ANDROID / ROROTICS NEWS VOL 3

Robots are coming: Morgan Stanley updates its ‘Humanoid 100’ stock list

Morgan Stanley updated its "Humanoid 100" stock list to add companies from two sectors: video game developers and cybersecurity firms.

The "Humanoid 100" list tracks key enablers of physical artificial intelligence, and the additions of the two sectors reaffirm the belief that the AI transition will go beyond chips and robots.

Video game developers

Morgan Stanley added Unity (NYSE:U), Roblox (NYSE:RBLX) and Take-Two (NASDAQ:TTWO) to its list.

"The MS Humanoid & Embodied AI team believes that video game developers, as creators of aforementioned hyperrealistic simulated worlds (and the action of playing the game itself) will eventually play a major role in training the impending robot tsunami," analysts led by Adam Jonas said.

Unity (NYSE:U): Morgan Stanley believes U will be useful for training humanoids in simulated environments, and firms can ensure the efficacy of a humanoid’s task-oriented action in a safe and controlled setting.

The company can also be used as a source of data to train robotics through observed player behavior and reactions to different stimuli.

Roblox (NYSE:RBLX)/Take-Two (NASDAQ:TTWO): Both companies have rich datasets of player activity and reactions to stimuli, which can be applied to training AI robotics. The tools from each of the firms can be used to create environments for robotics trainings.

Cybersecurity Firms

"As AI penetrates the physical world—spanning manufacturing, retail, and everyday households—both the total number and severity posed by vulnerable 'threat vectors' will rise considerably. Cybersecurity firms will be critical to protecting the rapidly expanding surface area of IT," Jonas said.

Morgan Stanley added the following firms to its list under cybersecurity:

CyberArk (NASDAQ:CYBR): The firm is expected to benefit from a growth in IT assets, the number of users that will need protection, and the adoption of AI agents that drive an expanding attack surface area.

"Physical AI and its proliferation across the enterprise hasn't been a material focus in investor conversations, though, CyberArk is in a unique position to potentially benefit from the ongoing increase in enterprise OT footprints," Morgan Stanley said.

Palo Alto Networks (NASDAQ:PANW): The firm recently launched a suite targeting the AI security market, which will help clients to secure access, workloads, and AI-related traffic.

"Longer-term, Palo Alto Networks should benefit as a leader in the AI security market given the need for 1) securing employee access to AI, 2) securing AI workloads in the Cloud, and 3) securing AI-related network traffic," Morgan Stanley said.

Apart from the additions, Morgan Stanley also removed some names from its list: Micron (NASDAQ:MU), NXP Semiconductor (NASDAQ:NXPI), SK Hynix, Valeo, and Zhongda Leader.

"We remove these companies due to either relatively limited materiality for physical AI or small size vs. other companies in the list," Jonas said.

Below are the firms in Morgan Stanley's updated "Humanoid 100" list:

Morgan Stanley

The technology sector (NYSEARCA:XLK) has been up 3.9% since the start of the year.

Here are some tech-related ETFs: (NYSEARCA:VGT), (NYSEARCA:IYW), (NYSEARCA:FTEC), (NYSEARCA:IXN), and (NYSEARCA:RSPT).

Artificial Intelligence/Robotics ETFs: (NASDAQ:AIQ), (NASDAQ:BOTZ), (NYSEARCA:DTEC), (NYSEARCA:GINN), (NASDAQ:ROBT), (NYSEARCA:TECB), (NASDAQ:XT), (NYSEARCA:THNQ), and (NYSEARCA:CHAT).

US breakthrough system lets humanoid robots copy human moves in real-time

Stanford University and Simon Fraser University researchers have developed a new AI system that enables humanoid robots to mimic human movements in real time.

Known as TWIST (Teleoperated Whole-Body Imitation System), the technology allows users to remotely control robots by replicating their full-body motions with high precision.

Designed for real-world applications, TWIST combines motion capture data with reinforcement and imitation learning to guide robots through complex tasks.

Researchers say the system marks a significant step forward in teleoperation and human-robot collaboration.

“We accurately capture human motion and then use AI to map it to commands that humanoids may execute. Our system has much higher accuracy in whole-body control than prior work and enables diverse motions and skills that cannot be accomplished before,” said Yanjie Ze, first author of the paper, in a statement.

Advanced teleoperation system

Teleoperation—the real-time remote control of robots—has promising applications across many fields. In recent years, engineers have focused on systems that allow users to control humanoid robots by mirroring their full-body movements.

In the new research, the team aimed to enable humanoid robots to achieve the same level of whole-body dexterity as humans. In complex environments like a messy kitchen, humans naturally use their entire bodies—holding objects with both hands, moving obstacles with their feet, or opening doors with their elbows or sides.

TWIST uses motion capture (MoCap) technology to precisely track human movements and enable real-time control of humanoid robots. By combining this data with reinforcement learning, the system trains a controller that translates human actions into balanced, full-body robot motions, allowing the robot to mimic the user's movements closely.

The system handles challenges like delays and jerky movements using a two-stage training process and combining high-quality offline data with smaller, real-time datasets. It also improves accuracy by optimizing both joint positions and orientations. The system trains robots with added disturbances to handle tasks that require force, like lifting objects, making them more stable and effective during real-world teleoperation tasks.

