a privacy light, but it’s not always easily visible.© Photo by Amelia Holowaty Krales / The Verge

Two Harvard students have created an eerie demo of how smart glasses can use facial recognition tech to instantly dox people’s identities, phone numbers, and addresses. The most unsettling part is the demo uses current, widely available technology like the Ray-Ban Meta smart glasses and public databases.

Facial recognition tech has been frighteningly accurate for a while now, and I-XRAY is largely just chaining together a bunch of existing technologies. It relies in part on PimEyes, which *The New York Times* described in 2022 as an “alarmingly accurate” face search engine that “anyone can use.” Concerns around this tech have been heightened since it came out that Clearview AI was using facial recognition to help law enforcement. What’s new about Nguyen and Ardayfio’s demo is how the tech is being paired with a consumer gadget that is discreet and easy to access.

“The purpose of building this tool is not for misuse, and we are not releasing it,” Nguyen and Ardafiyo write in a document explaining the project. Instead, the students say their goal is to raise awareness that all this isn’t some dystopian future — it’s all possible now with existing technology. In particular, they point out that I-XRAY is unique because large language models (LLMs) enable it to work automatically, drawing relationships between names and photos from vast data sources.

As you can see from this photo, the privacy light can be very hard to see in outdoor lighting. Even at night.© Photo by Amelia Holowaty Krales / The Verge

Privacy has always been a major concern with smart glasses. Google Glass originally failed due in part to public backlash at being recorded without consent in public spaces. However, it's also true that in the decade since, people have become more accustomed to being filmed due to the rise of smartphones, vloggers, and TikTok. What's unsettling about modern smart glasses, however, is that they don't stand out quite as much as Google Glass did.

Meta Connect 2024 recap: Mark Zuckerberg reveals Orion smart glasses, new AI features, transparent Ray-Bans, and an affordable Quest 3S©Getty/picture alliance

- Mark Zuckerberg kicked off the Meta Connect 2024 developer conference on Wednesday with a keynote.
- The big news was his demo of Meta's first "true AR" prototype glasses, "Orion," which are still a work in progress.
- He also revealed new Meta AI features, limited-edition Ray-Ban smart glasses, and a $299 Quest 3S.

Mark Zuckerberg knocked it out of the park during Meta's big day.

The Meta CEO looked calm, cool, and collected as he took the stage on Wednesday to announce a slew of new AI and hardware products — including a teaser of the company's long-awaited fully holographic glasses, Orion.

The Orion glasses were the news of the day, and in a surprising turn for AR glasses, they looked ... pretty slick!

The smart glasses integrate visuals into the lenses, making them the company's first "true AR" glasses. They still have a ways to go until they truly blend in like Meta's Ray-Ban smart glasses, but they were notably sleeker than the rival Snap Spectacles that Snap CEO Evan Spiegel showed off last week.

Zuckerberg ran a sizzle reel of famous names in tech reacting positively to the Orion glasses in early previews, with Nvidia CEO Jensen Huang to Reddit CEO Steve Huffman praising the prototype as a leap forward.

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But people will have to wait a while to get their hands on them. The current Orion prototype isn't launching to consumers, although Zuckerberg said some external developers get access. It'll be the next version, however, that the company eventually launches to the public.

Zuckerberg's other announcements were more tangible. He showed off limited-edition transparent frames of Meta's Ray-Ban glasses and a slew of new AI features coming to the product, which has been a sleeper hit for the company.

Meta's AI, which is available through Instagram, Facebook, Messenger, and WhatsApp, is also getting new celebrity voices for its chatbots and multi-modal voice and vision features to better compete with OpenAI's ChatGPT.

The CEO covered some of the big names behind the new Meta AI voices, which range from John Cena to Awkwafina. He also demonstrated some impressive real-time assistance tools and debuted a new entry-level Quest 3S mixed-reality headset that costs $299, which will only apply increasing pressure to Apple's rival Vision Pro and its $3,499 price tag.

The keynote was a chance for Zuckerberg to outline his vision of the future — and Meta's role in shaping what could be the next big computing platform.

Wall Street seemed impressed. Meta's stock was up more than 2% as Zuckerberg exited the stage.

Scroll on to get the full recap of Zuckerberg's Meta Connect keynote.

Phones drool, glasses rule. That's the mantra Meta is banking on customers adopting. It starts with updates to the company's smart Ray-Ban glasses, but those may be just a stepping stone to a future with holographic augmented-reality glasses, where people can have more lifelike video calls, watch TV, or read text messages, all while still seeing the world around them.

In a July earnings call, Zuckerberg said the second generation of glasses "continue to be a bigger hit sooner than we expected — thanks in part to AI." People were buying the glasses quicker than the company could make them, he said. The market-intelligence firm International Data Corporation says some 700,000 pairs have been shipped since last October. Meta's Ray-Bans have a camera and speaker and are packed with AI. Updates give the wearer real-time translation if someone is speaking with them in Spanish, English, French, or Italian, and they also have features for everyday use, like remembering where you parked your car or helping you create an outfit from the clothes in your closet or make a smoothie with the fruits in front of you.

Earning a modicum of cool in what's been panned as perhaps the dorkiest market in tech is a big leap.

They're far from being widely adopted, but Meta hopes this will be the next frontier. Glasses are "a very natural computing platform," Zuckerberg said. The Ray-Bans also have the benefit of being "just good-looking glasses," he told the crowd during Meta's Connect 2024 event, and he said "people want to have something on their face that they're proud of and that looks good."

not expected to sell more than 500,000 devices this year (in comparison, some 500,000 iPhones are sold globally every *day*). Its $3,500 price point is certainly a deterrent to widespread adoption, but so is the feasibility; they're clunky, there are too few programs made for them, and they're stuck among a niche user.
VR headsets are "not going to be mass market, ever, in this current form," says George Jijiashvili, the senior principal analyst of games at the research firm Omdia. But if Meta's can make AI work in a way that combines video capture, sound, and location context together, the glasses could be a game changer. "If they manage to create an AI solution that actually works very well, then having glasses in that situation makes a lot of sense. You can see the road to mass adoption more clearly with glasses than with VR headsets."

That's what Zuckerberg hopes, too. Even though the Orion glasses won't be sold anytime soon, if ever (Zuckerberg acknowledged they have to become more stylish and affordable), he's trying to drum up excitement, and, as my colleague Peter Kafka noted, convince the world that he can build the future of computing. "These glasses exist. They are awesome," Zuckerberg said. "They are a glimpse of a future that I think is going to be pretty exciting." So far, it's been hard to convince the average person they need a computer strapped to their face. But a fancy version of the same specs worn by Bob Dylan, Lady Gaga, and countless other celebrities who arguably bring more cool cache than a founder wearing an oversize T-shirt emblazoned with "Either Zuck or nothing" in Latin at a product launch may be the way to start.

Smart glasses, an arguably niche but rapidly advancing category of wearable devices that allows users to interact with digital content while keeping their eyes on the real world, will largely replace smartphones as the world's primary computing platform by the end of the decade, according to the latest word from Mark Zuckerberg, co-founder, chairman, and CEO of Meta. Zuckerberg, who is partially known for having dropped out of Harvard after creating a successful platform called Facebook, shared the prediction last week following the introduction of Orion, Meta's first true augmented reality glasses. A look at Orion, including Zuckerberg's thoughts, can be found below.

What I think is going to happen with glasses is that we're going to get to this point, probably sometime in the 2030s, where you have your phone with you, but it's going to stay in your pocket more, because you're going to be doing more and more things on your glasses than maybe today you'd do on your phone. The glasses will be your main computing platform, and that will be kind of your default, go-to thing.

It's official; we're living in a dystopian nightmare, only without any of the cool clothes or neon-covered megacities. As first reported by 404 Media, two Harvard students recently proved that it was possible to knock together some software that can turn a pair of Ray-Ban Meta smart glasses into a face recognition doxxing tool.

PimEyes offers a fairly simple opt-out process which involves uploading a photo of yourself . PimEyes will then remove any photos that are a match in its database. The original images will still exist on whichever websites they were scraped from, but anyone making a search for your face using PimEyes will no longer find any matching results.

1. Visit the PimEyes website.
2. At the top of the screen, select **Opt-out**.
3. Click **Upload photo**.

4. You should choose high-quality photos that are full-face, well-lit, and with nothing covering your face or eyes.
5. For the best results, upload multiple photos that give different angles of your face.
6. Agree to the terms and confirm that you are over 18, then click **Next**.
7. Upload a scan or photograph of a government issued ID. You should blur or cover any personal information such as your name, address, and any other personal information. Make sure that the photograph and expiry date of the ID remains uncovered.
8. Once you have uploaded your ID, enter an email address. This will only be used to send you confirmation that your images have been removed. You can use an email alias for safety if you wish.
9. Once your application has been processed, you should receive an email confirming that your images have been removed from the PimEyes database.

How to remove your photos from FaceCheck

Images are removed immediately but can take five days to be permanently deleted

Instructions to remove photos from FaceCheck website

FaceCheck / Pocket-linet

FaceCheck is another website that offers the ability to search based on an image of a face. Searching for a face will bring up results from other websites that include images of the same face. The results are ranked using a color coding system, with dark orange results being certain matches, yellow being confident matches, green being uncertain matches, and gray being weak matches.

What Is Doxxing? 5 Ways to Protect Yourself

What is doxxing? The practice, also spelled "doxing," is when netizens use the internet to source and collect someone's personal and private information and then publicly release that information online [source: S-W].

Derived from the word "documents," the term is an abbreviated version of "dropping dox," a method of revenge that dates back to the hacker culture of the early 1990s [sources: Goldman, Honan].

How Doxxing Works

The internet makes it easy to find publicly available information, such as landline phone numbers or mailing addresses, once you know a person's name, and white pages-style directory sites have long replaced old-school phone books.

But doxxing takes things much further than an innocent search for contact information.

Doxxers often set out to tie an anonymous online profile on social media sites to the true identity of the person behind it. They then publicly reveal that person's real name, along with personal details ranging from home addresses and unlisted cell phone numbers to Social Security numbers, the names of family members or bank account details.

Like identity theft, doxxing usually requires a bit of unscrupulous investigation on the part of the person digging up the info, such as stalking the target's social media profiles looking for pets' names, maiden names or other clues that they may use to guess passwords or answer security questions.

Unlike identity theft, however, the goal of doxxing is typically retribution, harassment or humiliation rather than access to financial accounts. Of course, once doxxers reveal a victim's personal details publicly, there's no telling what other internet users may do with them.

Doxxing Victims

Both private and public figures have been "doxxed" and, surprisingly, the practice is often completely legal, especially if the information is in the public domain. However, established communities like Reddit widely frown upon the practice [sources: Honan, Pelisek, S-W].

In 2013, doxxing (both the word and the practice) gained mainstream exposure when celebrities including Beyoncé, Ashton Kutcher and Hillary Clinton had closely guarded information such as their home addresses and cell phone numbers revealed online [source: Pelisek].

More recently, some have used the word "doxxing" — sometimes controversially — to describe the practices of investigative journalists who use techniques associated with doxxing to identify and research the targets of their reporting [sources: Goldman, S-W].

How to Protect Yourself From Doxxing

Doxxing can lead to death threats and people showing up to your physical address — actions that may require that you involve law enforcement. To protect yourself from doxxing, you should:

1. **Use a virtual private network.** A VPN can keep your information private that a doxxer would otherwise try to exploit through your internet service provider.

2. **Create better passwords.** Even though it's easier to memorize one password, avoid using the same one for every account. Also, use unique passwords that are not easy to guess.
3. **Hide domain registration information.** This database can contain personal information, like your home address.
4. **Create separate email accounts.** If you use different emails for different parts of your life — for example, financial and social online accounts — an attacker won't have access to all your information.
5. **Keep personal details off the internet.** Don't share your birthdate, hometown or other private information online so that a doxxer cannot easily gain access to your accounts.

Lots More Information

Sources

- Goldman, Alex. "The Problem with 'Doxxing.'" On the Media. March 10, 2014. (August 9, 2014) http://www.onthemedia.org/story/problem-doxxing/
- Honan, Matt. "What is doxing?" Wired. March 6, 2014. (August 9, 2014) http://www.wired.com/2014/03/doxing/
- Janssen, Cory. "Definition -- What does 'Doxing' mean?" Techopedia. (August 9, 2014)
- Pelisek, Christine. "Doxxing: It's Like Hacking, But Legal." The Daily Beast. March 13, 2013. (August 9,

2014) http://www.thedailybeast.com/articles/2013/03/13/doxxing-it-s-like-hacking-but-legal.html

- S-W, C. "What doxxing is, and why it matters." The Economist. March 10, 2014. (August 9, 2014) http://www.economist.com/blogs/economist-explains/2014/03/economist-explains-9

(Photo credit: DALL·E)© PsyPost

Ever heard a snippet of a song and instantly known what comes next? Or picked up the rhythm of a chorus after just a few notes? New research from the Center for Music in the Brain at Aarhus University and the Centre for Eudaimonia and Human Flourishing at the University of Oxford has found that our brains process music through a specific hierarchical activation of several regions. The findings, published in *Nature Communications*, provide new insights into the neural mechanisms underlying our ability to anticipate and identify familiar melodies.

Following this memorization phase, the participants were subjected to an auditory recognition task while their brain activity was recorded using magnetoencephalography (MEG). MEG is a non-invasive imaging technique that captures the magnetic fields produced by neural activity, providing precise temporal and spatial resolution.

The recognition task consisted of 135 five-tone musical sequences, some of which were identical to the original piece while others were systematically varied. These variations were introduced at different points in the sequence to observe how the brain responds to changes in familiar patterns.

Bonetti and his colleagues found that when participants recognized the original memorized sequences, their brain activity followed a specific hierarchical pattern. This pattern began in the auditory cortex, the region responsible for processing basic sound information, and progressed to the hippocampus and cingulate gyrus, areas associated with memory and cognitive evaluation.

A rendering of the poppy seed–sized brain of a fly (Drosophila melanogaster)© Tyler Sloan / Amy Sterling / FlyWire / Princeton University

What happened

A consortium of scientists published the first complete map of a fruit fly's brain Wednesday in the journal Nature. Identifying and charting the 130,000 neurons and 50 million connections inside the poppy seed–sized brain of the fly, Drosophila melanogaster, took 10 years and involved hundreds of researchers worldwide.

the first time we've had a complete map of any complex brain," said Mala Murthy, a Princeton neurobiologist who helped lead the FlyWire project, to The New York Times. The "stunning detail" of the "tremendous complexity" packed into the fruit fly's tiny brain could "reveal principles that apply to other species, including humans, whose brains have 86 billion neurons," the Times said.
The "beautiful" and complex "tangle of wiring" mapped out in computer simulations may hold the "key to explaining how such a tiny organ can carry out so many powerful computational tasks," like sight, hearing and movement, the BBC said.

What next?

This "amazing technical feat" paves the way for mapping the neural pathways of "larger brains such as the mouse and, maybe in several decades, our own," brain researcher Lucia Prieto Godino of London's Francis Crick Institute said to the BBC. A mouse brain "contains about 1,000 times as many neurons as a fly," while the human brains has a million times more, the Times said, and scientists recognize that "bigger brains may not follow" the same "fundamental rules" for sending signals quickly across a fly's brain.

Apple has been stuck in an innovation rut for the past few years. Aside from the Vision Pro headset — which expectedly didn’t gain a mass reception — the company hasn’t made any notable hardware strides apart from its bread-and-butter mobility and computing portfolio. That could change in the next few years.

