LASER FOCUS WORLD

- OPTICS

Prototype to product: What will it take to bring AR glasses to everyone?

Waveguides play a vital role in commercializing augmented reality (AR) glasses—but their performance must go beyond optics to improve power efficiency, durability, and scale cost-effectively. Satoshi Shiraga Aug. 6, 2025

AR glasses enable seamless shopping experiences by automatically recognizing selected items and completing payments—no cash register required. Personalized recommendations and targeted advertisements are displayed in real time for each customer.
After years of anticipation, AR glasses are finally reaching a pivotal point. As hardware design evolves to deliver lighter, slimmer, and more comfortable devices, we are on the cusp of making AR truly wearable for everyday life. This breakthrough is driven by the convergence of miniaturized components and scalable manufacturing that enable brands to develop a wide range of AR form factors—without compromising performance.

The AR industry has long grappled with critical tradeoffs. Expansive fields of view (FOV) have historically required bulky optics. High-brightness displays have been difficult to shrink without losing visual clarity. And fitting these technologies into a sleek, all-day-wearable form factor has been a complex engineering challenge.

An essential part of solving this challenge lies in using plastic-based waveguides over glass. They're lightweight, durable, cost-effective, and capable of delivering the necessary performance for compact AR devices.

As a manufacturer of both glass and plastic waveguides, Cellid has evaluated the two materials from multiple perspectives, as detailed below.

Assessing user experience in a real-world AR glasses trial

Cellid conducted a real-world pilot study at 7-Eleven to validate AR glass–based purchasing experiences, such as item recognition, personalized product recommendations, and payment. Our study was conducted using our reference design—an AR glasses prototype equipped with our plastic waveguide (the previous model with FOV 30°, 960 nit/lm released a year ago).

Cellid Launches Demonstration Experiment of Convenience Store Purchasing Experience Using AR Glasses

SMBC and 7-Eleven collaborate to create a new AR glasses-based shopping service June 02,2025 Press release

Cellid Inc., a developer of displays and spatial recognition engines for next-generation AR glasses today announced that it has joined forces with Sumitomo Mitsui Financial Group, Inc. (SMBC Group, CEO, Tatsu Nakajima), and Seven-Eleven Japan Co. (Seven Eleven, President and Representative Director, Tomohiro Akutsu) to launch a demonstration experiment using AR glasses for in-store shopping and this pilot test starts this week..

Outline of the Demonstration Experiment

This demonstration will utilize Cellid's independently developed Reference Design - AR glasses prototype to offer a new shopping experience for employees at 7-Eleven stores located in the East Wing of SMBC Group's offices. The test will assess several key AR-powered functions necessary for in-store purchases, including customer identification, product recognition and payment processing. The purchasing experience will be verified step by step, adding advanced features such as "product recommendation display" and "product display shelf guidance", which are unique to AR technology.

Cellid-developed AR glasses will be used in the demonstration experiments

Background and Future Prospects of the Demonstration Experiment
Since November 2023, Cellid, in collaboration with SMBC Group, has been exploring the possibility of next-generation services utilizing AR glasses. This demonstration experiment represents a major step in those efforts, accelerating the use of AR glasses to enhance the purchasing experience. It aims to deliver an intuitive and seamless experience by superimposing digital information onto the real world through AR glasses.

The test will evaluate how this technology can enhance everyday convenience and transform consumer purchasing behavior. In addition, it will assess the practicality and potential of new services that leverage the unique capabilities of AR technology.

Cellid's core business is the development of displays for AR glasses and spatial recognition engines. In particular, Cellid boasts the industry's most advanced technology in the development and design of the world's largest, widest field of view and lightest weight waveguide, and was the first to successfully develop technology capable of projecting full-color images made of plastic. In preparation for the increasing use of AR glasses in the near future, the company is accelerating its collaboration with partner and user companies, and this demonstration experiment is a part of these efforts.

Comments from Satoshi Shiraga, CEO, Cellid
“We are very honored to be participating in this experiment with Sumitomo Mitsui Financial Group and Seven-Eleven Japan. AR glasses are expected to be used to solve social issues and provide next-generation services, becoming a more familiar next-generation of computing devices. We expect that the use of AR glasses will make shopping more convenient and will enable a new shopping experience in real stores as well, such as the proposal of products optimized for each individual shopper. Cellid intends to utilize the feedback and findings obtained through this demonstration experiment in future product development, both in terms of hardware and software. We also plan to conduct further demonstrations using lightweight AR glasses with various partner companies, contributing to the adoption of AR glasses across diverse industries.”