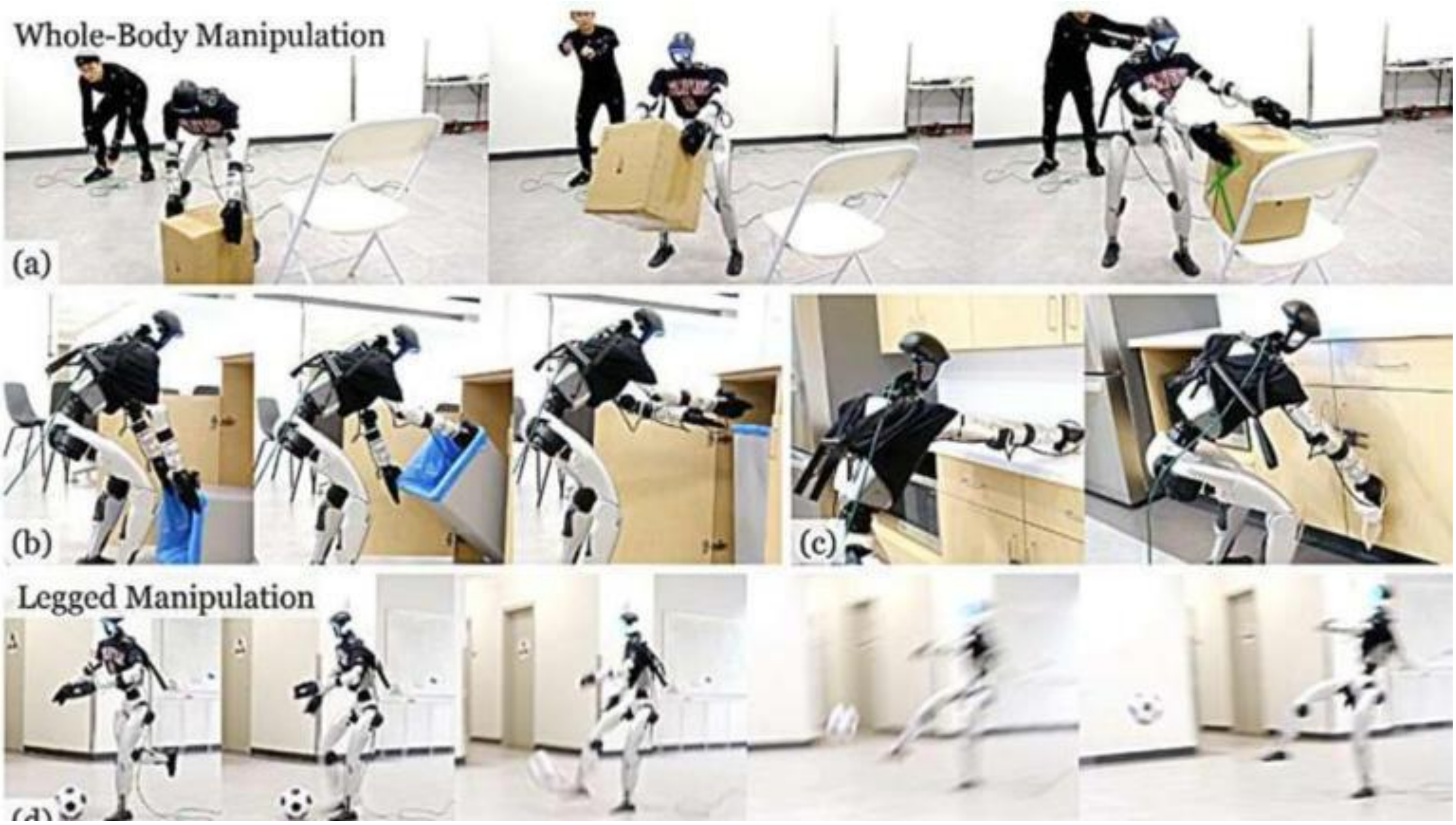
"TWIST is a system that teleoperates humanoid robots using the whole-body movement of a person in real time," said Ze, in a statement.

Smarter humanoid robots

The team tested their teleoperation system in real-world experiments using the G1 humanoid robot from Unitree Robotics. The system effectively enabled real-time control of the robot and showed potential for use with other humanoids, such as Booster Robotics' T1.

One key finding was that full-body human motion data alone is powerful enough to control all parts of a humanoid robot—including its legs, feet, waist, knees, and elbows—demonstrating the system's versatility and precision.

“Our system allows all these body parts to move as those of humans do, which enables robots to exhibit human-like, whole-body dexterity. The immediate application is to use humans to control humanoids to collect large-scale data to train robotic foundation models,” said Ze, in a statement.



The team’s robot can perform whole-body manipulation (e.g., lifting boxes from the ground), legged manipulation (e.g., kicking the football), locomotion (e.g., walking sideways), and expressive motions (e.g., Waltz dance).

TWIST shows promise but faces challenges, including the lack of visual and tactile feedback for operators, limited hardware durability in current humanoids, and dependence on non-portable MoCap systems. Future work aims to improve feedback, enhance hardware reliability, and adopt RGB-based pose estimation to replace MoCap for broader usability.

According to researchers, with further development, the system could be deployed in real-world scenarios, enabling robots to perform manual tasks in hazardous environments or take on industrial jobs that demand high precision.

“We want humanoid robots to be truly intelligent and capable of accomplishing real-world tasks. Our next step will be to scale up data collection and then to enable robots to learn autonomous skills,” said Ze, in a statement.

The details of the team’s research were published in the preprint server *arXiv*.