For Apple, the inspiration would come from its pricey headset.“The plan is to bring the Vision Pro’s ability to understand its surroundings to more products,” adds the report. But it’s going to be a long wait until we see Apple’s take on the smart glass category.

The XR wearables industry is at somewhat of a pivotal point. On one hand, we have products like the Meta Quest 3s headset that are bringing premium features like color passthrough to a price point that is nearly one-tenth of what Apple commands for the Vision Pro.

Digital Trends© Provided by Digital Trends

Then we have players like Xreal, Rokid, and RayNeo trying to make smart glasses that don’t look like nerdy gizmos. Yet, at the same time, we have giants like Microsoft shutting the doors on ambitious XR products like the HoloLens despite being at the forefront of the AI race.

Meta Ray-Ban glasses can collect data from other people.© meta.com, Meta

Ray-Ban Meta glasses may look like a simple accessory, but their features can be surprising. Two students from Harvard University conducted an experiment that demonstrated how quickly and easily personal

By integrating facial recognition systems, public databases, and artificial intelligence, a glasses user could gather detailed information about people captured by the camera. As the experiment indicates, **Ray-Ban glasses** could become dangerous for obtaining personal data, such as names, addresses, phone numbers, and even insurance policies.

Meta's Orion Glasses: The Future of Augmented Reality Unveiled

It's mea culpa time as the Macalope is here again to talk about Meta, AR glasses, and the icky mess that is humanity. First off, here's to today's college kids! When the Macalope was in college he… well, let's just say mistakes were made. He was decidedly not doing experiments to point out the flaws in modern technology.

And now? We cheer for these new devices. Last week the Macalope wrote about Meta's Orion prototype, taking a look at the variety of opinions about the device. And even he neglected to bring up the privacy issue, focusing instead on the aesthetics. Yes, Meta's Orion pass better for regular glasses than the Vision Pro. Meta's Ray Bans pass even easier for regular glasses.

Is that something we *want*, though? It's all well and good if they're being used for harmless entertainment, walking directions or idly looking up what "brat" is supposed to mean, anyway. But that's not all they're going to be used for.

Remember how Facebook got started.

It all began in 2003, when Facebook founder and CEO Mark Zuckerberg created an online programme called "Facemash," which allowed users to objectify fellow students by comparing photos of their faces and selecting who they deemed as “hotter.”

Who knew that rewarding someone for making something gross by turning them into a billionaire would be a mistake?

Immediate, in-the-wild privacy violation is simply the next logical step. Social media companies do not care about your privacy except for the way it tastes as it slides past their tongues. So sweet.

Meta Connect 2024 recap: Mark Zuckerberg reveals Orion smart glasses, new AI features, transparent Ray-Bans, and an affordable Quest 3S©Getty/picture alliance

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- The big news was his demo of Meta's first "true AR" prototype glasses, "Orion," which are still a work in progress.
- He also revealed new Meta AI features, limited-edition Ray-Ban smart glasses, and a $299 Quest 3S.

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The Meta CEO looked calm, cool, and collected as he took the stage on Wednesday to announce a slew of new AI and hardware products — including a teaser of the company's long-awaited fully holographic glasses, Orion.

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The smart glasses integrate visuals into the lenses, making them the company's first "true AR" glasses. They still have a ways to go until they truly blend in like Meta's Ray-Ban smart glasses, but they were notably sleeker than the rival Snap Spectacles that Snap CEO Evan Spiegel showed off last week.

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Scroll on to get the full recap of Zuckerberg's Meta Connect keynote.

- Meta's Reality Labs is exploring all kinds of wearable AI tech, CTO Andrew Bosworth says.
- Its projects include camera earbuds and mixed-reality goggles.
- Reality Labs, known for VR and AR, has also faced budget cuts and layoffs.

The rapid advancement of wearable technology is making it easier to accessorize with incorporate AI.

But the cuts haven't stopped Reality Labs from dabbling in new ideas. Behind the scenes, Reality Labs has many projects, from camera earbuds to mixed reality goggles. "If there's a concept that you could imagine, we either have had or do have somebody building a thing around it," Bosworth told Command Line.

Reality Labs uses a step-by-step process to develop products from concept to release, Bosworth said. It begins with a pre-discovery team that prototypes new ideas, which are then reviewed to select a few for further exploration. After prototyping, successful concepts enter the company's product road map, and about half of those make it through final testing to be released to the public.

The camera earbuds are in an early stage of development, while a pair of "steampunk" mixed reality goggles have advanced to the product release process, Command Line reported.

"We definitely don't want to be outflanked by someone who came up with some clever, integrated wearable that we hadn't thought about," Bosworth said.

Meta did not immediately respond to a request for comment from Business Insider.

- Meta Ray-Ban smart glasses make it easier to document things that happen in your life.
- A new project by two students called I-XRAY showcases what can be done with custom software and a pair of Meta Ray-Bans.
- The app allows almost instant recognition of subjects, with data that includes names, addresses, phone numbers, and more.

Meta makes one of the best smart glasses you'll find on the market, with the Ray-Ban collaboration sitting at the very top of our "best of" list. Of course, this is still a very niche product, which means, you're probably not going to see many of these out in the wild, despite the latest version of these glasses being available for close to a year now. Again, these glasses aren't for everyone, but if you're someone that likes to take photos and videos, and wants to capture the world in a different way, then the Meta Ray-Ban smart glasses are going to be worth trying out.

Ray-Ban Meta Black close-up with charging case in the background© Provided by Android Police

Related

Ray-Ban Meta smart glasses review: Built for social creators

Ray-Ban style meets Meta smarts to create a pair of almost perfect POV glasses for social creators

Now, with the introduction of these types of devices, there will always be privacy concerns. Especially now, with the implementation of AI in lots of modern products, which has led to companies to be very cautious about how their products are portrayed and how each device collects data that's captured. Meta even has a dedicated privacy page that goes through the ins and outs of its Ray-Bans in order to try and better educate its users. Of course, a brand can only control so much, which is why there will always be outlying examples of tech that can be used in ways not originally intended.

This isn't the future, this is our new reality

This is where a project called I-XRAY by two Harvard students comes into play, with AnhPhu Nguyen and Caine Ardayfio giving us real world examples of how the Meta Ray-Bans can be used when some clever tweaks are applied (via The Verge). In a post on X by Nguyen, we can see the work in action, showcasing how a string of available services and a custom application that can process it all, can really make an episode of Black Mirror come to life.

So let me paint a word picture for you (it is my job, after all). I've got two big things to save up for — my wedding and my home. It was all going so well until Meta Connect 2024, when the Zuck came up on stage and showed off the new transparent Ray-Ban Meta smart glasses.

The moment I saw them, I knew it was inevitable. Even if it meant I had to live off instant noodles for the next month, these are *extremely* my vibe. And now that I have one of the 7,500 pairs that Meta sold of this limited edition, zero regrets are felt. These see-through specs are easily the best-looking gadget I've seen in a long time.

Ray-Ban Meta smart glasses (with transition lenses): $379 @ Best Buy These smart glasses far exceed their 12MP camera capture abilities. Meta AI features give them all the smarts to answer any questions about the world around you (thanks to multimodal AI). And all of this is underpinned by a stellar-looking set of specs that feel great to wear all-day round.View Deal

Nothing at all...nothing at all...

((Image credit: Future))

Stupid sexy glasses! There is absolutely nothing new about them — no improvement to the Bluetooth and wi-fi connectivity, no Meta AI for me in the U.K. (unless you use one of the best VPNs to trick them), and no updates to the camera or battery life.

All Meta has done in its love-in with Ray-Ban is house all of the components in a completely transparent frame. And that's all these two needed to do, as it tickles every single of my nerdy itches at once to make this oh-so-divine on my face.

And the most recent additions are set to make these smarter than ever — an updated prompting system with the multimodal AI that understands more natural questions leads the charge. Instead of having to say "hey Meta, look and..." followed by your question, you can word it a lot more naturally.

But everything else coming too makes these a must-buy, from the ability to remember the location of items on request, reading QR codes and calling numbers it sees. Special shout-out to live translation, which is going to be *huge* for a traveler like me.

Outlook

((Image credit: Future))

So while this limited edition is sold out now, I'd still highly recommend you pick up a pair with transition lenses. The capabilities extend super far beyond just being a pair of camera glasses — thanks to all of its AI smarts.

Yes, I may be looking at my bank account and diet of baked beans and feeling a little poor right now, but damn do these look like something special.

Apple smart glasses tipped to launch in 2027 to fight Meta with Visual Intelligence© Martin Hajek/iDropnews)

Following up on a report from February this year, Bloomberg's Mark Gurman is doubling down on claims that Apple is developing new wearable products, suggesting that it could bring smart glasses and AirPods with cameras to market as early as 2027, as discussed in his latest Power On newsletter.

And while it's hard to say how AirPods with cameras could benefit the average user, Gurman has previously stated that the rumored product "would give consumers many of the benefits of smart glasses without needing lenses and frames."

Of course, if Gurman's report is to be believed, we're a few years out from seeing these products go on sale, we may have to settle for the Apple Intelligence features which are expected to arrive with iOS 18.2 in December.

In the meantime, you can access similar features such as the ability to take photos, record video stories, and access an AI voice assistant via the Ray-Ban Meta smart glasses.

A new study published in *Molecular Psychiatr*y has revealed that a single dose of the psychedelic drug 2,5-dimethoxy-4-iodoamphetamine (DOI) can lead to long-lasting changes in brain structure and cognitive flexibility in mice. The researchers found that mice treated with DOI became more attuned to previously overlooked cues, allowing them to learn more efficiently from their experiences. These effects appeared to depend on the timing of drug administration and the animals' experiences after the treatment.

The study, conducted while Sabanovic was a PhD candidate at the University of Oxford, was carried out on young adult mice to assess the structural and cognitive effects of DOI. The researchers administered a single dose of DOI to the mice and then evaluated their behavior using a complex reversal learning task designed to measure cognitive flexibility. This task required the mice to adapt their behavior based on changing reward patterns, allowing the researchers to see how well the animals could learn from both positive and negative outcomes.

In addition to behavioral testing, the researchers performed brain imaging to assess changes in brain structure following DOI treatment. They used magnetic resonance imaging (MRI) to look for alterations in brain volume, focusing on regions associated with sensory processing and cognitive control. Brain samples were collected from the mice 24 to 36 hours after drug administration to capture the early structural changes, as well as several weeks later to investigate any long-term effects.

In his sci-fi film "Inception," (2010), Christopher Nolan imagined his protagonist slipping into other people's dreams and even shaping their contents. But what if this story wasn't so far away from real life?
Our research suggests that it is possible to interact with volunteers while they are asleep, and even to converse with them at certain key moments.

Lucid dreaming

Most of us only realize we've been dreaming upon waking. Lucid dreamers, on the other hand, have the unique ability to remain aware of the dreaming process during REM sleep, a stage of sleep during which brain activity is closer to that of the waking phase.

Even more surprisingly, lucid dreamers can sometimes exercise partial control over their dream's narrative. They are then able to fly away, make people appear or disappear, change the weather or transform themselves into animals. In short, the possibilities are endless.

Such lucid dreams can occur spontaneously or be engineered by specific training. The existence of lucid dreaming has been known since ancient times, but for a long time it was considered esoteric and unworthy of scientific exploration.

Such views have changed thanks to a clever experiment set up by psychologist Keith Hearne and psychophysiologist Stephen Laberge in the 1980s. These two researchers set out to prove that lucid dreamers were indeed asleep when they realized they were dreaming.

Adaptive deep brain stimulation trial results poised to "transform" Parkinson's disease© University of California

A new type of self-adjusting neuromodulation is poised to transform the landscape of neurology, as per analyst reaction to results from two studies evaluating the technology.

The pair of studies, conducted at University of California, San Francisco (UCSF), tested what it calls 'intelligent brain pacemakers' – an implant that uses an approach called adaptive brain stimulation (aDBS). This method involves using artificial intelligence (AI) to spot changes in patient symptoms via brain activity monitoring and then delivering personalised care.

The studies "mark a major advancement in the management of Parkinson's disease" according to GlobalData analysis, which also reflects the growing influence of digital technologies in neurological disease treatment.

The global market for neurological devices was valued at $12.5bn in 2023 and is forecast to reach $20.9 billion by 2033, as per a GlobalData report.

DBS has been a US Food and Drug Administration (FDA)-approved option for Parkinson's disease patients since 1997. Whilst effective, this type of intervention does not adapt to natural fluctuations in brain activity and cannot account for changes in levels of medications patients take for the disease.

"The big shift we've made with adaptive DBS is that we're able to detect, in real time, where a patient is on the symptom spectrum and match it with the exact amount of stimulation they need," said Little, associate professor of neurology and a senior author of both studies.

"Adaptive deep brain stimulation trial results poised to "transform" Parkinson's disease" was originally created and published by Medical Device Network, a GlobalData owned brand.

Microscopic magnetic nanodiscs could provide a much less invasive means of providing deep brain stimulation, a new study says.

The tiny discs -- about 250 nanometers across, or 1/500 the width of a human hair -- would be injected directly into specific regions of a person's brain, researchers say.

From there, researchers said, the discs could be activated by applying a magnetic field outside the patient's body.

Tests in lab mice show that the discs "had an impact on neuron activity and on behavior," researcher Ye Ji Kim, a doctoral student at MIT, said in a news release.

Deep brain stimulation uses electrodes implanted in target brain regions to treat conditions like Parkinson's disease, epilepsy, obsessive-compulsive disorder, tremors and Tourette syndrome, the Mayo Clinic says.

But placing the implants involves major brain surgery, which opens patients up to a number of harmful complications, researchers noted.

These nanodiscs could provide a less invasive alternative to currently used electrodes, researchers said.

The nanodiscs contain a magnetic core and an electrically charged outer shell. When exposed to a magnet, the core presses against the outer shell and causes it to deliver electrical pulses to nearby neurons, researchers said.

Stimulation can be switched on and off by flipping a switch on an electromagnet, researchers said.

The discs successfully stimulated brain regions in mice associated with feelings of reward and motor control, researchers report.

This included the subthalamic nucleus, "the region where electrodes typically get implanted to manage Parkinson's disease," Kim explained.

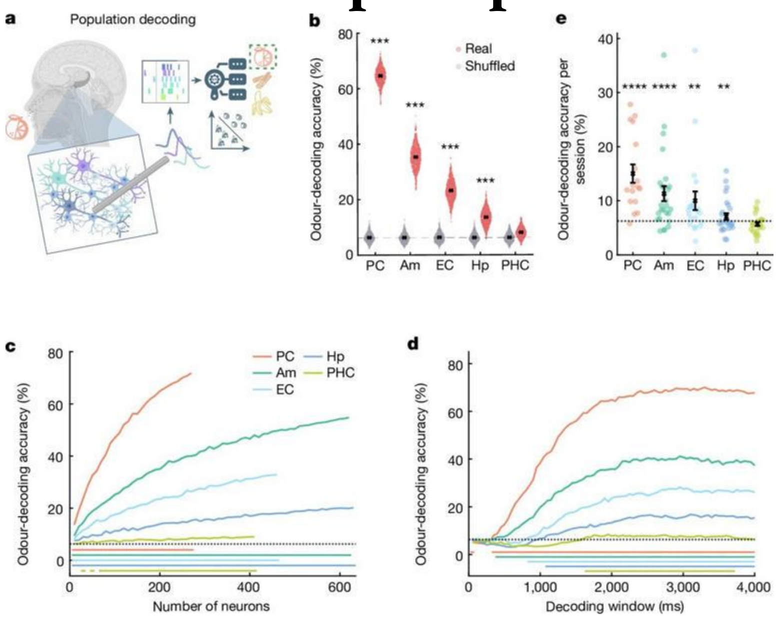
However, researchers say the discs need more work to make them powerful enough to provide the sort of brain stimulation needed to treat human illnesses. And experts stress that research done in animals often has different results in people.