LASER FOCUS WORLD

Global coverage of photonics technologies, applications, and innovations

- **EXECUTIVE FORUM**

Photonics IP Update: July 2025

This roundup summarizes photonics-related patent litigation and Patent Office procedures for July 2025. Iain McIntyre Aug. 4, 2025

Photonics IP Update *offers a monthly brief of intellectual property-related legal activities in the U.S. photonics community. Designed to inform scientists, engineers, entrepreneurs, and business leaders, the series highlights the competitive technologies of interest not only in the marketplace but also in the courtroom—to provide insight into the strategies of major and emerging players and offer tips about the IP vital to protect.*

Written by a U.S.-based IP attorney, this series covers the primary areas of IP, including trademarks, copyrights, and trade secrets.

July's photonics-related IP activities include 32 cases concerning various technologies, including displays; lighting and light sources; cameras, imaging systems, and image

processing; sensors; optical communications; medical and dental applications; biological applications; optical character recognition; solar energy; manufacturing; and color printing.

Displays

The Patent Trial and Appeal Board (PTAB) of the U.S. Patent Office denied institution of four *Inter Partes* Reviews (IPRs) sought by **Samsung Electronics Co. Ltd.** on patents owned by **Sinotechnix LLC**. The patents, U.S. Patent Nos. 7,618,162; 7,748,873; 7,901,113; and 8,132,952, relate to backlit display technology. Samsung had sought the IPRs after being sued by Sinotechnix for infringement. The PTAB's reasons for the denial were that the district court trial was scheduled to take place four months before the PTAB could issue a final written decision and that, because the patents had been in force for more than 10 years, the patent owner had a settled expectation that the patents were valid.

On July 10th, **BOE Technology Group Co. Ltd. (BOE)** filed petitions for IPRs on U.S. Patent Nos. 8,803,836 and 9,250,758, owned by **PanelTouch Technologies LLC**. The patents describe a touch panel and a display device comprising, in order, a touch panel, an organic emitting display, and a circular polarizing plate. BOE filed the petition in response to PanelTouch suing BOE for infringement of the patents in February this year. The PTAB will decide whether to institute the IPRs by mid-January 2026.

The PTAB denied the petition submitted by **Caihong Display Devices Co. Ltd.** to institute an IPR on U.S. Patent No. 7,851,394, owned by **Corning Inc**. The patent describes a boro-aluminosilicate glass used in flat-panel display devices. The glass composition improves the melting properties of batch materials, which permits the glass to be refined using more environmentally friendly fining agents than previously. The Director of the PTAB denied the petition because the parallel ITC procedure was due to complete more than a month before an IPR would have and because the patent had been in force for more than 14 years, which gave Corning a strong settled expectation that the patent was valid.

The PTAB also denied petitions submitted by **Coretronic Corp.** and **Optoma Corp.** to institute IPRs on U.S. Patent Nos. 7,850,313; 8,593,580; 9,322,530; and 9,547,226, owned by **Maxell Ltd. f/k/a Hitachi Maxell Ltd.** The patents describe a projection image display and a light-emitting diode (LED) light source for use in the display. The Director of the PTAB denied the petition because the parallel litigation was due to be tried in court about four months before the PTAB would have issued a final written decision, and because the patents had been in force for 8, 12, and 15 years, respectively, which gave Maxell a strong settled expectation that the patents are valid.