JUNE 12, 2025

Q&A: Why improving robot design is essential to achieving true intelligence

by Rimma Gerenstein, Albert Ludwig University of Freiburg

edited by Lisa Lock, reviewed by Robert Egan

Jun.-Prof. Edoardo Milana, Junior Professor for Soft Machines at the University of Freiburg. Credit: Lucia Brunold

Thanks to artificial intelligence, robots can already perform many tasks that would otherwise require humans. In this interview, Edoardo Milana, a junior professor of soft machines in the Department of Microsystems Engineering at the University of Freiburg, explains how improved design and innovative mechanics are broadening the range of applications for these machines.

Why is there a need for an alternative to conventional robots?

Robots can already perform amazing things with the help of artificial intelligence and machine learning. However, all this intelligence is concentrated in the software—the brain—and no comparable focus is placed on the mechanical design—the body. As such, robots are pretty much like puppets. Software is used to try to exert full control over all the body's movements.

This approach requires the hardware to be very simple from a mechanical point of view and easier to operate using digital microcontrollers. Depending on the area of application, this may be sufficient and even needed to meet the precision and high force requirements. However, when we look at motion efficiency and agility, the performance of robots falls far short of that of living beings.

Nevertheless, there are already robots that imitate animals, such as dogs and cats

These quadrupeds—and even humanoids—are impressive engineering masterpieces, however, they cannot compete with real animals in terms of motion agility. They also consume a lot of energy to move, whereas animals and humans can perform much more complex movements using far less energy. A quadruped walking at normal pace consumes roughly 300 Watt on average to drive its 12 motors, the robot's "muscles," while a dog consumes 30 Watt to activate hundreds of muscles.

This is possible because, in nature, movements strongly rely on the mechanical properties of the body, which passively and actively adapts to the external forces exerted by the environment, harnessing the compliance of biological materials. Beyond digital control, the focus in robotics should also be on implementing intelligence, or "embodied intelligence," into the design of the robot. This would free up computing capacity and energy currently used for low-level motion control for the high-level logical operations of the robot, such as reasoning, planning and perceiving.

The concept of embodied intelligence originates from the fields of philosophy and psychology. But what does it mean for you as an engineer who develops robots?

For me, the interesting thing is that the theory behind it can be applied not only to biological beings, but to robots, too. The basic idea is that physical interaction between the body and the environment shapes intelligent behavior. It's not just about having a body controlled by the mind—this control lies partly in the body itself and in the way it interacts with the mind.

In robotics, this means that if we want a truly intelligent robot, we can't just build a body consisting of two or three metal bars and a few joints, then put a very intelligent computer inside it. If that were the case, we would already have robots with completely different capabilities.

What could such intelligent robots look like instead?

I am researching soft robots made of soft materials, which could be considered as inspired by primitive and aquatic biological organisms. There are already robots in this field whose control is based entirely on physical principles, and that do not require digital microcontrollers. They utilize the non-linear physical properties of soft materials to generate the control signals that drive the robot.

Together with researchers from Stuttgart, the Netherlands, and Belgium, I have written an article published in *Science Robotics* presenting such soft robots, which introduces a new concept: The concept of "physical control." We have identified three particular control mechanisms for such soft robots.

One interesting example is robots with self-oscillating valves. When air pressure is added, the valves open and close again, increasing and then releasing air pressure. This transmits a rhythmic air pressure signal through the system, controlling the movement of the individual robot parts.

In the future, we will need to find a compromise: We won't be able to manage without software and microcontrollers in robotics, but we can achieve a lot through better robot body design.

More information: Edoardo Milana et al, Physical control: A new avenue to achieve intelligence in soft robotics, *Science Robotics* (2025). DOI: 10.1126/scirobotics.adw7660
Journal information: Science Robotics
Provided by Albert Ludwig University of Freiburg

RisingAttacK: New technique can make AI 'see' whatever you want

Researchers have demonstrated a new way of attacking artificial intelligence computer vision systems, allowing them to control what the AI "sees." The research shows that the new technique, called RisingAttacK, is effective at manipulating all of the most widely used AI computer vision systems.

At issue are so-called "adversarial attacks," in which someone manipulates the data being fed into an AI system to control what the system sees, or does not see, in an image. For example, someone might manipulate an AI's ability to detect traffic signals, pedestrians or other cars—which would cause problems for autonomous vehicles. Or a hacker could install code on an X-ray machine that causes an AI system to make inaccurate diagnoses.

"We wanted to find an effective way of hacking AI vision systems because these vision systems are often used in contexts that can affect human health and safety—from autonomous vehicles to health technologies to security applications," says Tianfu Wu, co-corresponding author of a paper on the work and an associate professor of electrical and computer engineering at North Carolina State University.

"That means it is very important for these AI systems to be secure. Identifying vulnerabilities is an important step in making these systems secure, since you must identify a vulnerability in order to defend against it."

RisingAttacK consists of a series of operations, with the goal of making the fewest changes to an image that will allow users to manipulate what the vision AI "sees."

First, RisingAttacK identifies all of the visual features in the image. The program also runs an operation to determine which of those features is most important to achieve the attack's goal.

"For example," says Wu, "if the goal of the attack is to stop the AI from identifying a car, what features in the image are most important for the AI to be able to identify a car in the image?"

RisingAttacK then calculates how sensitive the AI system is to changes in data and, more specifically, how sensitive the AI is to changes in data of the key features.

"This requires some computational power, but allows us to make very small, targeted changes to the key features that make the attack successful," Wu says. "The end result is that two images may look identical to human eyes, and we might clearly see a car in both images. But due to RisingAttacK, the AI would see a car in the first image but would not see a car in the second image.