"Yes, it's a record-breaking particle, but it's not as record-breaking as it could be," senior researcher Polina Anikeeva, a professor of materials science and engineering and brain and cognitive sciences at MIT, said in a news release.

"When we find that these particles are really useful in a particular clinical context, then we imagine that there will be a pathway for them to undergo more rigorous large animal safety studies," Anikeeva added.

The new study was published Friday in the journal Nature Nanotechnology.

Another step towards decoding smell: Investigating the neuronal mechanisms of human odor perception



Neuronal activity decodes odor identity. Credit: Nature (2024). DOI: 10.1038/s41586-024-08016-5

We often only realize how important our sense of smell is when it is no longer there: food hardly tastes good, or we no longer react to dangers such as the smell of smoke. Researchers at the University Hospital Bonn (UKB), the

University of Bonn and the University of Aachen have investigated the neuronal mechanisms of human odor perception for the first time.

While the activity of nerve cells in the olfactory cortex most accurately predicted which scent was smelled, neuronal activity in the hippocampus was able to predict whether scents were correctly identified. Only nerve cells in the amygdala, a region involved in emotional processing, reacted differently depending on whether a scent was perceived as pleasant or unpleasant.

Nerve cells react to the smell, image and name of the banana

In a next step, the researchers investigated the connection between the perception of scents and images. To do this, they presented the participants in the Bonn study with the matching images for each odor, for example, the scent and later a photo of a banana, and examined the reaction of the neurons. Surprisingly, nerve cells in the primary olfactory cortex responded not only to scents, but also to images.

"This suggests that the task of the human olfactory cortex goes far beyond the pure perception of odors," says co-corresponding author Prof. Marc Spehr from the Institute of Biology II at RWTH Aachen University.

The researchers discovered individual nerve cells that reacted specifically to the smell, the image and the written word of—for example—the banana. This discovery indicates that semantic information are processed early on in human olfactory processing. The results not only confirm decades of animal studies, but also show how different brain regions are involved in specific human odor processing functions.

"This is an important contribution on the way to decoding the human olfactory code," says Prof. Mormann. "Further research in this area is necessary in order to one day develop olfactory aids that we can use in everyday life as naturally as glasses or hearing aids."

More information: Marcel S. Kehl et al, Single-neuron representations of odours in the human brain, *Nature* (2024). DOI: 10.1038/s41586-024-08016-5

Provided by University Hospital of Bonn

How a medtech market opportunity is shaping up for wearable neurotech

When you think of brain stimulating medtech, startups building wearables as therapeutics probably aren't the first thing that springs to mind. Such tech is still flying fairly under the radar — perhaps, in part, because these sorts of companies have raised a fraction of the investment that's been ploughed into invasive technologies for targeting treatments at the human brain.

This medtech startup, which was founded back in 2013, has raised a total of $30.4 million to date to fund development of its wearable brain-stimulating technologies targeting a range of mental health and metabolic conditions. It has said it's aiming to close a Series B by the end of the year, too – which could add another $40M to that pot.

But the amounts involved — still in the tens of millions — look modest compared to the costs of commercializing invasive neurotech. Or the billions that can be required to develop new pharmaceuticals. Which is explains why Baldwin is so bullish on neurotech, dubbing it "a great place to invest".

A portfolio of treatment wearables

The scope of the market opportunity is another angle here that's exciting investors. There are many potential therapeutic applications for neurotech wearables – with depression just one of multiple conditions and diseases where devices makers claim they can make a difference.

It’s also running U.S. clinical trials for separate wearables targeting PTSD and Type II diabetes — and the startup hopes to turn all these efforts into a pipeline of approvals over the next two years. Including another neurotech device that’s focused on treating obesity risk and promoting weight loss by targeting biological mechanisms that store visceral fat.

Baldwin tells TechCrunch the deeptech fund was attracted to Neurovalens by “the sheer breadth of where this technology could be applied”.

“In terms of how you can get to market in massive [healthcare] markets, once you’re through all the clearance regulations… you can do this quite effectively,” she explains, saying the relatively small capital outlay required to get to that point “made sense” for a deep tech, early stage investor.

She’s also upbeat about where the neurotech market is headed – pointing to projections that brain-targeting medtech is poised for major growth over the next five years.

Currently, the market as a whole – factoring in both invasive and non-invasive neurotech – is worth around $13 billion-$14 billion, per Baldwin, but she flags forecasts predicting this will rise to $40 billion by 2030.

Image Credits: Bryce Durbin/TechCrunch

How much of that growing pie ends up going to invasive neurotech startups vs wearables remains to be seen. But it seems a fair bet that non-invasive approaches have a good chance of gaining ground quickly – since, once they have the necessary approvals, their kit can be prescribed earlier, thereby potentially reaching more patients.

When IQ was first considering a neurotech investment, Baldwin recounts how McKeown – who was a neuroscience professor at San Diego university at the time – had been exploring neurostimulation as a treatment for obesity.

“We’re stimulating the same area in the brain that controls how your body manages energy,” he explains, saying the startup has been able to show “really significant” reductions in visceral fat, i.e. fat that’s stored around organs, elevating a person’s health risks.

“One of the joys of being a deep tech investor is just sitting down with your founders and saying, yeah, what if?” Baldwin continues. “That was what was so particularly attractive to Neurovalens; that they were able to apply their technology to several massive, globally important themes, rather than just have to drill down into one.”

IQ opted to make its neurotech investment in a startup developing wearable medtech, rather than something more invasive like brain implants – but Baldwin stresses they were looking at “bold treatments”. Evidently, though, the complexity and cost involved in commercializing implanted neurotech tipped the scales in favor of a head-mounted route in.

“When you go invasive it’s a whole different level of complexity,” she emphasizes. “In terms of regulatory, the cash required to get there, the kind of team support you need – from not only the medical profession but also the regulatory profession. It’s a very different investment.”

A cost efficient, scalable market opportunity

What about market opportunity? Given how many conditions and diseases medtech neurotech builders are eyeing this could end up scaling considerably, too, in the coming years.

According to the CDC, the percentage of people in the U.S. aged 18 and above who report having “regular feelings of depression” stands at 5%. While data from the U.S. National Center for Health Statistics for 2015 to 2018 found that 13.2% of U.S. adults had used antidepressant medications over the past 30 days – with rates of medication for depression trending upwards since its last survey.

Anxiety is another target area for non-invasive neurotech – and the CDC records U.S. adults experiencing regular feelings of “worry, nervousness, or anxiety” as even greater: 12.5%.

Turning to sleep disorders, between 30%-40%+ of U.S. adults report getting insufficient sleep. Although rates of chronic insomnia specifically are lower: A recent survey commissioned by the American Academy of Sleep Medicine found that 12% of U.S. adults had been diagnosed with this more disruptive sleep disorder.

Diabetes is another major problem, in the U.S. and globally – one which can have very serious health consequences. According to the Centers for Disease Control and Prevention (CDC) more than 38 million Americans have diabetes – around 1 in 10 of the population – and between 90% to 95% of those have Type II diabetes, aka the kind Neurovalens hopes to be able to treat with its neurotech wearable.

Obesity, which can lead to a person developing diabetes, is even more prevalent – with more than 2 in 5 adult Americans being obese, per the CDC.

Another of Neurovalens' target conditions — PTSD — is a lot rarer. But the National Center for PTSD, a division of the U.S. Department of Veteran Affairs, has suggested about six in every 100 people will experience it at some point in their lives. And while there's a strong association between PTSD and military service, McKeown highlights that a particularly high risk group are middle aged women who have suffered from domestic abuse.

He says the startup is particularly excited about the PTSD wearable in development as the condition is notoriously difficult to treat. "PTSD doesn't respond very well to drugs – there are no really approved treatments. So we might be the first treatment available," he suggests.

When its PTSD trial wraps up, giving them a chance to fully review the data, he says they may seek to submit that wearable under the FDA's Breakthrough Devices Program which can speed up the process of U.S. regulatory review. So McKeown says they're hopeful this medtech product – slated to be called Modius Spiro – could be approved as soon as next year.

Closer in line for clearance is Neurovalens' obesity device (aka the Modius Lean) — which they've been trialing for longer. McKeown says they're anticipating approval for that either later this year or early next. While the aforementioned diabetes device (Modius DM) is further out – but he says they hope to have FDA approval for it in 2026.

Neurovalens is also considering commercializing a wearable for depression — which, if it goes ahead, would be called the Modius Mood — but the startup has yet to decide on whether to take that forward.

While the commercialization of these higher risk category treatments must wait for a greenlight from the FDA before they can proceed, the medtech company does have two products approved already (for chronic insomnia and GAD). These therapeutic wearables will be launching in the U.S. in the next few months so it will be switching into active marketing soon.

These first, lower risk neurotech products offer a chance for Neurovalens to test how much appetite there is for wearable neurotech in healthcare.

Despite being based in and developing out of Europe, its go-to-market strategy has always been focused on going to the U.S. first. McKeown says the FDA represents the "gold standard" for medical device approval. It's also a required step to access the country's massive healthcare market.

While there's no guarantee the FDA will approve any of the startup's more novel (and higher risk category) treatments, McKeown is convinced the market opportunity it's been working towards for so long is poised for lift-off.

"There's so much research being carried out – even [implanted] devices are now slowly making their way through to get reimbursement in the U.S., under the MediCare or the private healthcare payers. So the opportunity in general is just really exploding."

He argues this is even more true of the non-invasive sector – pointing out these types of devices sit "quite close" to the consumer health category, where neurotech kit makers are bringing more devices to market that make (unregulated) wellness claims. "Although our devices are prescribed, they're prescribed at the really earliest stages," he emphasizes.

"An implanted device for, say, anxiety or a mental health issue is a last resort," he adds, whereas neurotech wearables — being totally non-invasive — have the potential to achieve much greater scale and patient impact.

Now for the challenges...

Still, even with close to a decade of development work clocked up by some neurotech startups the challenges of commercializing head-mounted brain-stimulators undoubtedly makes for a long list.

Discussing hurdles Neurovalens has had to negotiate to get this far McKeown talks unbroken for several minutes.

His list includes taking theoretical lab work and presenting it to investors to convince them to cut a check and take a bet it can be translated into clinically validated outcomes; convincing doctors to involved their patients in trials for novel and experimental treatments; and conducting clinical trials to amass data to make a convincing case for medical device regulators to approve novel treatments.

"We just focus on making patients better. So the challenge… is showing to the FDA how well we can do this, and [that] the safety profile and the risk profile is proportionate to that," he explains.

"And then the challenge after that is, well, how do you start selling it?"

Assuming an FDA greenlight, medtech players also need to tackle the issue of reimbursement — convincing healthcare payers the treatment represents value for money — if they want to get their kit into the hands of patients at major scale. And, if that goes well, they arrive at the next challenge: Patient education.

For neurotech, this means getting people to look beyond what are still rather whacky optics (brain zapping headbands) and see a wearable device as a viable treatment for, say, a mental health issue alongside more established choices like therapy and medication.

There's a further wrinkle where patients are concerned, too, as a positive outcome from neurostimulation as a treatment is not guaranteed.

As is often the case with all sorts of medical treatments, patient outcomes can vary. But there's perhaps a particular incongruity if a gadget is not doing what it's supposed to given consumers are so accustomed to having high tech utility on tap, thanks to the rise of smartphones or even consumer wearables.

Flow Neuroscience, the Swedish medtech we met in the first part of this series, has had to device a strategy to tackle the challenge of variable efficacy.

It's chosen to commercialize an electrical form of neurostimulation known as transcranial direct current stimulation (tDCS) for its first product, which is depression-treating wearable. However CEO and co-founder Erik Rehn accepts tDCS may not work for every person — but he's quick to point out that antidepressants and other drugs have the same issue: "With some people it works great, with others not."

"The reality of it is that people's brains are different, and also people's depression. Depression as a diagnosis is very heterogeneous," he tells TechCrunch. "It's a big problem, of course, but we're kind of stuck with the terminology… that's what treatments are approved for."

Medtech builders have two options, in Rehn's view. One: taking a "precision medicine" pathway that narrows and optimizes targeting – but also requires "advanced equipment" and techniques that may crimp accessibility and raise costs. Two: "Make something that's cheap and available to everyone, but it might not work for everyone – but everyone can try it." The second route is what Flow opted for.

This strategy shoots for greater scale, and in doing so — the idea is — there's a better chance of finding those patients who will respond well to the treatment. Crudely put, it could be described as spray and pray. (Or perhaps scale to prevail.) And, along the way, there will be some patients for whom the wearable therapeutic works as hoped and some who will be disappointed.

Rehn admits it would be "very interesting" to better understand and predict patient outcomes – and he says Flow has done research exploring why tDCS helps some people but not others. But moving too far in that direction this would shift the startup's strategy closer to the "precision medicine" approach he believes is too restrictive to build traction and scale.

How to maximize efficacy while also keeping neurotech cheap and convenient to use — while also building a viable business that can deliver returns to investors — is, he suggests, "an open question."

It’s striking how different Neurovalens’ approach is to this neurotech challenge of uncertain outcomes. It’s opted for an R&D intensive strategy that has enabled it to develop a range of devices during a pre-market phase, each aimed at distinct and precisely defined conditions (and, therefore, patients).

“We really want to have a well defined patient that has the very specific disease that we treat,” emphasizes McKeown.

This portfolio play allows the startup to tweak the neurostimulation dosage for each patient segment — a degree of targeting that should help it to mitigate uncertain outcomes. (So, for example, its wearable for treating anxiety is not just for anyone suffering anxiety but for the specific condition generalized anxiety disorder (GAD); similarly its insomnia device is not for any sleep disorder, just “chronic insomnia”.)

It’s fair to say this is not the typical startup approach as it involves years of preparatory way-paving before a budding business is even able to introduce its first products. Whereas Flow’s B2C (and, later, it hopes B2B) route looks more a more familiar startup playbook.

Having multiple medtech products in development simultaneously obviously ramps up costs and demands on the team. It also requires a decent funding cushion to support years of R&D before the business is in a position to pull in meaningful revenue from device sales. This explains why Neurovalens has raised so much more (around 3x) investor cash vs Flow (the Swedish startup had raised a total of just over $11M back in 2021 when it bagged its $9M Series A so appears to have taken a far leaner approach to funding.)

“We have been doing R&D for a long, long time,” McKeown admits. “It feels like forever.”

How has the startup stuck at it for so long? “We were quite reserved in our milestones,” he responds. “Every big milestone we hit ahead of time and ahead of budget gives investors confidence to keep reinvesting and to get to the next milestone.” Whereas, he suggests, an excess of ambition can lead to investors jumping ship when unrealistic expectations are not met.

Neurovalens getting its first couple of FDA approvals – the first was for the insomnia wearable in fall last year – was a major credibility milestone, he adds.

"Now that we have got our first two approvals then there's really no doubt in the investor's mind that we can do this."

Even with carefully curated patient segments, it's clear Neurovalens' neurostimulation won't work for every brain it's applied to. And, as we noted above, that's a particularly interesting challenge for a hardware startup to grapple with. Patients have learned to expect patchy results from popping pills but when it comes to consumer tech expectations can be a lot more demanding of insta results.

"People assume that it's a bit like an iPhone – that technology just works for everyone," McKeown observes, yet 'it just works' is not the case with neurotech. "There's a bit of an education piece."

One future hope for further reducing variable outcomes from non-invasive neurostimulation is if device makers can find ways to better personalize the treatment per patient. But that's something else startups in this space will have to scratch their heads over in the coming years.