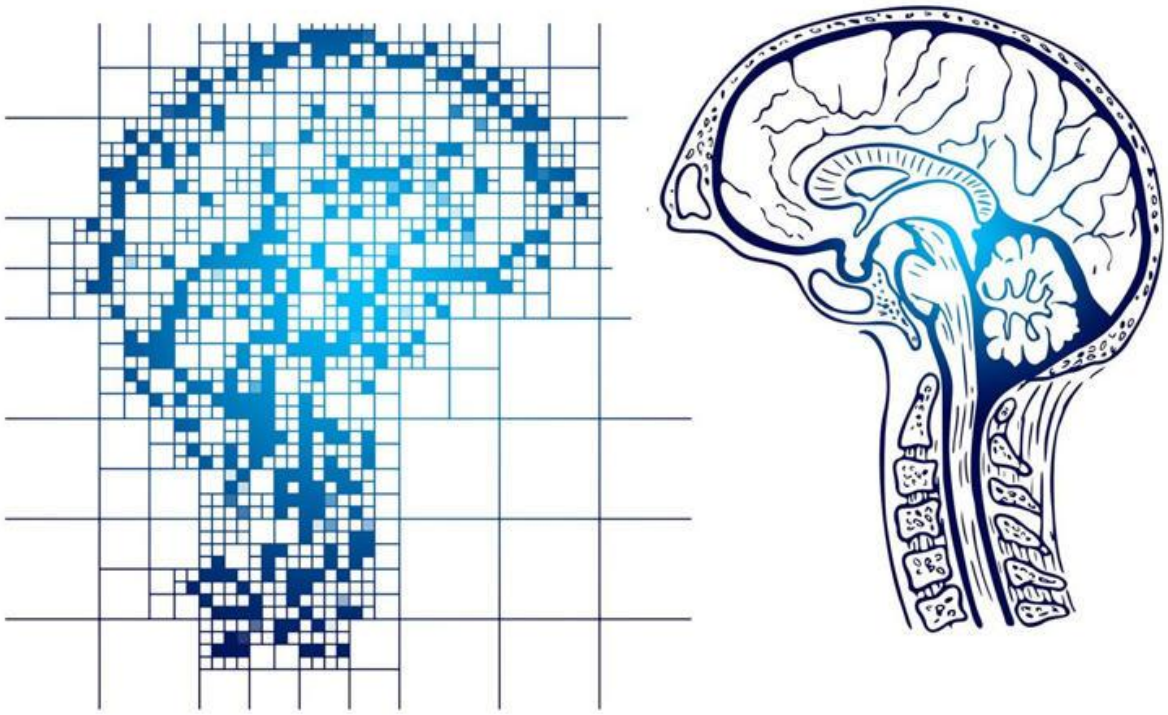
On July 15th, **BOE Technology Group Co. Ltd.** and **Chengdu BOE Optoelectronics Technology Co. Ltd.** sued **Samsung Display Co. Ltd.** in the Eastern District of Texas

for infringement of four patents that relate to barrier coatings on polymeric substrates in displays, a complementary metal-oxide semiconductor (CMOS) circuit useful in active displays, and to electronic and conducting components used within active displays. The patents are U.S. Patent Nos. 8,704,211; 9,147,772; 12,073,037; and 12,205,506.

On July 28th, **BOE Technology Group Co. Ltd.** filed petitions for IPRs on U.S. Patent Nos. 7,995,047 and 8,093,830, owned by **Bishop Display Tech LLC**. The patents describe LED driving circuits that can be used in an OLED display. BOE Technology filed the petitions in response to being sued by Bishop for infringement in March. The PTAB should determine whether to institute the IPRs by the end of January 2026.

The PTAB declined to institute IPRs on U.S. Patent Nos. 8,502,757 and 8,604,471, owned by **Optronic Sciences LLC**. The patents describe OLEDs and OLED displays having a threshold voltage compensation mechanism. The IPRs had been sought by **BOE Technology Group Co. Ltd.** after being sued for patent infringement by Optronic Sciences. The PTAB stated the reason for denial was that the patents had been in force for about 12 years, creating strong settled expectations for Optronic Sciences, and any written decision from an IPR would likely be issued several months after the district court trial.

On July 31st, **FORM Athletica Inc.** sued **Guangli** in the District of Utah for infringement of U.S. Patent No. 10,698,219. The patent describes a heads-up display in swimming goggles.



BOE Technology Group Co., Ltd is a leading company in the global semiconductor display industry and have a strong focus on innovative display solutions.

BOE Flexible AMOLED Display

Flexible display refers to the display technology designed for ultra-thin, ultra-light, and flexible products on the base of a flexible substrate. mobile phone can be worn on the wrist, tablet computer can be folded into a small pocket, and TV can also be rolled up like a scroll.