"And the nature of RisingAttacK means we can influence the AI's ability to see any of the top 20 or 30 targets it was trained to identify. So, that might be a car, a pedestrian, a bicycle, a stop sign, and so on."

The researchers tested RisingAttacK against the four most commonly used vision AI programs: ResNet-50, DenseNet-121, ViTB and DEiT-B. The technique was effective at manipulating all four programs.

"While we demonstrated RisingAttacK's ability to manipulate vision models, we are now in the process of determining how effective the technique is at attacking other AI systems, such as large language models," Wu says.

"Moving forward, the goal is to develop techniques that can successfully defend against such attacks."

The paper, "Adversarial Perturbations Are Formed by Iteratively Learning Linear Combinations of the Right Singular Vectors of the Adversarial Jacobian," will be presented July 15 at the International Conference of Machine Learning (ICML 2025), being held in Vancouver, Canada.

More information: Paper: Adversarial Perturbations Are Formed by Iteratively Learning Linear Combinations of the Right Singular Vectors of the Adversarial Jacobian

Provided by North Carolina State University

Chinese firm boosts humanoid, legged robot development with game-changer suite Jun 13, 2025

Named EngineAI RL Workspace, the training framework is a modular reinforcement learning platform built specifically for legged robotics.

EngineAI RL Workspace emphasizes development efficiency through reusable logic structures.

AChinese firm has released a comprehensive suite of open-source resources to lower technical barriers in humanoid robots' development. The new suite by EngineAI Robotics', based in Shenzhen, provides developers with structured guidance across key areas of robotics, from modular architecture design to multimodal control systems.

The prime focus of the latest release is a dual-framework offering: a training code repository and a deployment code repository.

Engine AI revealed that together, dual-framework form an end-to-end solution that enables robotics development from algorithm training to real-world application.

Ecosystem-building effort for robot development

"EngineAI views open-sourcing as more than a technical offering, it is an ecosystem-building effort," said Zhao Tongyang, the founder and CEO of EngineAI.

"By sharing advanced tools and frameworks, this release aims to empower startups, research institutions, and independent developers. Our long-term vision is to create the world's leading general-purpose humanoid robot and continue to promote revolutionary innovation in embodied intelligence."

Training platform built specifically for legged robotics

Named EngineAI RL Workspace, the training framework is a modular reinforcement learning platform built specifically for legged robotics.

It integrates the full development pipeline, from environment setup to algorithm training and performance evaluation. The system is architected with four core clusters: environment modules, algorithm engines, shared toolkits, and integration layers. Each component is independently encapsulated, allowing developers to modify modules without impacting the entire system, according to a press release.

The company highlighted that the latest design significantly reduces communication overhead and facilitates multi-person collaboration.

At the Consumer Electronics Show-2025 (CES), EngineAI presented a range of humanoid robots, including the SE01, SA01, and PM01 models.

SE01's capabilities are not limited to advanced mobility, it is a general-purpose robot. Standing 5.5 feet (170 cm) tall, this robust machine is built to perform demanding tasks, from heavy lifting to detailed assembly work in intricate factory environments.

Workspace emphasizes development efficiency

The company's latest EngineAI RL Workspace emphasizes development efficiency through reusable logic structures.

EngineAI underlined that its single-algorithm executor supports both training and inference using a unified execution flow, enabling developers to focus on algorithmic innovation rather than infrastructure repetition. The decoupling of algorithms and environments allows for seamless iteration without altering interface definitions, according to robotics leader.

Autonomous robot designed to simplify warehouse inventory tracking APRIL 29, 2025

by Raynard Churchwell , Kennesaw State University

Kennesaw State University assistant professor Jian Zhang. Credit: Darnell Wilburn / Kennesaw State University

Tracking thousands of products in massive warehouses presents a logistical nightmare for many businesses. To address this, Kennesaw State University assistant professor Jian Zhang has introduced an autonomous robot that can log inventory.

Developed in collaboration with RugGear U.S. LLC and KSU's College of Computing and Software Engineering, the OmniScanBot is an autonomous robot designed to simplify, speed up, and safeguard the process of warehouse inventory tracking. Unlike manual counting methods, Zhang's innovation harnesses radio frequency identification (RFID) technology to automate the entire process.

Zhang's motivation for developing the robot stemmed directly from the needs of industry partners. RugGear provided Zhang with access to one kitchen cabinet warehouse in Duluth, Georgia and equipment, often providing feedback on the product's development.

The goal was to design a cost-effective robot that could navigate industrial warehouses—some as large as 100,000 square feet and with inventory stacked up to 32 feet high—and scan everything efficiently and autonomously.

"We wanted to build something that didn't require a person to operate it," Zhang said. "It should move and scan by itself. However, the biggest challenge was the environment—navigating tall shelves, changing layouts, and avoiding people and forklifts."

Traditionally, warehouses of small business at Atlanta perform inventory checks once a year using special forklifts and manual labor. However, Zhang said this method is inefficient, inaccurate, and prone to costly errors. Zhang illustrated this issue with an anecdote of a company that shipped a cabinet to the wrong warehouse but didn't notice the mistake until eight months later.

OmniScanBot was designed to prevent such issues. Built on a multi-sensor platform, it includes cameras, LiDAR, and navigation software that enables it to create a map of the warehouse and autonomously plan its route.

The robot's main feature is its ability to scan RFID tags on box-level inventory without needing a direct line of sight, making it much more accurate than barcode scanning or manual counts.