Revolutionizing Neuroprosthetics Through AI-Driven Brain-Computer Interfaces: New Frontiers Unlocked by Dr. Pulicharla

he integration of Artificial Intelligence (AI) with neuroprosthetics is opening new horizons in the world of Brain-Computer Interfaces (BCIs). This innovative approach is transforming the way we understand human cognition and interaction with external devices, especially for individuals with neurological conditions. Dr. Mohan Raja Pulicharla's recent research, *"**AI-powered Neuroprosthetics for Brain-Computer Interfaces (BCIs)**,"* delves deep into this cutting-edge technology, exploring its potential and future implications.

What Are Brain-Computer Interfaces (BCIs)?

BCIs are systems that allow direct communication between the brain and external devices, enabling individuals to control machines or computers using their thoughts. Historically, BCIs have been an experimental technology used primarily in research settings. However, the advent of AI has propelled their development, allowing for more precise, adaptable, and efficient systems.

Applications and Future Impact

Dr. Pulicharla's study outlines several promising applications of AI-powered BCIs, particularly in medical settings. For instance, individuals with spinal cord injuries or neurodegenerative diseases can regain motor function through the use of neuroprosthetics controlled by BCIs. AI-powered systems can also assist stroke survivors in recovering speech or motor abilities by bypassing damaged neural pathways and directly connecting the brain to assistive devices.

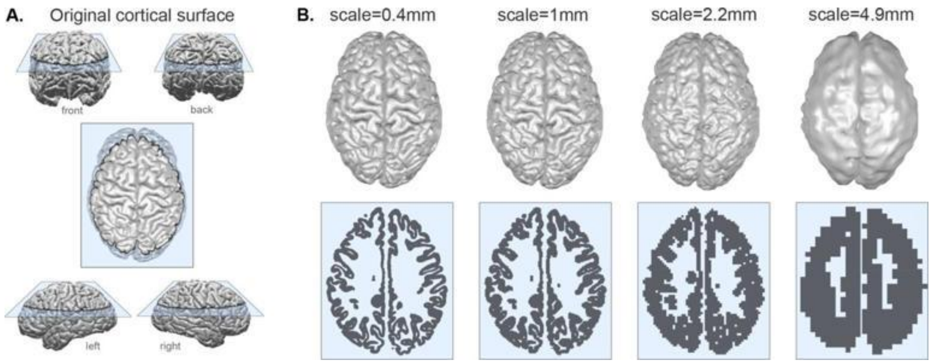
Beyond medical applications, this technology has the potential to revolutionize various industries. Imagine hands-free control of machinery, computers, or even vehicles, driven purely by thought. AI-powered BCIs could also serve as communication tools for individuals with severe disabilities, offering them a newfound sense of independence and control over their environment.

The Future of Human-Machine Integration

As highlighted in Dr. Pulicharla's research, the fusion of AI with BCIs and neuroprosthetics is still in its early stages, but the trajectory of this technology is clear. The enhanced capabilities provided by AI will allow BCIs to evolve from experimental setups to widely available tools with broad applications. The continuous development of AI algorithms, coupled with advancements in neuroprosthetic devices, will drive the next wave of innovation in human-machine integration.

In the coming years, we can expect AI-powered BCIs to become more intuitive, efficient, and accessible, with far-reaching impacts on healthcare, rehabilitation, and everyday life. Dr. Pulicharla's research marks an important step in this journey, paving the way for future breakthroughs in this rapidly evolving field.

For a deeper dive into this pioneering work, read the full article here: AI-powered Neuroprosthetics for Brain-Computer Interfaces (BCIs).



Coarse-graining a cortex at different scales. A: Example original pial surface from a healthy human viewed from varying angles. B: Same example cortical surface from A, coarse-grained to different spatial scales. Top row shows resulting pial surfaces (with a small amount of smoothing applied for visualization purposes here). Bottom row shows the corresponding voxelisation at each scale through the slice indicated by blue plane in panel A. Note that the actual size of the brains for analysis are rescaled; we display all brains scaled at an equal size here for the ease of visualization of the method. Credit: (2024). DOI: 10.7554/eLife.92080.3© Provided by Phys.org

Perfect balance: How the brain fine-tunes its sensitivity

A sensitive perception of the environment is crucial for guiding our behavior. However, an overly sensitive response of the brain's neural circuits to stimuli can lead to neurodevelopmental disorders such as epilepsy. University of Basel researchers report in the journal *Nature* how neuronal networks in the mouse brain are fine-tuned.

We are constantly exposed to a wide range of sensory stimuli, from loud noises to whispers. In order to efficiently process these diverse stimulus intensities, the brain needs to strike a balance in its responsiveness. An excessive sensitivity triggers an over-activation of nerve cells in response to a stimulus, leading to epileptic seizures. Conversely, insufficient sensitivity results in a reduced ability to perceive and discriminate stimuli.

But how does the brain manage to be highly sensitive without becoming over-activated? "The key lies in maintaining a balance between neural excitation and inhibition," explains Professor Peter Scheiffele from the Biozentrum, University of Basel.

"In mouse models, we have now discovered how this balance is maintained to ensure stable brain function." The study particularly focused on the neocortex, a brain area responsible for perception and a range of complex functions such learning.

Our brain consists of billions of interconnected nerve cells that interact through so-called synapses and process sensory stimuli such as sounds, touch, and sights. While excitatory neurons pass on the input signal, inhibitory neurons control the timing and intensity of the information flow. This internal control system ensures that the nervous system responds appropriately to stimuli.

Neurons are able to detect an elevated neuronal network activity and subsequently reduce the system's sensitivity to stimuli. But how the cells are instructed at the molecular level was poorly understood.

"We have now revealed that highly activated excitatory neurons release a protein called BMP2," says lead author Dr. Zeynep Okur. "BMP2 signals to the inhibitory neurons, initiating a genetic program that leads to the formation of new synapses." These additional synapses increase the impact of inhibitory neurons and dampen network activity.

This feedback mechanism is critical for tuning the sensitivity of neuronal networks, preventing over-activation and thus excessive responses to stimuli. "Switching-off the BMP2-induced genetic program in inhibitory neurons triggers epileptic seizures in mice, but only when they are older," explains Okur. Thus, this process is involved in long-term adaptations of cortical networks.

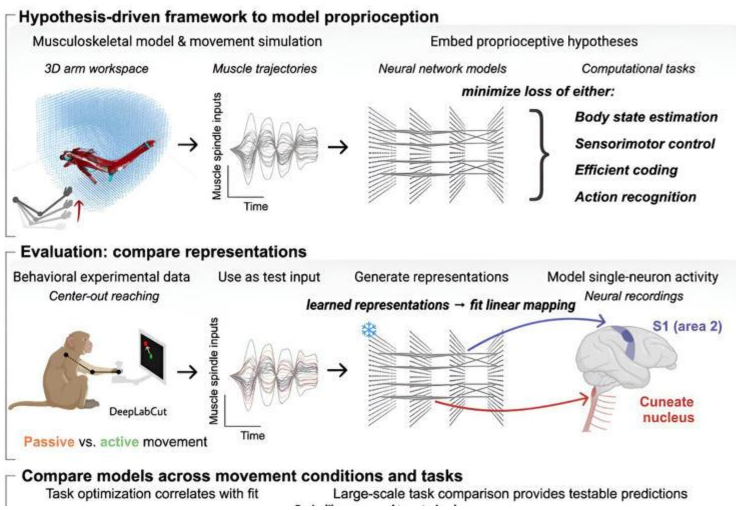
The BMP2 signaling pathway has been known for its role in early brain developmental, particularly in nerve cell differentiation. "We have been able to show that this pathway is re-purposed to stabilize neuronal circuits in the adult brain," emphasizes Scheiffele. This plays an important role for brain plasticity in adulthood—the basis for learning and memory.

"We now understand at the molecular level how neural networks balance excitation and inhibition," says Scheiffele. "With our work, we are expanding the repertoire of options to treat epilepsy and other neurodevelopmental disorders." Targeted interventions in the BMP2 signaling pathway could help to fine-tune and re-adjust brain sensitivity.

More information: Zeynep Okur et al, Control of neuronal excitation–inhibition balance by BMP–SMAD1 signalling, *Nature* (2024). DOI: 10.1038/s41586-024-07317-z

Provided by University of Basel

Unraveling the 'sixth sense': New study explores how the brain senses body position and movement



Graphical abstract. Credit: Cell (2024). DOI: 10.1016/j.cell.2024.02.036© Provided by Medical Xpress

How does your brain know the position and movement of your different body parts? The sense is known as proprioception, and it is something like a "sixth sense," allowing us to move freely without constantly watching our limbs.

Proprioception involves a complex network of sensors embedded in our muscles that relay information about limb position and movement back to our brain. However, little is known about how the brain puts together the different signals it receives from muscles.

A new study led by Alexander Mathis at EPFL now sheds light on the question by exploring how our brains create a cohesive sense of body position and movement. Published in *Cell*, the study was carried out by Ph.D. students Alessandro Marin Vargas, Axel Bisi, and Alberto Chiappa, with experimental data from Chris Versteeg and Lee Miller at Northwestern University.

"It is widely believed that sensory systems should exploit the statistics of the world, and this theory could explain many properties of the visual and auditory system," says Mathis. "To generalize this theory to proprioception, we used musculoskeletal simulators to compute the statistics of the distributed sensors."

The researchers used this musculoskeletal modeling to generate muscle spindle signals in the upper limb to generate a collection of "large-scale, naturalistic movement repertoire." They then used this repertoire to train thousands of "task-driven" neural network models on sixteen computational tasks, each of which reflects a scientific hypothesis about the computations carried out by the proprioceptive pathway, which includes parts of the brainstem and somatosensory cortex.

Our brains take rhythmic snapshots of the world as we walk

For decades, psychology departments around the world have studied human behavior in darkened laboratories that restrict natural movement.

Our new study, published today in *Nature Communications*, challenges the wisdom of this approach. With the help of virtual reality (VR), we have revealed previously hidden aspects of perception that happen during a simple everyday action—walking.

We found the rhythmic movement of walking changes how sensitive we are to the surrounding environment. With every step we take, our perception cycles through "good" and "bad" phases.

This means your smooth, continuous experience of an afternoon stroll is deceptive. Instead, it's as if your brain takes rhythmic snapshots of the world—and they are synchronized with the rhythm of your footfall.

The next step in studies of human perception

In psychology, the study of visual perception refers to how our brains use information from our eyes to create our experience of the world.

Typical psychology experiments that investigate visual perception involve darkened laboratory rooms where participants are asked to sit motionless in front of a computer screen.

Often, their heads will be fixed in position with a chin rest, and they will be asked to respond to any changes they might see on the screen.

This approach has been invaluable in building our knowledge of human perception, and the foundations of how our brains make sense of the world. But these scenarios are a far cry from how we experience the world every day.

This means we might not be able to generalize the results we discover in these highly restricted settings to the real world. It would be a bit like trying to understand fish behavior, but only by studying fish in an aquarium.

Instead, we went out on a limb. Motivated by the fact our brains have evolved to support action, we set out to test vision during walking—one of our most frequent and everyday behaviors.

A walk in a (virtual) forest

Our key innovation was to use a wireless VR environment to test vision continuously while walking.

Several previous studies have examined the effects of light exercise on perception, but used treadmills or exercise bikes. While these methods are better than sitting still, they don't match the ways we naturally move through the world.

Instead, we simulated an open forest. Our participants were free to roam, yet unknown to them, we were carefully tracking their head movement with every step they took.

We tracked head movement because as you walk, your head bobs up and down. Your head is lowest when both feet are on the ground and highest when swinging your leg in-between steps. We used these changes in head height to mark the phases of each participant's "step-cycle."

Participants also completed our visual task while they walked, which required looking for brief visual "flashes" they needed to detect as quickly as possible.

By aligning performance on our visual task to the phases of the step-cycle, we found visual perception was not consistent.

Instead, it oscillated like the ripples of a pond, cycling through good and bad periods with every step. We found that depending on the phases of their step-cycle, participants were more likely to sense changes in their environment, had faster reaction times, and were more likely to make decisions.

Oscillations in nature, oscillations in vision

Oscillations in vision have been shown before, but this is the first time they have been linked to walking.

Our key new finding is these oscillations slowed or increased to match the rhythm of a person's step-cycle. On average, perception was best when swinging between steps, but the timing of these rhythms varied between participants. This new link between the body and mind offers clues as to how our brains coordinate perception and action during everyday behavior.

Next, we want to investigate how these rhythms impact different populations. For example, certain psychiatric disorders can lead to people having abnormalities in their gait.

There are further questions we want to answer: are slips and falls more common for those with stronger oscillations in vision? Do similar oscillations occur for our perception of sound? What is the optimal timing for presenting information and responding to it when a person is moving?

Our findings also hint at broader questions about the nature of perception itself. How does the brain stitch together these rhythms in perception to give us our seamless experience of an evening stroll?

These questions were once the domain of philosophers, but we may be able to answer them, as we combine technology with action to better understand natural behavior.

Neuroscientists discover small group of dopamine neurons play critical role in controlling range of behaviors

A finding by a McGill-led team of neuroscientists could open doors to new treatments for a range of psychiatric and neurological disorders attributed to dysfunctions in specific dopamine pathways.

For those struggling with a psychiatric disorder such as schizophrenia, addiction or ADHD, or with neurological disorders such as Parkinson's disease or Alzheimer's, there might be good news ahead. The neuroscientists have discovered that a small group of dopamine neurons in the striatum play a crucial role in balancing several essential brain functions, including those related to reward, cognition and movement.

Dopamine is a messenger molecule that is often associated with pleasure and reward. But it plays an equally important role in mood regulation, sleep and digestion, as well as in motor and cognitive functions. An excess release of dopamine, induced by certain drugs or behaviors, is responsible for addiction. Conversely, its absence can cause profound alterations in motor control, as is the case in Parkinson's disease.

A critical balancing act

Scientists had previously identified the functions of two distinct pathways and types of dopamine receptors in the forebrain: the D1 receptors, which activate neurons, and the D2 receptors, which inhibit them. A third group of dopamine receptors that possess both D1 and D2 dopamine receptors was known to exist, but until now, no one had been able to identify their specific function.

By using innovative genetic tools to specifically target these dopamine receptors, which comprise just five percent of the dopamine neurons in the striatum, the researchers were able to begin to understand their functions.

The researchers discovered that this group of neurons present unique cellular characteristics in response to dopamine and are at the origin of a new pathway that is essential for the balance of forebrain functioning. It ensures motor control under normal physiological conditions and curbs hyperactivity induced by psychostimulant drugs.

"Without these neurons, the entire brain systems under dopamine control would become overactive and uncontrollable, since they act to balance the functions of the two types of dopamine receptors in the brain which either facilitate or inhibit the activation of the two pathways we already knew of," explains Bruno Giros, a professor in McGill's department of psychiatry and a researcher at the Douglas Hospital Research Institute. He is the senior author of a recent article on the subject published in *Nature Neuroscience*.

"It's a very exciting finding for us because we've been working on this specific project for close to eight years in collaboration with a team at Université Libre de Bruxelles (ULB)."

For Giros, the discovery comes after 30 years of work in the field, including alongside renowned neuroscientist Marc Caron and 2012 Nobel prize winner Robert J. Lefkowitz as a postdoctoral fellow at Duke University Medical Centre.

"We are only in the early days of working with the tools that we developed to help us to identify this pathway," adds Alban de Kerchove d'Exaerde from the Neurophy Lab at ULB, who collaborated on the research. "I'm sure that a lot of laboratories will work with our tools and will, with time, discover more about the important role that this very specific pathway plays in various fields."