Active matrix organic light-emitting diode (AMOLED) is an organic light-emitting display device mainly consisting of a substrate, a TFT-driven array and OLED light-emitting device (metal cathode + organic light-emitting layer + anode). It is an ultra-thin device with fast response time, wide view angle, and high contrast， which is suitable for flexible display technology. AMOLED, with polymer plastic or metal foil as its flexible substrate material, has a strong anti-bending capability and can realize dynamic bending display or even folding display. It has broad application prospects in smart phones, wearable devices, and automotive devices. Through persistent technical innovation, BOE has made great breakthroughs in several key technologies such as flexible AMOLED display. BOE has now successfully developed foldable display, wrist display, flexible display with double fixed edges and other flexible AMOLED products, presenting unlimited potential of the innovation of smart display devices.

As China’ s first enterprise mastering flexible display technology, BOE has been actively building flexible AMOLED production lines in many regions, which will further enhance the global competitive power of China's display industry.

BOE Life Data Detection Technology

Life data detection is a technology that obtains the physiological information of human body by utilizing a special acquisition method, and evaluates the

health conditions via data processing and analysis, which is mainly used for the detection of electrophysiological indexes (e.g. ECG, EEG, EMG, etc.), biochemical indexes (e.g. blood oxygen, blood glucose, etc.), image indexes (e.g. CT, PET, etc.), and other physiological indexes (e.g. body temperature, blood pressure, etc.), so as to comprehensively evaluate the health conditions of the user and provide a reliable basis for disease diagnosis and chronic disease management.

However, limited by the sensor technology and computing power of chips, the existing life data detection devices cannot completely satisfy users' demand for sport
health and chronic disease management due to such shortages as poor wearing ability of electrophysiological index detectors, impossibility of non-invasive detection of biochemical index detectors, and impossibility of continuous detection of physiological index detectors. Considering this, it is a major trend to transform life detection technologies from small to wearable, from invasive to non-invasive, and from random to continuous.

BOE integrates its years of experience in the four core technologies of display, sensor, AI, and big data with the medical and life science for cross-border innovation.
In the field of non-invasive vital sign detection device, BOE has launched MTX (noninvasive multi-parameter detector), with which, the patients can accurately measure and record 14 important physiological indexes such as blood pressure, oxyhemoglobin saturation, and hemoglobin within 1 minute by wearing MTX on the finger without blood sampling, so as to evaluate the user's health conditions based on the measurement results. In the field of continuous detection of life data, BOE has independently developed an undisturbed blood pressure measuring technology that is completely different from the traditional method of blood pressure measurement. It deduces the blood pressure by computing the transmission time with pulse signal and ECG signal without a cuff and air pump, and achieves wearable and continuous blood pressure monitoring.