Based in the College of Computing and Software Engineering, Zhang and his team specialize in intelligent systems and automation, expertise that proved essential in quickly turning the concept into a functional, real-world solution. The team developed the prototype in just four months.

"The speed was possible because we've been working in robotics for a long time," he said. "But every new environment still presents challenges, changing layouts, obstacles, and moving people or equipment. The robot must adjust constantly."

The OmniScanBot project also serves as yet another example of how academic research can drive industry innovation, CCSE Dean Sumanth Yenduri added.

"Innovative projects like OmniScanBot exemplify the real-world impact our faculty are making through applied research," Yenduri said. "Dr. Zhang's work not only advances warehouse automation but also reinforces our commitment to solving industry challenges with practical, scalable technology."

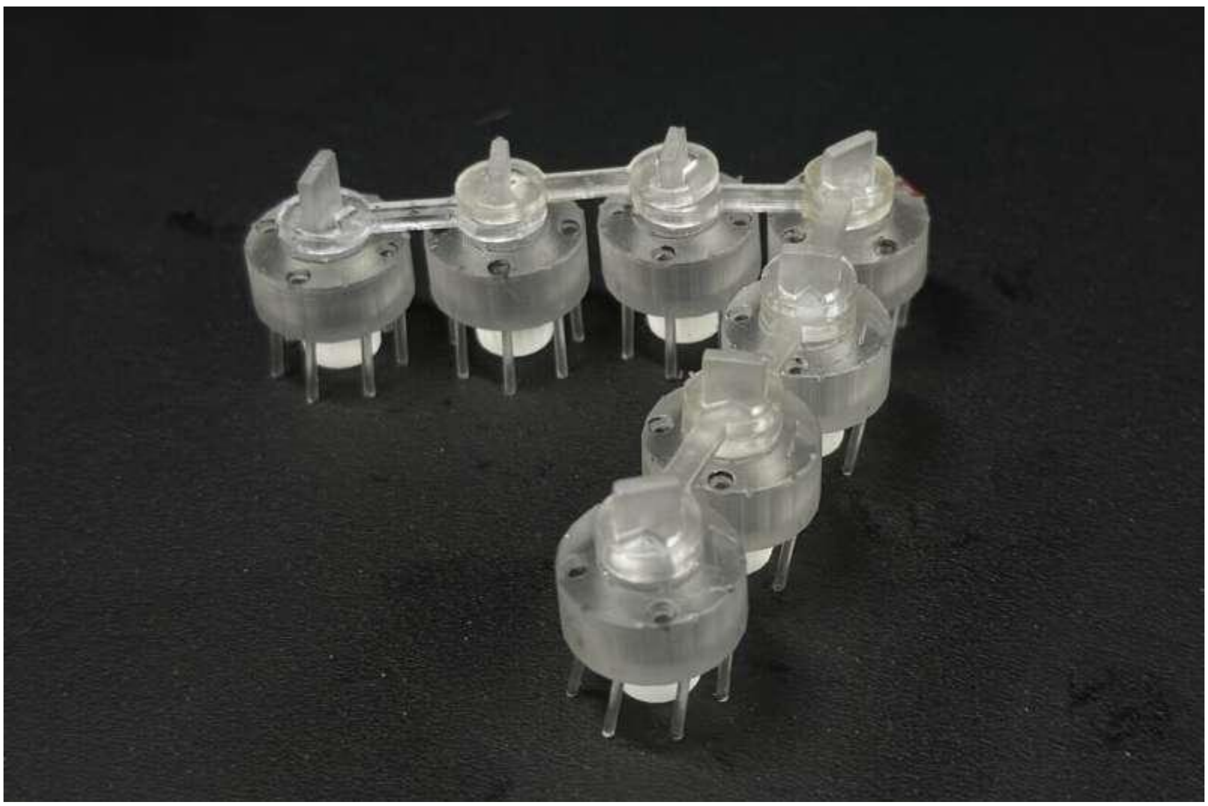
While the OmniScanBot prepares for market, Zhang is most proud of the impact it's already having.

"Seeing the smiles on the faces of warehouse workers is the most rewarding part for me," he said. "Nobody likes doing inventory. It's boring and exhausting. But with OmniScanBot, we're giving people their time and peace of mind back."

Provided by Kennesaw State University

MAY 9, 2025

Researchers build next-gen swarm robots using simple linked particles



by Seoul National University

A V-shaped link-bot composed of self-propelled particles connected through chain-like links. Credit: Seoul National University College of Engineering

A joint research team from Seoul National University and Harvard University has developed a next-generation swarm robot system inspired by nature—capable of movement, exploration, transport, and cooperation, all without the need for precise sensors or centralized control.