Giros adds, "Now that we understand how this third pathway controls motor functions, the next goal of our research will be to understand more precisely how it is implicated in the control of cognitive processes, and how it could be impaired in psychiatric disorders."

More information: Patricia Bonnavion et al, Striatal projection neurons coexpressing dopamine D1 and D2 receptors modulate the motor function of

D1- and D2-SPNs, *Nature Neuroscience* (2024). DOI: 10.1038/s41593-024-01694-4

Provided by McGill University

Human study provides evidence that theta phase precession supports memory formation and retrieval

Past neuroscience research has pinpointed many of the neural processes through which the human brain forms, stores and retrieves important information, such as domain-specific knowledge and memories. One dimension of human memory is the ability to link various aspects of experience to specific life events.

Past studies have suggested that this memory-related process is supported by phase precession, which is a shift in the timing at which specific neurons are fired. Up until now, however, this hypothesis had not been confirmed experimentally.

Researchers at the University of California, Davis, Harvard Medical School, Toronto Western Hospital and Cedars-Sinai Medical Center recently carried out a study aimed at probing the relationship between phase precession and memory.

Their findings, published in *Nature Human Behaviour*, suggest that theta phase precession, the shift in the time at which specific neurons fire relative to the theta rhythm in brains, contributes to memory formation and retrieval.

"Our study was inspired by previous work showing that the relative timing of spikes with respect to population activity in the form of field potentials dynamically changes as animals navigate through an environment," Jie Zheng, first author of the paper, told Medical Xpress.

"Extending this idea to human memory, the primary objective here was to test the functional role of such dynamic spike timing signals during episodic memory formation and retrieval of complex event sequences in a natural and non-spatial task."

Zheng and her colleagues recruited 22 study participants and recorded single-neuron activity and local field potentials in their medial temporal lobe as they encoded and retrieved memories from movie clips. The team embedded the movie clips with event boundaries (i.e., contextual shifts), as this allowed them to mimic the process through which humans form memories in their everyday lives.

The researchers subsequently asked participants to recall events they observed in the movie clips and the order in which they occurred. They then analyzed the single-neuron activity they recorded as the participants were both viewing the movie clips and recalling the memory of the watched clips.

"The study was conducted in patients with pharmacologically resistant epilepsy where we could concurrently record the activity of individual neurons as well as population field potential signals," said Zheng. "We observed that the precise time at which neurons fired was related to the ongoing theta rhythms inside brains and that this relative timing evolved dynamically (called phase precession)."

The experiments carried out by Zheng and her colleagues yielded very interesting results. The team observed dynamic phase precession in the brains of participants throughout the experiment, with specific neurons shifting the timing with which they fired at different stages of the experimental task.

"We found strong theta phase precession at event boundaries when participants watched the clips and also when the participants answered memory questions," said Zheng. "The strength of theta phase precession was also predictive of participants' memory accuracy, especially for their order memory."

Overall, the findings of this recent study confirm the role of theta phase procession in the formation and retrieval of episodic memories. In the future, they could pave the way for further studies exploring the link between phase precession and specific memory processes.

"We would like to investigate the mechanisms underlying memory formation and retrieval of dynamic experiences with different sensory inputs (e.g., both visual and auditory), how the order of events is encoded, and how theta phase precession supports these consolidation and retrieval processes," added Zheng.

More information: Jie Zheng et al, Theta phase precession supports memory formation and retrieval of naturalistic experience in humans, *Nature Human Behaviour* (2024). DOI: 10.1038/s41562-024-01983-9

Scientists discover "glue" that holds memory together in fascinating neuroscience breakthrough

A team of scientists has made a significant discovery about how the brain retains long-term memories. They identified the molecule KIBRA, which acts as a "glue" to anchor PKMζ, an enzyme critical for strengthening synaptic connections between neurons. This interaction ensures that memories are not lost as brain proteins degrade and regenerate, offering a deeper understanding of memory stability. The findings have been published in *Science Advances*.

The scientists were driven by a long-standing question in neuroscience: how can memories last for years or even decades when the molecules in our brains are constantly being replaced? Neurons store information in the strength of synapses, but the proteins and molecules in those synapses are unstable and degrade after just a few days. This creates a puzzle—if the building blocks of memory are so short-lived, what allows us to maintain long-term memories?

The idea that certain molecular interactions might provide stability to memory storage has been around since 1984, when Francis Crick proposed that continuous interactions between proteins might maintain synaptic strength over time. This new study sought to explore this hypothesis further, focusing on the role of PKMζ and how its interaction with another molecule, KIBRA, might contribute to the stability of long-term memory.

"I have been interested in memory since I was a little boy. I also had the sense that there were always deeper, simpler levels of understanding for any mysterious process, and I was driven by curiosity to find the deepest for memory," said study author Todd C. Sacktor, a distinguished professor at SUNY Downstate Health Sciences University.

Sacktor explained that in college, he became interested in understanding how memory is stored at the molecular level, focusing on the persistent strengthening of synapses during learning. During his neurology residency at Columbia, he worked in James Schwartz's lab, which guided him toward discovering PKMζ, an enzyme that strengthens synaptic connections.

"The rest was simply trying to figure out what PKMζ did and how it worked," Sacktor continued. "Ultimately, for memory to last years, i.e., beyond the lifespans of individual molecules, we realized PKMζ had to have a partner, which is the discovery presented in this paper."

André Fenton, a professor of neural science at New York University and another of the study's principal investigators, added that he was drawn to this research because he is interested in uncovering the fundamental processes underlying our subjective experience.

"While experience requires complex brain activity to process information, I have long thought that our concept of memory is essential to this processing, not merely for storing what has already happened but also for generating expectations and beliefs that influence, if not dictate, subsequent experience," Fenton said. "While it has always been a fascinating problem to work out how memory can persist for years when the constituent protein components only last days to weeks, work that challenged some of our prior findings and understanding pointed to a solution."

To explore the connection between KIBRA and PKMζ, the researchers used male laboratory mice. The scientists conducted a series of experiments involving hippocampal slices, a region of the brain critical for memory, and various techniques such as proximity ligation assays and confocal microscopy to visualize the molecular interactions between KIBRA and PKMζ.

They also used genetically modified mice lacking PKMζ to see how memory maintenance differed when this enzyme was missing. In addition, behavioral tests, such as spatial memory tasks, were used to assess the impact of disrupting the KIBRA-PKMζ interaction on memory retention.

One key experiment involved applying a drug called ζ-stat, which blocks the interaction between KIBRA and PKMζ, to see if this would disrupt the stability of synaptic potentiation and long-term memory. Another experiment introduced a peptide called K-ZAP, which mimics KIBRA's binding site and interferes with its ability to anchor PKMζ, further testing the importance of this interaction.

The study found evidence that KIBRA plays a vital role in stabilizing PKMζ at synapses, effectively creating a "persistent synaptic tag" that helps maintain long-term memory. The researchers found that when synapses are activated during learning, KIBRA binds to those synapses and helps PKMζ stay attached. This connection ensures that the synapses remain strong, even as other molecular components degrade and are replaced.

"For the first time, we have a fundamental biological understanding of how memory can last for years, perhaps even decades," Sacktor told PsyPost.

Memories are stored by the interaction of two proteins: a structural protein, KIBRA (green), that acts as a persistent synaptic tag, and a synapse-strengthening enzyme, protein kinase Mzeta (red). Drugs that disrupt the memory-perpetuating interaction (other colors) erase pre-established long-term and remote memories. (Credit: Changchi Hsieh)© PsyPost

More specifically, they observed that when ζ-stat was used to block the KIBRA-PKMζ interaction, it reversed the potentiation of synapses that had previously been strengthened during learning. This effect was selective, impacting only the activated synapses that were involved in memory formation, while leaving unactivated synapses unaffected. This indicates that the KIBRA-PKMζ interaction is crucial for maintaining the strength of memory-related synapses.

In behavioral tests, disrupting the KIBRA-PKMζ interaction in mice also led to a loss of long-term memory. Mice that received ζ-stat injections after learning a spatial memory task were unable to recall the location of a shock zone in subsequent tests. Interestingly, this effect was not seen in genetically modified mice that lacked PKMζ, further confirming that KIBRA's interaction with PKMζ is essential for memory maintenance.

The researchers also found that this molecular interaction is not just important for short-term memory, but can maintain memory for weeks. Even when PKMζ was degraded over time, the KIBRA-PKMζ complexes remained at the synapses, suggesting that new PKMζ molecules continue to be synthesized and incorporated into the same synaptic locations, allowing memories to persist long after the initial learning.

"The persistent KIBRA-PKMζ interaction explains how memory can last for a lifetime, something humans have been trying to understand for a very long time, at least since Plato wrote about it," Fenton said.

"But there's more if we connect some dots. A human brain is made up of about 100 billion neurons, each of which receives input connections at synapses from about 10 thousand other neurons. When we have any experience we use the neural circuits of our brain to process information defined by the flow of electrochemical activity through subnetworks of those connections between millions of neurons. Memory may be the result of experience changing those connections, typically a very small (1%) subset. How does an experience today persistently change connections so memory of the experience last years?"

"Our work determined that memory is the result of an active, ongoing biochemical process in which the kinase action of a persistently active catalyst protein, PKMζ is targeted to the experience-activated connections within the neurons that constitute the information processing connections of the experience-mediating neural circuit," Fenton explained. "PKMζ is generated in an activated neuron and because KIBRA, a targeting molecule accumulates at the activated connections, it directs the kinase action of PKMζ to those specific locations.

"The KIBRA-PKMζ interaction persists because the KIBRA-PKMζ complex is more stable than the individual protein components and like the paradox of Theseus' ship persisting despite all the planks being replaced, the KIBRA-PKMζ complex persists even though the individual protein components are continually replaced."

"The takeaway is that experience activates neural circuits that process information and that processing creates memory, which depends on an elegant continually active biophysical process, which at once stores information and by storing that information also changes the neural circuit and with it the information processing within which future experience will occur," Fenton told PsyPost. "Memory is about the future."

Although the study offers strong evidence that KIBRA is crucial for sustaining long-term memory by stabilizing PKMζ at synapses, certain limitations remain. The researchers acknowledge that not all forms of memory may rely on this molecular interaction. For example, the study found that some types of memory, such as contextual fear memory, are maintained through PKMζ-independent mechanisms. Understanding how these different systems operate will require further investigation.

“There are some memories that are not stored by PKMζ,” Sacktor noted. “Does KIBRA play a role in these by interacting with a different, but related synapse-strengthening molecules, or is there completely different mechanisms?”

Another limitation is that while KIBRA helps explain how memories can last for years despite molecular turnover, the study did not fully explain how the process of memory formation begins—specifically, how KIBRA is initially recruited to the synapses involved in memory formation. This will be an important area for future research.

The researchers also plan to explore the potential applications of their findings for treating memory-related disorders. Since the KIBRA-PKMζ interaction is so critical for memory stability, drugs that target this process could potentially be used to enhance memory in conditions like Alzheimer’s disease or to weaken harmful memories in conditions like post-traumatic stress disorder.

“We wish to explain how the process of memory persistence is initiated,” Fenton said. “In other words, how does the KIBRA appear and accumulate; how are the memory-changed connections arranged within a neuron and between neurons; how specifically does the KIBRA-PKMζ mediated change in connections change information processing; and how can this fundamental neurobiology be used to improve outcomes in disorders like Alzheimer’s disease, and mental illness?”

“In any fundamental discovery in biology, there will be ‘low-lying fruit’ in medicine—diseases that can now be treated,” Sacktor said. “Often which diseases cannot be predicted ahead of time. I am curious which psychiatric or neurological diseases it will be for the discovery of KIBRA-PKMζ’s role in memory.”

“Doing this work is painstakingly slow and careful, and at times frustrating but has always been joyous!” Fenton added.

The study, "KIBRA anchoring the action of PKMζ maintains the persistence of memory," was authored by Panayiotis Tsokas, Changchi Hsieh, Rafael E. Flores-Obando, Matteo Bernabo, Andrew Tcherepanov, A. Iván Hernández, Christian Thomas, Peter J. Bergold, James E. Cottrell, Joachim Kremerskothen, Harel Z. Shouval, Karim Nader, André A. Fenton, and Todd C. Sacktor.

Activating One Specific Brain Cell Extended Lifespan in Mice by 70 Days

Aging might have advantages in wisdom, experience, and even evolution, but the gradual breakdown of biology that comes with growing old is rarely much fun for anybody.

A new study in mice suggests it may not always have to be this way.

"We demonstrated a way to delay aging and extend healthy lifespans in mice by manipulating an important part of the brain," says Washington University developmental biologist Shin-ichiro Imai.

Our brains control a vast number of bodily functions, primarily by way of nervous impulses, which can manage communication networks based on the ebb and flow of hormones.

The infrastructure carrying these communication signals and their surroundings deteriorate as we age, causing increasing faults.

So our organs and tissues start to miss out on signals needed to maintain themselves.

Signaling chemicals that form parts of the pathway between our brains and fat tissues, specifically white adipose fat, have been associated with aging in mice previously, so Imai and colleagues took a closer look at the critical early steps in this communication network.

They allowed one group of rodents to age naturally while tweaking the neurons at the beginning of the brain to fat pathway so they remained active. These cells, DMHPpp1r17, are tucked away in our brain's hypothalamus, an important conduit between our nervous system and the body's hormone system.

Incredibly, the mice that received the neuron activation treatment lived 60 to 70 days longer than the control mice, who died within the typical laboratory mouse lifespan of about 1,000 days.

More importantly, the mice that underwent neural treatment had thicker, shinier coats and were more active during their old age, suggesting they were healthier for longer too.

Further investigation revealed parts of the mechanism at play.

When the DMHPpp1r17 neurons are on, they can activate our body's fight or flight response – our sympathetic nervous system using the Ppp1r17 molecule. This promotes the use of our body's white adipose stores that release a protein called eNAMPT, which in turn regulates hypothalamus neurons, completing the circuit.

"Ppp1r17 is also well conserved in various vertebrate species such as human, chimpanzee, monkey, rat, mouse, bovine, rabbit, chicken, xenopus, and zebra finch, suggesting that Ppp1r17 carries some essential functions throughout evolution," the researchers explain in their paper.

This is a vital circuit for fueling our bodies, but the normal aging mice started producing less Ppp1r17, activating fewer fat stores.

With less activity, the nerves through our adipose tissues begin to degrade, meaning even less eNAMPT is produced, so even fewer hypothalamus neurons are activated, creating a self-propagating system of deterioration.

There are still many details to hash out, including if eNAMPT works directly on the hypothalamic neurons or if there are more intermediary steps. The team is also keen to discover if this feedback loop influences communication between other tissue types within our bodies, like skeletal muscle.

If so, this could explain an awful lot, as many known factors of biological aging, including stress and stress mitigators, weight, and exercise, all influence some part of this brain to fat system – another example of just how physiologically linked we are to the world around us.

This research was published in *Cell Metabolism*.

Scientists show how shallow learning mechanism used by the brain can compete with deep learning

Neural network learning techniques stem from the dynamics of the brain.

However, these two scenarios, brain learning and deep learning, are intrinsically different. One of the most prominent differences is the number of layers each one possesses.

Deep learning architectures typically consist of numerous layers that can be increased to hundreds, enabling efficient learning of complex classification tasks. Contrastingly, the brain consists of very few layers, yet despite its shallow architecture and noisy and slow dynamics, it can efficiently perform complex classification tasks.