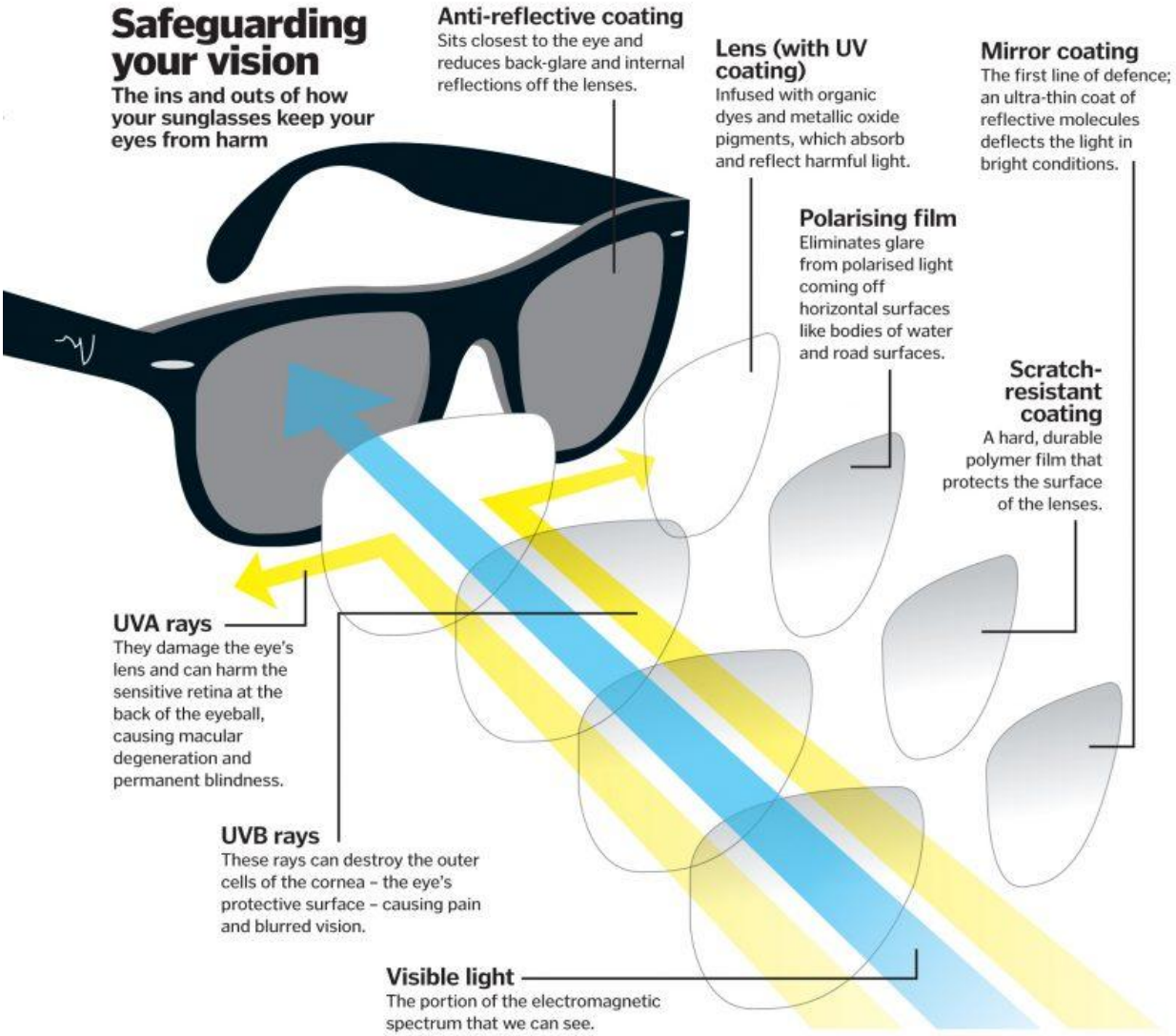
In the future, the company will continue to forge ahead in the field of life data detection, launch more high-end products and services, and make more contributions to the healthcare of human beings.

BOE ADSDS Ultra Hard Screen Technology

In the last century relatives and friends used to sit in front of a black-and-white TV to watch a program chosen from a very limited number of channels, which is now still
a nice and unforgettable memory about sharing. In BOE, we seek to bring this happiness to a higher level. As one of the world’s leading Ultra Hard screen technologies, the unique ADSDS (Advanced Super Dimension Switch) technology owned by BOE provides higher transmittance, brightness, and contrast ratio, as well as a visual angle of about 180° to present a vivid image effect. Meanwhile, the ADSDS panel is featured by low power consumption and environmental friendliness, and can be used as the screen of smart phones, tablet PCs, laptops, displays, and TVs.

As for the traditional TN/VA display mode, the liquid crystal molecules are vertically arranged, with a relatively narrow visual angle. When an external force is exerted on the screen, the liquid crystal molecular structure will obviously sink in a herringbone pattern, and the recovery is slow, a phenomenon called VA. There will be an evident “water ripple” when it is touched, which may affect the user’s experience. ADSDS technology is a general name for core technologies invented by BOE independently, which is represented by the wide-view-angle technology. In the ADSDS mode, the liquid crystal molecules are arranged horizontally, with a much wider visual angle. When an external force is exerted on screen, the liquid crystal molecular structure only sinks slightly, but the overall molecular structure remains horizontal, without producing any water ripple. In addition, BOE’s ADSDS technology effectively solves the problem of low light transmittance, and achieves high light transmittance with a wide visual angle.

Currently, a series of high-end display technologies developed by BOE based on the ADSDS Technology Platform have been successively applied to the whole series of TV products from HD to 8K UHD, and from 32inch to 110inch, and have contributed a lot to the perfect integration of high definition and low power consumption, bridging China's gap in large-sized high-end TFT-LCD display products and improving the competiveness of China's display industry in the field of high-end displays worldwide.



New 3D headset uses holograms and AI to create lifelike mixed reality visuals

by Andrew Myers, Stanford University edited by Lisa Lock, reviewed by Andrew Zinin JULY 28, 2025
Holographic virtual reality displays enable lifelike 3D experiences in ultra-compact devices. Credit: Nathan Matsuda
Using 3D holograms polished by artificial intelligence, researchers introduce a lean, eyeglass-like 3D headset that they say is a significant step toward passing the "Visual Turing Test."