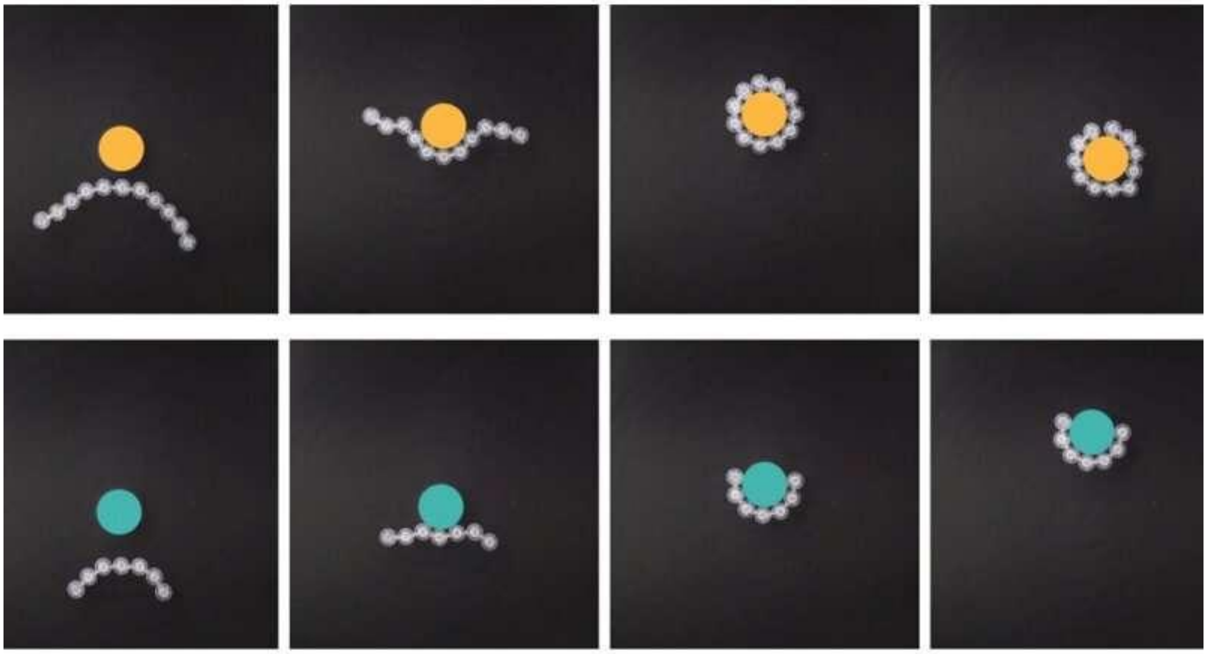
The study was led by Professor Ho-Young Kim, Dr. Kyungmin Son, and master's student Kwanwoo Kim at SNU's Department of Mechanical Engineering, and Professor L. Mahadevan and Dr. Kimberly Bowal at Harvard.

Their approach connects simple, active particles into chain-like structures that can carry out complex tasks without any advanced programming or artificial intelligence. The research is published in *Science Advances*.

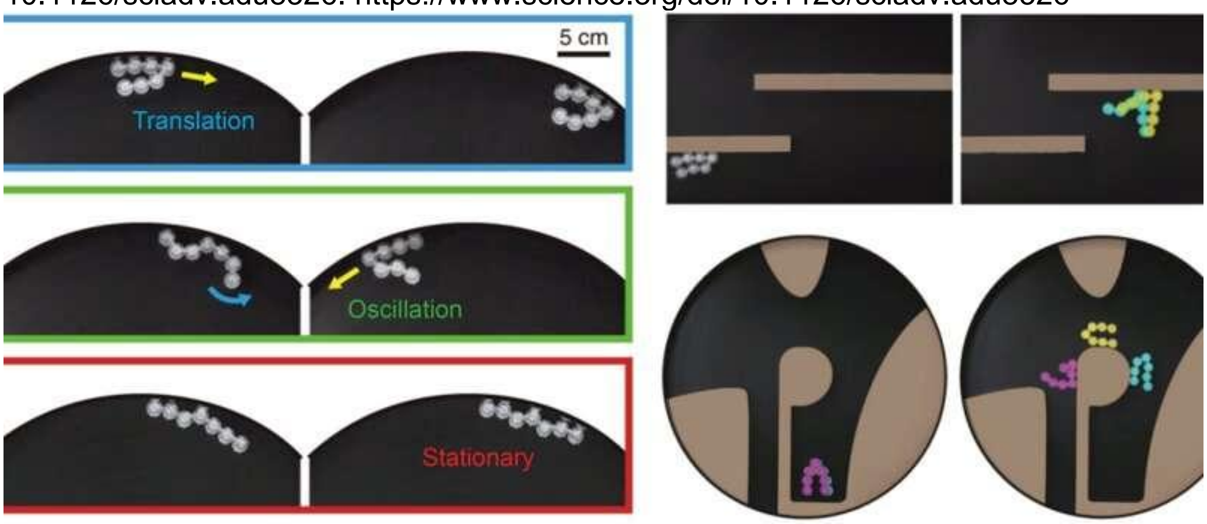
The short video showcases link-bots—a new class of chain-linked active particles capable of moving, exploring, and working together without sensors or central control. Inspired by collective behaviors in nature, these simple yet versatile robots demonstrate tasks like navigating tight spaces and transporting objects, even in complex environment.
Credit: *Science Advances* (2025). DOI: 10.1126/sciadv.adu8326.
https://www.science.org/doi/10.1126/sciadv.adu8326
Traditional swarm robots—such as those made from drones or small individual bots—typically rely on high-tech components, like sophisticated sensors, wireless communication, and detailed control algorithms. While powerful, these systems often come with limitations in terms of size, material choice, cost, and environmental conditions.

In contrast, nature offers a different model. Just as ant colonies or groups of cells exhibit complex collective behaviors using only simple individual units. The research team created a new type of robot inspired by this phenomenon, known as "emergent collective behavior." Their solution, called the link-bot, connects small self-moving particles in a V-shaped chain formation that naturally gives rise to coordinated, lifelike movement—without any embedded intelligence.

These link-bots use simple mechanical constraints to control how each particle moves or rotates. By adjusting the geometry of the links, the system can adapt its shape and behavior to suit different tasks or environments.