The critical question driving new research is the possible mechanism underlying the brain's efficient shallow learning, enabling it to perform classification tasks with the same accuracy as deep learning. In an article published in *Physica A: Statistical Mechanics and its Applications*, researchers from Bar-Ilan University in Israel show how such shallow learning mechanisms can compete with deep learning.

"Instead of a deep architecture, like a skyscraper, the brain consists of a wide shallow architecture, more like a very wide building with only very few floors," said Prof. Ido Kanter of Bar-Ilan's Department of Physics and Gonda (Goldschmied) Multidisciplinary Brain Research Center, who led the research.

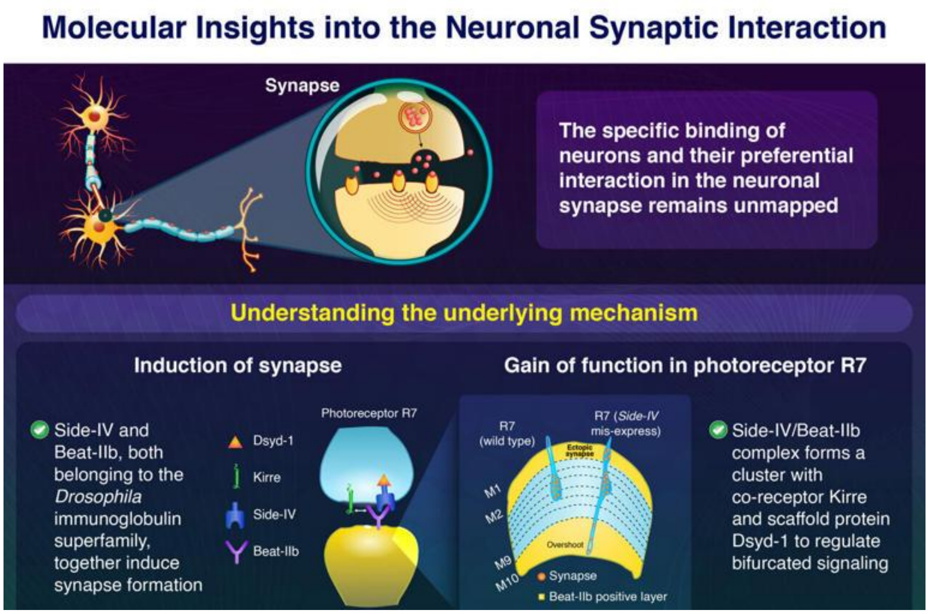
"The capability to correctly classify objects increases where the architecture becomes deeper, with more layers. In contrast, the brain's shallow mechanism indicates that a wider network better classifies objects," said Ronit Gross, an undergraduate student and one of the key contributors to this work. "Wider and higher architectures represent two complementary mechanisms," she added.

Nevertheless, the realization of very wide shallow architectures, imitating the brain's dynamics, requires a shift in the properties of advanced GPU technology, which is capable of accelerating deep architecture, but fails in the implementation of wide shallow ones.

More information: Ofek Tevet et al, Efficient shallow learning mechanism as an alternative to deep learning, *Physica A: Statistical Mechanics and its Applications* (2024). DOI: 10.1016/j.physa.2024.129513

Provided by Bar-Ilan University

A molecular route to decoding synaptic specificity and nerve cell communication



This study provides insights into the molecular mechanisms underlying the neuronal synaptic interaction. Credit: Tokyo Tech© Provided by Medical Xpress

Neurons or nerve cells are the fundamental components of the central nervous system and are critically involved in signal transduction pathways. Transmission of information or signal from one neuron to another requires the establishment of a neuronal synapse: either chemical (neurotransmitters) or electrical (protein channels and ions). However, little is known about the underlying mechanism regarding the binding specificity and the ability to form preferential interactions between neuronal pairs.

In this regard, a team of researchers from Japan, led by Associate Professor Takashi Suzuki from the School of Life Science and Technology at Tokyo Institute of Technology (Tokyo Tech), recently attempted to unravel the molecular mechanisms behind the complex neuronal communication circuit.

Dr. Suzuki explains, "Take, for example, a person driving an automobile. The precise and rapid communication between the driver's perception and the locomotor system can be the difference between life and death. The appropriate functioning of the nervous system ultimately comes down to a precise synaptic interaction between different types of neurons.

"Hence, our group focused on studying the molecular mechanisms of synaptic specificity using Drosophila, which allowed a genotypic as well as phenotypic assessment."

The researchers employed a combination of genomic and interactome (protein–protein interactions) analyses to identify the molecular mechanisms involved in synaptic communication.

The results revealed that the specific interaction of Side-IV/Beat-IIb immunoglobulin superfamily protein molecules was responsible for inducing the formation of synapse. This combination of Side-IV/Beat-IIb was central to the synaptic specificity between neurons. Side-IV/Beat-IIb, along with Side-IV's co-receptor, Kirre, and Dsyd-1, a synaptic scaffold protein, formed a cluster to regulate a preferential signaling mechanism among neuron pairs.

The research findings were published in *Cell Reports*.

Knockdown studies of synaptic scaffold protein Dsyd-1 and Liprin-α revealed the suppression of synapse formation. Moreover, Side-IV protein interaction with Dsyd-1 led to the formation of an active zone and resulted in a higher preference for synapse formation between specific neurons, thereby preventing miswiring.

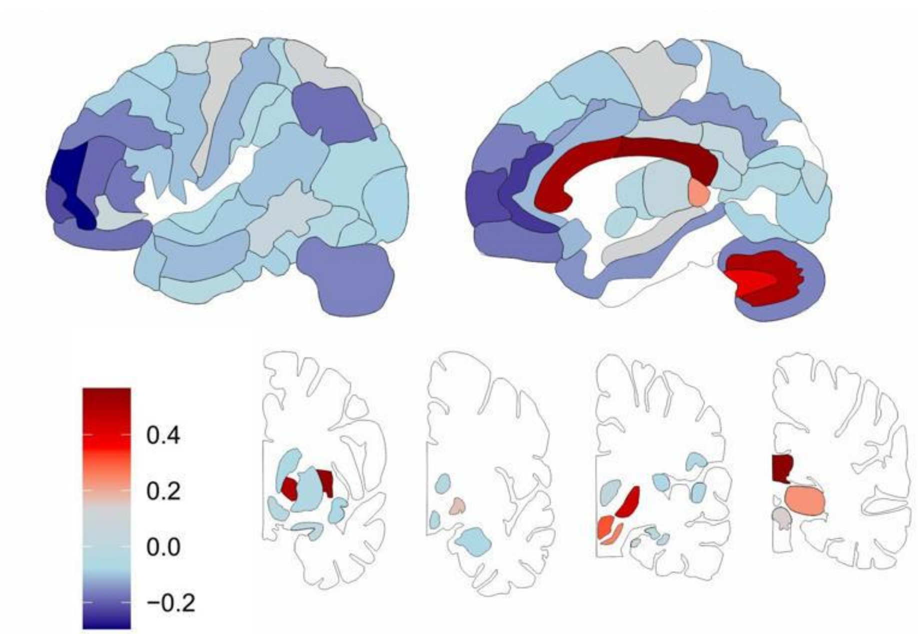
Dr. Suzuki says, "We believe that our study can contribute to our current understanding of neuronal synapse and hierarchical ranking interactions among neuronal pairs. Future research involving higher order mutant species can build on our study to address the neurodegenerative disease landscape and aid in developing therapeutic strategies in the long term."

Overall, this study sheds valuable light on the molecular intricacies of neuronal communication.

More information: Jiro Osaka et al, Complex formation of immunoglobulin superfamily molecules Side-IV and Beat-IIb regulates synaptic specificity, *Cell Reports* (2024). DOI: 10.1016/j.celrep.2024.113798

Provided by Tokyo Institute of Technology

Scientists map the distribution of lipids in the human brain



Distribution of cholesterol in the human brain. Credit: Maria Osetrova© Provided by Medical Xpress

Scientists have found that 93% of the lipids in brain tissue are distributed differently in the white and gray matter, the subcortex, the visual and motor cortices, and the prefrontal cortex, which is responsible for decision-making, social behavior, and other functions.

Abnormalities in the brain lipidome tend to occur in mental and cognitive disorders, so mapping these molecules should help gain more information about the disease. The research was published in *Nature Communications*.

A major component of brain tissue, lipids are fatty compounds that make up 35%–40% of all the molecules in the gray matter cell bodies and as much as 78% of the axons' myelin sheaths in the white matter. Brain tissue lipids are very diverse and include cholesterol, phosphorus-containing compounds, such as phospholipids and sphingolipids, and other molecules.

Since lipids are involved in the metabolism and growth of neurons, the delivery of signals between cells and the control of inflammatory processes, abnormalities in the lipidome composition have been associated with cognitive disorders, such as autism, schizophrenia, and Alzheimer's disease.

However, the relationship between the lipidome and the structural features of brain tissue remains poorly understood, limiting the use of lipids as molecular markers for detecting brain diseases.

Researchers from the Skolkovo Institute of Science and Technology and their colleagues have created the world's first map of human brain lipids. They studied brain tissue samples from four healthy individuals and assessed the lipid composition in 75 different parts of the brain.

The lipids in the samples were identified using mass spectrometry, which allows determining a molecule's structure from the mass to charge ratio and its motion pattern in a magnetic field.

The researchers found a total of 419 different lipids, most of them (93%) unevenly distributed among the different parts of the human brain. For example, the subcortex (the oldest part of the brain), motor and visual cortices had relatively high levels of cholesterol, while the prefrontal cortex responsible for complex social behavior and decision-making had relatively low levels of this lipid.

Since most lipids are found in the myelin sheaths, the team checked whether the myelin content in a particular part of the brain affected its typical lipidome. The myelin-rich white matter turned out to contain mostly ceramides, two classes of phospholipids, and lipids with saturated fatty acids.

Since the main function of the white matter is to transmit signals via axons, these types of lipids are thought to be essential for the tissue to perform its function.

Polyunsaturated fatty acid lipids prevailed in the gray matter, which contains a concentration of cell bodies rather than axons and virtually no myelin. This suggests that such molecules may be important for signal processing in cells.

"In the future, we plan to thoroughly investigate the subcortical lipidome which was only partially covered by this research, and to study brain samples from patients with various mental disorders.

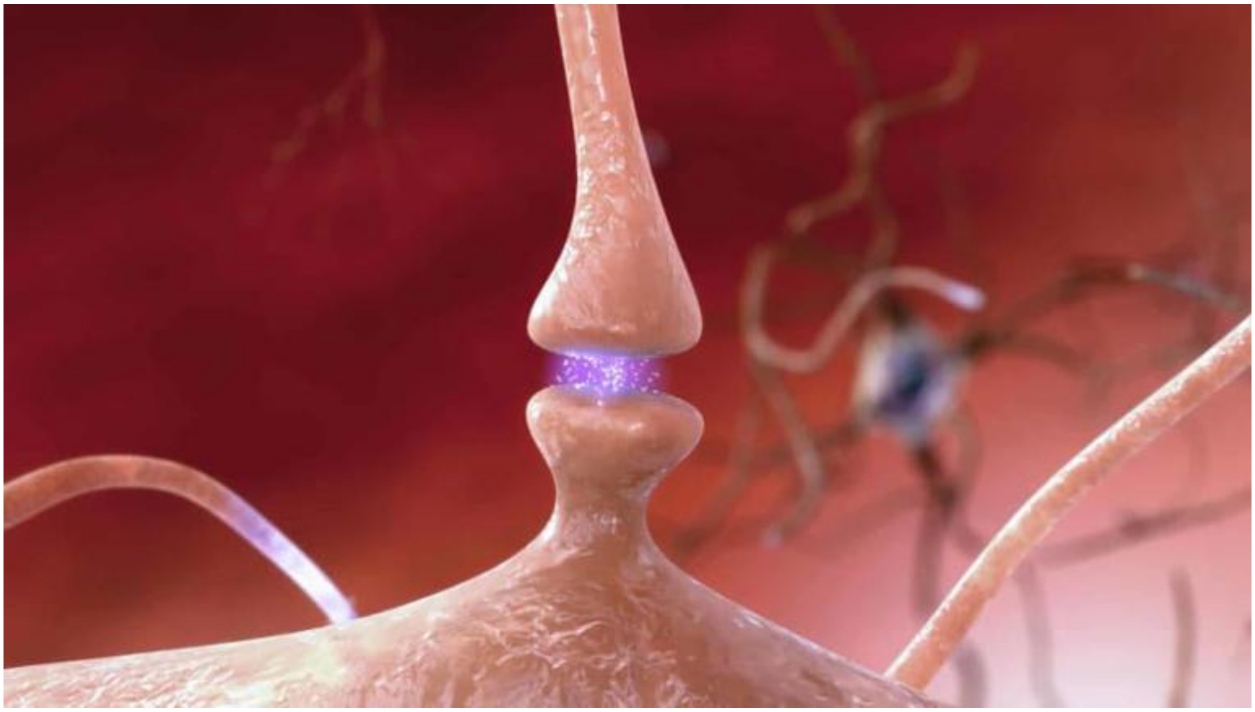
"The potential complete 'decoding' of the lipidome will help us to better understand the nature of mental illness and its impact on the structure and functioning of the brain," said Maria Osetrova, a research engineer at the Skoltech Neuro Center.

Other organizations involved in this research included Lomonosov Moscow State University, the Semenov Federal Research Center for Chemical Physics of RAS (Moscow), the University of Leipzig (Germany), and the National University of Singapore.

More information: Maria Osetrova et al, Lipidome atlas of the adult human brain, *Nature Communications* (2024). DOI: 10.1038/s41467-024-48734-y

Provided by Skolkovo Institute of Science and Technology

Human brain can store 10 times more information than previously thought



Our memories and thoughts stem from complex patterns of electrical and chemical activity in the brain. Central to this activity are synapses, the junctions where branches of neurons connect, similar to electrical wires. Here, an axon from one neuron links to a dendrite of another. At these synapses, neurotransmitters carry signals across the gap, instructing the receiving neuron to pass on an electrical signal to others. Remarkably, each neuron can form thousands of these connections.

Similar to computers, we measure the brain's memory storage in "bits," and the number of bits it can hold rests on the number and strength of its synapses. It's worth noting that brains are analog — just so you don't get the wrong idea. Brains process everything in parallel, in continuous time rather than in discrete intervals, so the "bit" (the smallest unit of digital data) in this case is not a perfect analogy for how information is stored in a biological system. Nevertheless, it serves the purpose of estimating information processing.

Previously, it was believed that synapses came in very limited sizes and strengths. However, recent research suggests otherwise. The human brain's capacity to store information is almost ten times greater than previously estimated, according to a new study.

New Insights into Synaptic Strength and Memory Storage

A team of researchers from the University of California, San Diego and the Salk Institute developed a highly precise method to assess the strength of synapses in the brain of a rat. These synapses, where brain cells communicate and store information, play a critical role in learning and memory. By understanding how synapses strengthen and weaken, the scientists precisely quantified the information storage capacity of these connections.

In the human brain, over 100 trillion synapses exist between neurons. These synapses facilitate information transfer across the brain by launching chemical messengers. As we learn, specific synapses strengthen, enabling us to retain new information. This process is known as synaptic plasticity, is essential for memory formation and cognitive function.

When neurons talk, they do so at different volumes — some neurons whisper to each other while others shout. The 'volume' setting of the synapse, or the synaptic strength, is not static, but rather can change in both the short term and long term. Synaptic plasticity refers to these changes in synaptic strength.

However, aging and neurological diseases like Alzheimer's can weaken synapses, reducing our cognitive ability. This is why studies like these are important — they can help scientists unlock new therapies that may stave off or even cure neurodegenerative diseases that currently plague millions of patients across the world. However, measuring the strength of synapses has traditionally been challenging.