"In the future, most virtual reality displays will be holographic," said Gordon Wetzstein, a professor of electrical engineering at Stanford University, holding his lab's latest project: a virtual reality display that is not much larger than a pair of regular eyeglasses. "Holography offers capabilities that we can't get with any other type of display in a package that is much smaller than anything on the market today."

Holography is a Nobel Prize-winning 3D display technique that uses both the intensity of light reflecting from an object, as with a traditional photograph, and the phase of the light (the way the waves synchronize), to produce a hologram, a highly realistic three-dimensional image of the original object.

Wetzstein's latest holographic display, detailed in a new paper published in *Nature Photonics*, moves the field toward a new age of lightweight, immersive, and perceptually realistic mixed reality glasses—glasses that project life-like three-dimensional moving images onto the wearer's real-world view.

From lens to screen, the display is just 3 millimeters thick. Such a tool could transform education, entertainment, virtual travel, communication, and other fields, the researchers said.

Extending reality

Holograms, Wetzstein said, provide a more visually satisfying, more realistic 3D visual experience than current stereoscopic approaches based on stereoscopic LED technology. And they come in a form that looks nothing like the bulky VR headsets of today. But, he acknowledges, it's not easy to achieve.

Wetzstein and others in the field refer to it as "mixed reality" to convey the full impact of the display's seamless melding of holographic imagery and views of the real world. One day, Wetzstein predicts, digital images and real-world scenes will be indistinguishable. In the meantime, this prototype is a "significant step" in that direction.

"Researchers in the field sometimes describe our goal as to pass the "Visual Turing Test,'" said Suyeon Choi, a postdoctoral scholar in Wetzstein's lab and first author of the paper, in reference to the AI standard named for the famed British polymath and computer scientist, Alan Turing. In AI, the Turing Test holds that machines can only be declared truly "intelligent" when one cannot distinguish whether one is chatting with a machine or a human being.

"A visual Turing Test then means, ideally, one cannot distinguish between a physical, real thing as seen through the glasses and a digitally created image being projected on the display surface," Choi said.

Thinking outside the eyebox

His group's latest headset design achieves breakthroughs in image realism and usability by integrating a custom waveguide that steers the image to the viewer's eye. The holographic image is enhanced by a new AI-calibration method that optimizes image quality and three-dimensionality.

The result is a display with both a large field of view and a large "eyebox" defined as the area in which the pupil can move and still see the entire image. This combination of large field of view and large eyebox—known in Wetzstein's world as the "étendue"—is highly coveted. The effect is a crisp 3D image that fills the user's field of view for a more satisfying and immersive 3D experience.

The leanness of the packaging cannot be overstated, Wetzstein said. The eyewear could be worn for hours at a time without the neck or eye fatigue that are a challenge with today's wearable displays.

"We want this to be compact and lightweight for all-day use, basically. That's problem number one—the biggest problem," Wetzstein said.

The other challenges are realism and immersiveness. AI helps solve the first by improving the image resolution and three-dimensional qualities of the holograph. The third challenge is achieved by the device's impressive eyebox and large field of view.

The experience is like having a bigger, more realistic screen in your home theater, Wetzstein said. "The eye can move all about the image without losing focus or image quality," he added, noting that this is "key to the realism and immersion of the system."

This latest research is the second installment in a scientific trilogy. Last year, in volume one, Wetzstein's lab introduced the holographic waveguide that enables high image quality in the lean form factor. Now, in volume two, they have built a working prototype to bring the finer details of the engineering to life.

Volume three could still be years off, Wetzstein admits, but that ultimate piece will come in the form of a commercial product that transforms how the world thinks of virtual reality—or extended reality, as the case may be.

"The world has never seen a display like this with a large field of view, a large eyebox, and such image quality in a holographic display," Wetzstein said. "It's the best 3D display created so far and a great step forward—but there are lots of open challenges yet to solve."

More information: Suyeon Choi et al, Synthetic aperture waveguide holography for compact mixed-reality displays with large étendue, *Nature Photonics* (2025). DOI: 10.1038/s41566-025-01718-w
Journal information: Nature Photonics
Provided by Stanford University