- 

  (Top) Link-bot wrapping around and retrieving an object. (Bottom) Link-bot transporting an object over a distance. Credit: *Science Advances* (2025). DOI: 10.1126/sciadv.adu8326. https://www.science.org/doi/10.1126/sciadv.adu8326

- 

  Movement of linkbots showing different gaits and directions depending on their link configuration. Credit: *Science Advances* (2025). DOI: 10.1126/sciadv.adu8326. https://www.science.org/doi/10.1126/sciadv.adu8326

The team demonstrated that link-bots can perform a variety of actions—such as moving forward, stopping, and changing direction—by simply modifying their link structures. They can squeeze through tight gaps, block openings, and even surround and carry objects. Multiple link-bots can also work together to accomplish tasks too difficult for a single robot.

To better understand and predict these behaviors, the researchers developed a computational model that simulates how different chain designs and particle counts affect movement. This allows for systematic exploration of the link-bot's mechanical logic.

The team showed that these robots can perform sequences of complex tasks—like searching, transporting, and cooperating—without relying on sensors or centralized control. This opens new possibilities for low-cost, energy-efficient robotics in disaster response, rough-terrain logistics, environmental monitoring, and beyond.

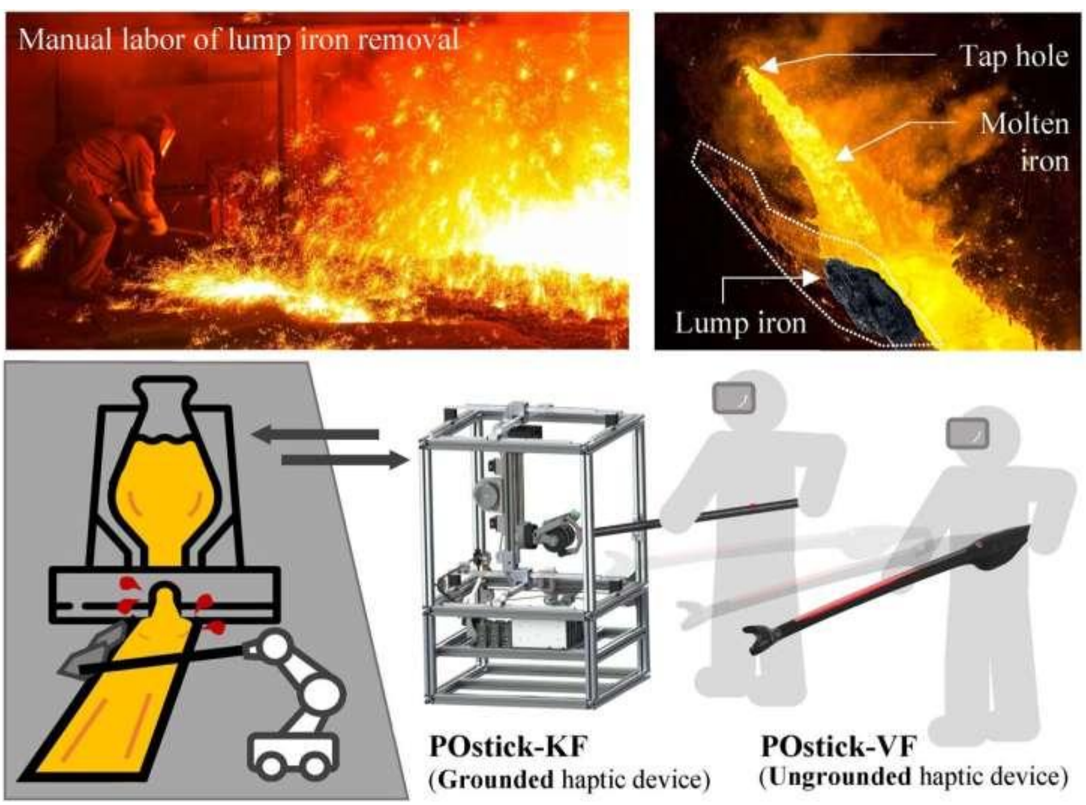
More information: Kyungmin Son et al, Emergent functional dynamics of link-bots, *Science Advances* (2025). DOI: 10.1126/sciadv.adu8326. www.science.org/doi/10.1126/sciadv.adu8326
Journal information: Science Advances
Provided by Seoul National University

MAY 19, 2025

Engineers develop intuitive haptic devices for safer remote robot control in industrial settings

by Pohang University of Science and Technology

edited by Gaby Clark, reviewed by Robert Egan



Robotic teleoperation system for high-risk steel production operations. Credit: POSTECH

A research team has developed a novel haptic device designed to enhance both safety and efficiency for workers in industrial settings. This research was recently published in the journal *IEEE Transactions on Industrial Informatics*. The team was led by Professor Keehoon Kim and Ph.D. candidate Jaehyun Park from the Department of Mechanical Engineering at POSTECH.

Robotic automation is rapidly advancing in high-risk industrial environments such as factories and steel mills. However, there remain many tasks that still require human intervention, despite advances in robotics. The challenge lies in the fact that operating robots can be more complex than anticipated, and even minor mistakes may lead to accidents.

To address this, the research team developed two types of haptic devices that allow users to feel interaction at their fingertips while controlling robots remotely.

The POstick-KF (Kinesthetic Feedback) device transmits the precise force changes a robot experiences when pushing or pulling objects directly to the user, enabling delicate and accurate manipulation. Meanwhile, the POstick-VF (Visuo-tactile Feedback) device provides a combination of tactile and visual feedback, making it effective for use in larger workspaces. Both devices are modeled after the actual size and shape of real tools, allowing even novices to adapt quickly, and can be selected according to the work environment or the operator's skill level.