The team analyzed pairs of synapses from a rat hippocampus, a brain region vital for learning and memory. The new study's method leverages information theory, which allows scientists to quantify how much information synapses can store and transmit. What this means is that a framework typically reserved for computers was applied to the brain in order to estimate the number of bits that synapses can hold. They found that these pairs of synapses responded to the same type and amount of brain signals, performing synaptic strength adjustment.

Current and Future Potential

Ultimately, this analysis indicated that hippocampal synapses could store between 4.1 and 4.6 bits of information. Scientists thought each synapse could hold one bit. Overall, this means the human brain could store ten times more information than previously thought, or at least a petabyte — that's as much as 500 billion DVDs or all the movies ever made in high-definition.

While the study focuses on a small part of the rat brain, future research could explore how information storage capacity varies across different brain areas and species. This method could also compare healthy and diseased brain states, offering insights into conditions that affect cognitive functions.

In 2016, the Salk researchers reached the same conclusions. The new findings serve to confirm this initial assessment. Back then, the researchers also made another important revelation: there are at least 26 size categories of synapses, rather than just a few.

These findings also provide insight into the brain's remarkable efficiency. Despite its complexity, the waking adult brain uses only about 20 watts of continuous power, comparable to a very dim light bulb. These discoveries could inspire computer scientists to design highly precise yet energy-efficient computers. These innovations could particularly benefit "deep learning" and artificial neural networks, enhancing their capabilities in areas like speech recognition, object identification, and language translation.

The findings appeared in the journal *Neural Computation*.

Ultra-thin wonder material absorbs 99% electromagnetic waves with ease

Scientists have developed a new material: an ultra-thin film that can absorb over 99% of electromagnetic waves.

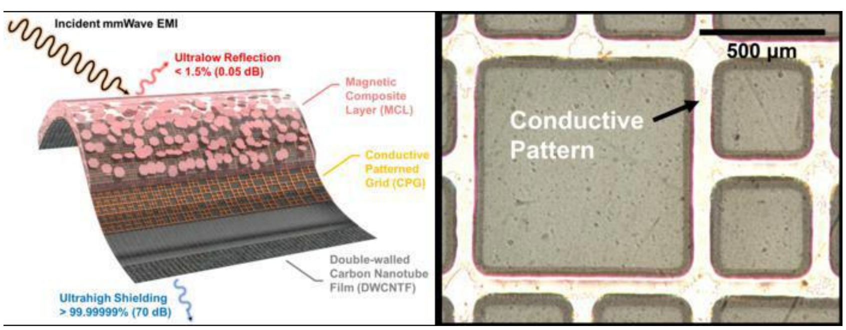
The Korea Institute of Materials Science (KIMS) states it to be the “world’s first ultra-thin film composite material capable of absorbing over 99% of electromagnetic waves.”

This material is less than half a millimeter thick, but it can effectively shield against a wide range of frequencies, including those used by 5G, 6G, Wi-Fi, and autonomous vehicle radar.

Unlike traditional shielding materials that reflect electromagnetic waves, this new material absorbs them, minimizing interference and improving the performance of electronic devices.

“As the applications of 5G/6G communications continue to expand, the importance of electromagnetic wave absorption and shielding materials is growing,” said Byeongjin Park, senior researcher of KIMS, who led the development.

Park added: “This material has the potential to significantly improve the reliability of wireless communication devices such as smartphones and autonomous vehicle radars.”



A conceptual diagram of the electromagnetic wave absorption and shielding material developed by the research team, along with the designed conductive pattern. Korea Institute of Materials Science (KIMS)

Need for new material

Electronic devices can emit waves that mess with other nearby devices, resulting in performance degradation.

These invisible waves can lead to glitches, signal loss, and even safety hazards.

Electromagnetic shielding materials are employed to mitigate this interference. These materials hold the potential to absorb the waves, which is said to be more effective than just reflecting them.

Conventional shielding materials primarily reflect electromagnetic waves, absorbing only a small fraction of 10%. Additionally, materials with higher absorption rates are often limited to a single frequency band.

To fix these problems, the team made a new material that can absorb waves from many different frequencies at the same time.

99% absorption

The material is super thin, bendy, and tough. It can bend without breaking, making it great for rollable phones and wearable tech.

“The team synthesized a magnetic material by altering the crystal structure of ferrite, enabling it to selectively absorb desired frequencies,” the press release noted.

They then combined this material with a thin polymer film and added conductive patterns to control wave propagation.

Finally, a carbon nanotube film was added to further improve the material’s shielding properties.

“This electromagnetic wave absorption and shielding material is less than 0.5mm thick and is distinguished by its low reflectance of less than 1% and high absorbance of over 99% across three different frequency bands,” the press release added.

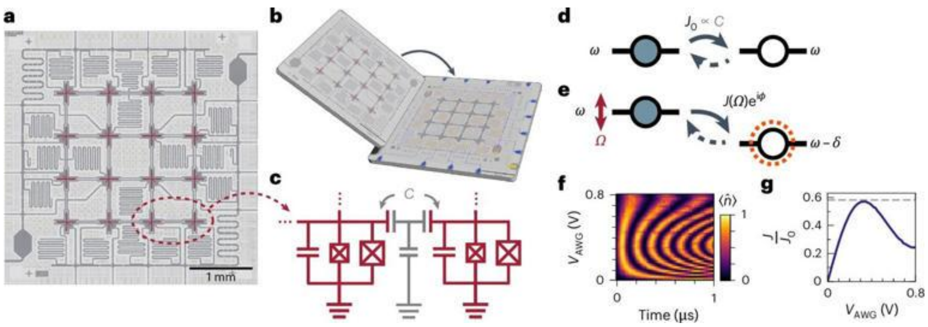
The research was supported by KIMS and the National Research Council of Science & Technology. The team has secured patents domestically and

internationally and has licensed the technology to several companies for use in real-world applications, including communication devices and automobiles.

The findings were published in the journal *Advanced Functional Materials*.

The revolution of millimeter-wave (mmWave) technologies is prompting a need for absorption-dominant EMI shielding materials. While conventional shielding materials struggle in the mmWave spectrum due to their reflective nature, this study introduces a novel EMI shielding film with ultralow reflection (<0.05 dB or 1.5%), ultrahigh absorption (>70 dB or 98.5%), and superior shielding (>70 dB or 99.99999%) across triple mmWave frequency bands with a thickness of 400 μm. By integrating a magnetic composite layer (MCL), a conductive patterned grid (CPG), and a double-walled carbon nanotube film (DWCNTF), specific resonant frequencies of electromagnetic waves are transmitted into the film with minimized reflection, and trapped and dissipated between the CPG and the DWCNTF. The design factors for resonant frequencies, such as the CPG geometry and the MCL refractive index, are systematically investigated based on electromagnetic wave propagation theories. This innovative approach presents a promising solution for effective mmWave EMI shielding materials, with implications for mobile communication, radar systems, and wireless gigabit communication.

Quantum simulator could help uncover materials for high-performance electronics



Generating Peierls phases using parametric coupling in a 16-qubit superconducting processor. Credit: Nature Physics (2024). DOI: 10.1038/s41567-024-02661-3

Quantum computers hold the promise to emulate complex materials, helping researchers better understand the physical properties that arise from interacting atoms and electrons. This may one day lead to the discovery or design of better semiconductors, insulators, or superconductors that could be used to make ever faster, more powerful, and more energy-efficient electronics.

But some phenomena that occur in materials can be challenging to mimic using quantum computers, leaving gaps in the problems that scientists have explored with quantum hardware.

To fill one of these gaps, MIT researchers developed a technique to generate synthetic electromagnetic fields on superconducting quantum processors. The team has demonstrated the technique on a processor comprising 16 qubits.

Their work is published in the journal *Nature Physics*.

By dynamically controlling how the 16 qubits in their processor are coupled to one another, the researchers were able to emulate how electrons move between atoms in the presence of an electromagnetic field. Moreover, the synthetic electromagnetic field is broadly adjustable, enabling scientists to explore a range of material properties.

Emulating electromagnetic fields is crucial to fully exploring the properties of materials. In the future, this technique could shed light on key features of electronic systems, such as conductivity, polarization, and magnetization.

"Quantum computers are powerful tools for studying the physics of materials and other quantum mechanical systems. Our work enables us to simulate much more of the rich physics that has captivated materials scientists," says Ilan Rosen, an MIT postdoc and lead author of a paper on the quantum simulator.

The study's senior author is William D. Oliver, the Henry Ellis Warren professor of electrical engineering and computer science and of physics, director of the Center for Quantum Engineering, leader of the Engineering Quantum Systems group, and associate director of the Research Laboratory of Electronics. Oliver and Rosen are joined by others in the departments of Electrical Engineering and Computer Science and of Physics and at MIT Lincoln Laboratory.

A quantum emulator

Companies like IBM and Google are striving to build large-scale digital quantum computers that hold the promise of outperforming their classical counterparts by running certain algorithms far more rapidly.

But that's not all quantum computers can do. The dynamics of qubits and their couplings can also be carefully constructed to mimic the behavior of electrons as they move among atoms in solids.

"That leads to an obvious application, which is to use these superconducting quantum computers as emulators of materials," says Jeffrey Grover, a research scientist at MIT and co-author on the paper.

Rather than trying to build large-scale digital quantum computers to solve extremely complex problems, researchers can use the qubits in smaller-scale quantum computers as analog devices to replicate a material system in a controlled environment.

"General-purpose digital quantum simulators hold tremendous promise, but they are still a long way off. Analog emulation is another approach that may yield useful results in the near-term, particularly for studying materials. It is a straightforward and powerful application of quantum hardware," explains Rosen. "Using an analog quantum emulator, I can intentionally set a starting point and then watch what unfolds as a function of time."

Despite their close similarity to materials, there are a few important ingredients in materials that can't be easily reflected on quantum computing hardware. One such ingredient is a magnetic field.

In materials, electrons "live" in atomic orbitals. When two atoms are close to one another, their orbitals overlap and electrons can "hop" from one atom to another. In the presence of a magnetic field, that hopping behavior becomes more complex.

On a superconducting quantum computer, microwave photons hopping between qubits are used to mimic electrons hopping between atoms. But, because photons are not charged particles like electrons, the photons' hopping behavior would remain the same in a physical magnetic field.

Since they can't just turn on a magnetic field in their simulator, the MIT team employed a few tricks to synthesize the effects of one instead.

Tuning up the processor

The researchers adjusted how adjacent qubits in the processor were coupled to each other to create the same complex hopping behavior that electromagnetic fields cause in electrons.

To do that, they slightly changed the energy of each qubit by applying different microwave signals. Usually, researchers will set qubits to the same energy so that photons can hop from one to another. But for this technique, they dynamically varied the energy of each qubit to change how they communicate with each other.

By precisely modulating these energy levels, the researchers enabled photons to hop between qubits in the same complex manner that electrons hop between atoms in a magnetic field. In addition, because they can finely tune the microwave signals, they can emulate a range of electromagnetic fields with different strengths and distributions.

The researchers undertook several rounds of experiments to determine what energy to set for each qubit, how strongly to modulate them, and the microwave frequency to use.

"The most challenging part was finding modulation settings for each qubit so that all 16 qubits work at once," Rosen says.

Once they arrived at the right settings, they confirmed that the dynamics of the photons uphold several equations that form the foundation of electromagnetism. They also demonstrated the "Hall effect," a conduction phenomenon that exists in the presence of an electromagnetic field.

These results show that their synthetic electromagnetic field behaves like the real thing.

Moving forward, they could use this technique to precisely study complex phenomena in condensed matter physics, such as phase transitions that occur when a material changes from a conductor to an insulator.

"A nice feature of our emulator is that we need only change the modulation amplitude or frequency to mimic a different material system. In this way, we can scan over many material properties or model parameters without having to physically fabricate a new device each time." says Oliver.

While this work was an initial demonstration of a synthetic electromagnetic field, it opens the door to many potential discoveries, Rosen says.

"The beauty of quantum computers is that we can look at exactly what is happening at every moment in time on every qubit, so we have all this information at our disposal. We are in a very exciting place for the future," he adds.

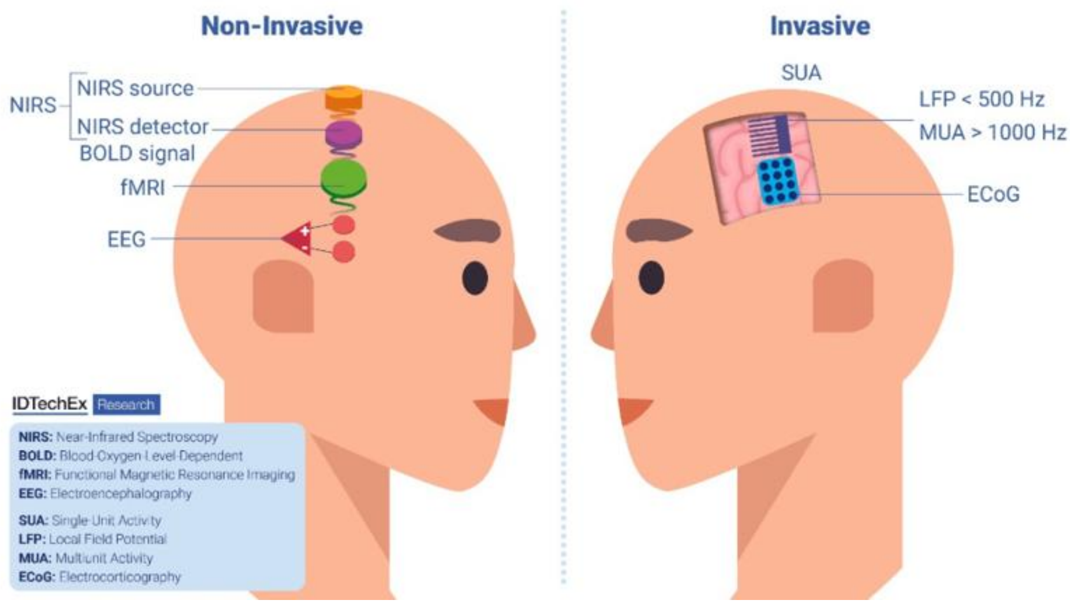
More information: Ilan T. Rosen et al, A synthetic magnetic vector potential in a 2D superconducting qubit array, *Nature Physics* (2024). DOI: 10.1038/s41567-024-02661-3

Brain computer interfaces represents an array of technologies that can decode neural signals, writes DR TESS SKYRME, senior technology analyst at IDTechEx.

The brain computer interface market represents an array of technologies which can decode neural signals, or in other words, read minds.

Electrodes or sensors can be placed either on the surface of the head, within the skull, or even within the brain itself to record brain activity. This data can then be used for cursor and keyboard control, speech decoding, and even exo-skeletons.

This technology has the potential to revolutionise the quality of life for people living with spinal cord injury, quadriplegia, and other motor and speech function impairments. IDTechEx predicts in their latest report, *Brain Computer Interfaces 2025-2045: Technologies, Players, Forecasts*, that there will be evolving opportunities for both non-invasive and invasive technologies across the next twenty years, with the overall brain computer interface market forecasted to grow to over US$1.6-billion by 2045.



Market for mind-reading takes shape

An overview of the major non-invasive and invasive methods of brain-computer interfacing. Source: IDTechEx

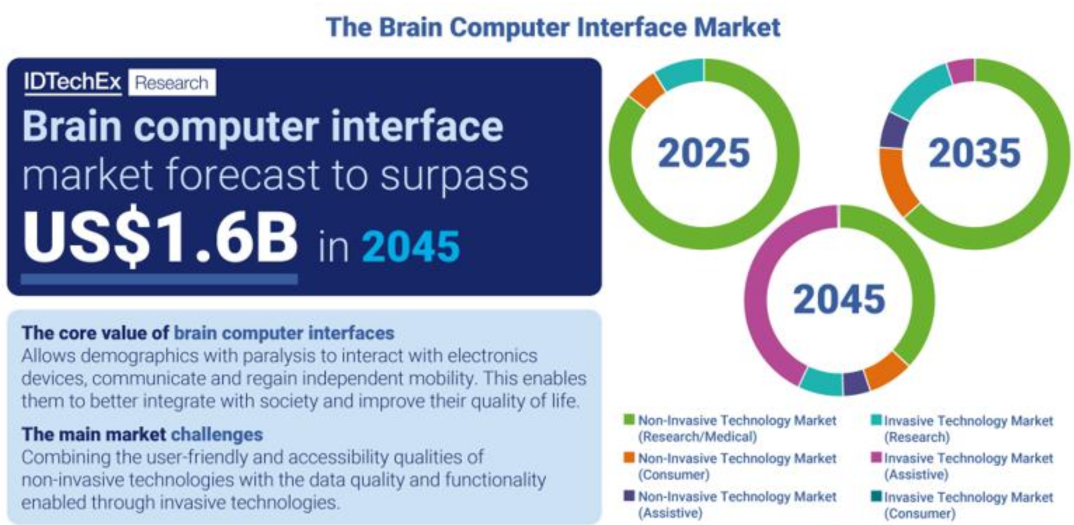
Non-invasive technology – the next generation of consumer HMI?

Non-invasive technology approaches include electroencephalography (EEG), functional near infrared spectroscopy (fNIRS), and now even wearable magnetoencephalography (MEG). While non-invasive devices have an established market for brain monitoring, their potential for brain computer interfacing is yet to be fully realized. However, as the technology continues to improve, so do data processing techniques. This is complemented by an increased consumer acceptance of head-worn wearables such as hearables and AR/VR headsets.

IDTechEx expects the scale of market opportunity will largely be dictated by the success of other human machine interfacing (HMI) approaches emerging for the next generation of consumer devices. This includes competition from approaches such as electromyography (EMG), eye tracking, and hand tracking. Yet, with more and more demonstrations of non-invasive BCIs being used for 'mind-controlled' gaming, wheelchair control, and speech decoding, this sector is putting pressure on the less accessible invasive sector to perform.

Invasive technology – big names, big promises, big challenges

The hype around invasive brain computer interfaces remains high. High-profile companies such as Neuralink and Blackrock Neurotech have gained more public attention as trials in human patients begin and funding levels dramatically increase. Yet more players are seeking to enter this market than many realize, competing on levels of invasiveness, biocompatibility, system complexity, and time to market. Collectively, this eco-system is making big promises about the revolutionary potential of their technology in becoming assistive tools that can rapidly improve patient quality of life. Yet behind the headlines, there are big challenges ahead for this sector, and the pressure to demonstrate the rewards outweighing the risks is mounting.

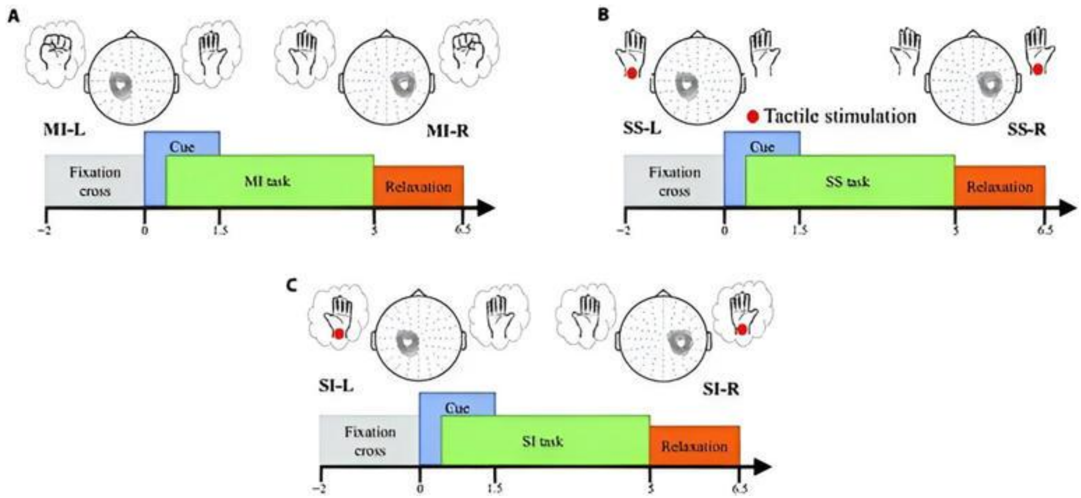


Market for mind-reading takes shape

The brain computer interface market. Source: IDTechEx

Market outlook

IDTechEx's latest report, "Brain Computer Interfaces 2025-2045: Technologies, Players, Forecasts", analyses the major technologies, players, applications, and challenges within the market. It includes coverage across non-invasive and invasive technologies, comparisons across key technical benchmarks, and market forecasts from 2025 to 2045. There is also detailed coverage of supply chain innovations impacting this market, including coverage of wearable sensors such as dry-electrodes, photo-detectors, and magnetic field sensors, including quantum sensors.



Researchers from Zhejiang University have unveiled significant findings that could enhance brain-computer interface (BCI) technologies, marking a crucial step towards more intuitive neuroprosthetic control and advanced rehabilitation therapies. Credit: Huan Wen, The Department of Neurobiology, Affiliated Mental Health Center & Hangzhou Seventh People's Hospital, Zhejiang University School of Medicine.

In a study recently published in the journal *Cyborg and Bionic Systems*, researchers from Zhejiang University have unveiled significant findings that could enhance brain-computer interface (BCI) technologies, marking a crucial step towards more intuitive neuroprosthetic control and advanced rehabilitation therapies.

The study, titled "Neural Correlates of Motor/Tactile Imagery and Tactile Sensation in a BCI paradigm: A High-Density EEG Source Imaging Study," employed high-density electroencephalogram (EEG) recordings to delve into the neural dynamics of motor and tactile imagery.

Brain-computer interfaces, devices that translate brain activity into commands for external software or hardware, have predominantly utilized motor imagery tasks where subjects imagine moving parts of their body without actual motion. This study expands on the BCI concept by integrating sensory imagery tasks, particularly focusing on tactile sensations, thereby providing new avenues for BCI applications.

The research team, led by Huan Wen and Lin Yao, conducted experiments involving eleven participants who were instructed to engage in both motor imagery (MI) and sensory imagery (SI) tasks. These tasks were designed to evoke brain responses from imagining motor actions and tactile sensations without physical stimuli. Using sophisticated EEG source imaging techniques, the study systematically examined the cortical activation differences and correlations between these tasks.

Key findings revealed that imagined tactile and motor tasks activate distinct regions within the sensorimotor cortex. While both tasks showed similar patterns in alpha bands, critical differences were noted in other frequency bands, indicating unique underlying neurophysiological processes. For instance, real sensory stimulation (SS) and imagined sensory tasks exhibited comparable activation patterns, suggesting potential strategies for training BCI systems.

This study is the first of its kind to use high-density EEG recordings to explore the intricate relationship between motor and tactile imagery. The researchers' approach has allowed for a detailed examination of the cortical sources of EEG signals, providing insights that were previously unattainable with traditional EEG methods.

The implications of these findings are vast. For one, they could significantly improve the accuracy and efficiency of BCIs, particularly in distinguishing between different types of imagery, which is crucial for the precise control of neuroprosthetics.

Moreover, the study paves the way for the development of new BCI designs that could include more diverse and complex commands, enhancing the interface's functionality.

In rehabilitation, these findings could revolutionize treatment protocols. Patients recovering from strokes or other motor impairments could benefit from tailored BCI therapies that harness both motor and tactile imagery, potentially accelerating the recovery process and improving outcomes.

The research also highlights the importance of sensory imagery in BCIs, an area that has received less attention compared to motor imagery. By demonstrating the feasibility and effectiveness of including sensory tasks in BCI frameworks, the study invites further exploration into multi-modal BCIs that could support more natural interactions with technology.

As we advance towards more integrated and responsive BCIs, the work of Wen, Yao, and their team provides a critical foundation for future innovations. Their study not only expands our understanding of the brain's imaging capabilities but also opens new pathways for enhancing human-computer interaction.

Elon Musk has long touted the potential for brain computer-interfaces (BCIs) to give humans the ability to control machines with our minds. But communication is a two-way street. What happens when the computers stop receiving commands and start sending them?

A group of researchers in China recently developed a machine interface that allowed them to manipulate what a subject could or couldn’t see. The purpose of the study was to investigate interventions for people with partial or complete loss of sight.

In order to test their hypothesis, the researchers conducted experiments on sedated cats and measured their brain activity as they experienced specific forms of external stimulation.

Per the team’s research paper:

“This demonstration supports the possibility that externally applied focal stimulation can access functional circuitry known to underlie normal visual perception.”

Visual prosthetics

Basically, the researchers showed that it’s technically possible for a system connected to a brain computer-interface to activate the same “circuits” in our eyes and brains that engage when we see something.

While this research focused specifically on cats, previous research has shown similar techniques were able to produce vague images of numbers and other simple pictures in the minds of humans without sight.

The team in China introduced several novel techniques in their paper. Perhaps the most important of which is what essentially amounts to the ability to interface with the visual cortex at the "columnar level."

This could lead to prosthetics that allow BCIs to remove, insert, or modify visual information, even in some people who are completely blind.

What could go wrong?

BCIs tend to have both "read" and "write" functions. If we imagine the brain and nervous system as a computer, and the BCI as a networking device meant to connect it to another computer, then both computers could technically have the same administrative privileges.

This means that, as Elon Musk's Neuralink has demonstrated, a human with a BCI can control computer functions with their thoughts. It also means that, theoretically, a computer can send commands back.

The Chinese research team discusses several theoretical situations where a BCI capable of interacting with the eye-brain loop could have a major impact. While the study focused solely on the positive use cases, it's not difficult to extrapolate the potential for harm from the team's assertions.

Firstly, such a device could be used to influence a person's behavior. While this could have myriad benefits for people with conditions such as nystagmus — an affliction causing uncontrollable eye movements — there also exists the possibility for nefarious use.

One dystopian view would involve a mechanism that forces us to pay attention to content. In this scenario, advertisements wouldn't just take up space on your screen, you'd literally be forced to focus your visual perception on the ad.

In another, darker scenario, a bad actor with sufficient access (whether human or AI) could send a signal to a victim's BCI causing them to experience vertigo, loss of balance, or nausea-inducing visual patterns.

The device could also be used to alter information in real time, potentially blurring faces or making the numbers in a transaction appear different. And, while it could also be used to restore vision in a blind person, it could also be used to force someone to hallucinate completely false images.

While it’s clear the scientists in China and at other laboratories working on BCIs, such as Musk’s Neuralink, are developing technology to assist people, the idea of introducing these devices to the general public as “enhancement” is, potentially, fraught with risk.

A remote, 'long-range' and 'large-volume' mind control device has been unveiled in South Korea — with plans to use the tech for 'non-invasive' medical procedures.

Researchers with Korea's Institute for Basic Science (IBS) developed the hardware, which manipulates the brain from a distance using magnetic fields, and tested the tech by inducing 'maternal' instincts in their female test subjects: mice.

In another test, they exposed a test group of lab mice to magnetic fields designed to reduce appetite, leading to a 10-percent loss in body-weight, or about 4.3 grams.

'This is the world's first technology to freely control specific brain regions using magnetic fields,' according to the professor of chemistry and nanomedicine who helped spearhead the new effort.

A remote mind control device has been unveiled in South Korea - with plans to use the tech for 'non-invasive' medical procedures. In one test, researchers exposed lab mice to magnetic fields designed to reduce appetite, leading to a 10-percent loss in body-weight (4.3 grams)© Provided by Daily Mail

That researcher, Dr Cheon Jinwoo, director of South Korea's IBS Center for Nanomedicine said he expects the new hardware to be used for a variety of healthcare applications where he said it was sorely needed.

'We expect it to be widely used in research to understand brain functions, sophisticated artificial neural networks, two-way brain-computer interface technologies, and new treatments for neurological disorders,' Dr Cheon said.

But despite the science fiction quality of remote mind control, health experts noted that magnetic fields have been used successfully in medical imaging for decades.

'The concept of using magnetic fields to manipulate biological systems is now well established,' Dr Felix Leroy, a senior scientist at Spain's Instituto de Neurociencias, wrote in an op-ed that accompanied the new study in Nature Nanotechnology.

'It has been applied in various fields,' he noted, 'magnetic resonance imaging [MRI], transcranial magnetic stimulation, and magnetic hyperthermia for cancer treatment.'

The novelty added by South Korea's IBS team was the genetic fabrication of specialized nanomaterials, whose role within neurons in the brain could be tuned from afar via carefully selected magnetic fields.

The technique, formally called magneto-mechanical genetics (MMG), guided Dr Cheon and his colleagues as they developed their brain-modulating technology.

In the new study, published this July in Nature Nanotechnology, the team called their invention Nano-MIND, for 'Nano-Magnetogenetic Interface for NeuroDynamics.'

Dr Cheon Jinwoo, director of South Korea's IBS Center for Nanomedicine, said he expects the new hardware to be used for a variety of healthcare applications where it is sorely needed. Above a diagram of the magnetic device in which the study's lab mice were remote controlled© Provided by Daily Mail

In the group's test of maternal instincts, the magnetic stimulation of certain female lab rats encouraged them to locate and collect their lost rat 'pups' more quickly in a maze-like course. The stimulated female rats began approaching the pups faster - on average 16 seconds faster© Provided by Daily Mail

The scientists' designed special mice for their experiments using a gene-replacement technique known to researchers as Cre-Lox recombination.

These genetically engineered lab mice developed more magnetically sensitive 'ion channels' which act as gates in their neurons, or nervous system cells, allowing certain molecules and atoms to enter at certain times and certain rates.

In the group's test of maternal instincts, the MMG stimulation of certain female lab rats encouraged them to locate and collect their lost rat 'pups' more quickly in a maze-like course.

The female rats stimulated by Nano-MIND began approaching the pups faster — on average 16 seconds faster — and 'quickly retrieved all the three pups in all the trials,' the researchers wrote.

The team also conducted a two-week experiment with control group and experimental group mice on how these genetically engineered animals would react to Nano-MIND magnetic impulses encouraging them to eat more or eat less.The technology proved capable of encouraging the mice both to overeat and to undereat.

In the experiment in which the MMG signal was encouraged the mice to eat, their body weight increased by approximately 7.5 grams on average, meaning roughly an 18-percent gain in body-weight.

The fasting magnetic impulse led to mice losing less (10-percent loss in body weight or about 4.3 grams), but significantly did not slow down the mice or inhibit their ability to move. 'Reduced feeding did not affect locomotion,' they wrote, implying that the effect was purely on appetite and not otherwise handicapping the mice's ability to operate.

The technology, Dr Cheon and his team wrote, will find its most immediate use in helping health researchers understand which parts of the brain and the rest of the neurological system are responsible for which moods and other behaviors.

But in his opinion piece on the Nano-MIND innovation and its gene-replacement aspect, Dr Leroy in Spain cautioned against rushing too soon to human testing.

'Further studies are needed to assess potential cumulative effects, including neuroadaptation or neurotoxicity,' Dr Leroy advised.