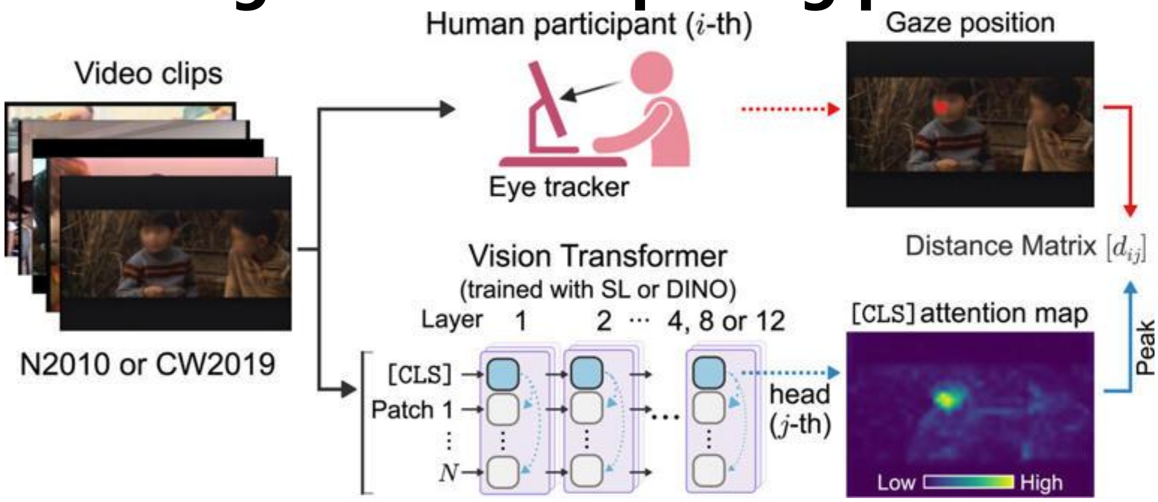
Simulation experiments demonstrated the effectiveness of these devices: users achieved higher accuracy in manipulation and significantly reduced collisions with obstacles compared to conventional haptic devices. Notably, the POstick-VF showed marked improvements in user proficiency over time, highlighting its training benefits.

The system also integrates digital twin technology, enabling users to simulate actual robot operations in virtual environments, and incorporates augmented reality (AR) to further enhance user immersion and concentration.

Professor Kim, who led the research, commented, "Our technology enables tasks requiring human dexterity to be performed more safely and precisely in collaboration with robots. We hope this will enhance safety in industrial sites and reduce the burden on workers."

More information: Jaehyun Park et al, Assessment of Novel Haptic Interfaces for Digital Twin Teleoperation in High-Risk Steel Production, *IEEE Transactions on Industrial Informatics* (2025). DOI: 10.1109/TII.2025.3556077
Provided by Pohang University of Science and Technology

Self-trained vision transformers mimic human gaze with surprising precision



Comparison of gaze coordinates between human participants and attention heads of vision transformers (ViTs). Credit: Neural Networks (2025). DOI: 10.1016/j.neunet.2025.107595

Can machines ever see the world as we see it? Researchers have uncovered compelling evidence that vision transformers (ViTs), a type of deep-learning model that specializes in image analysis, can spontaneously develop human-like visual attention patterns when trained without labeled instructions.

Visual attention is the mechanism by which organisms, or artificial intelligence (AI), filter out "visual noise" to focus on the most relevant parts of an image or view. While natural for humans, spontaneous learning has proven difficult for AI.

However, researchers have revealed, in their recent publication in *Neural Networks*, that with the right training experience, AI can spontaneously acquire human-like visual attention without being explicitly taught to do so.

The research team, from the University of Osaka, compared human eye-tracking data to attention patterns generated by ViTs trained using DINO ("self-distillation with no labels"), a method of self-supervised learning that allows models to organize visual information without annotated datasets.

Remarkably, the DINO-trained ViTs exhibited gaze behavior that closely mirrored that of typically developing adults when viewing dynamic video clips. In contrast, ViTs trained with conventional supervised learning showed unnatural visual attention.

"Our models didn't just attend to visual scenes randomly, they spontaneously developed specialized functions," says Takuto Yamamoto, lead author of the study. "One subset of the model consistently focused on faces, another captured the outlines of entire figures, and a third attended primarily to background features. This closely reflects how human visual systems segment and interpret scenes."

Through detailed analyses, the team demonstrated that these attention clusters emerged naturally in the DINO-trained ViTs. These attention patterns were not only qualitatively similar to the human gaze, but also quantitatively aligned with established eye-tracking data, particularly in scenes involving human figures. The findings suggest a possible extension of the traditional, two-part figure–ground model of perception in psychology into a three-part model.

"What makes this result remarkable is that these models were never told what a face is," explains senior author, Shigeru Kitazawa, "Yet they learned to prioritize faces, probably because doing so maximized the information gained from their environment. It is a compelling demonstration that self-supervised learning may capture something fundamental about how intelligent systems, including humans, learn from the world."

The study underscores the potential of self-supervised learning not only for advancing AI applications, but also for modeling aspects of biological vision. By aligning artificial systems more closely with human perception, self-supervised ViTs offer a new lens for interpreting both machine learning and human cognition.

The findings of this study could be used for a variety of applications, such as the development of human-friendly robots or to enhance support during early childhood development.

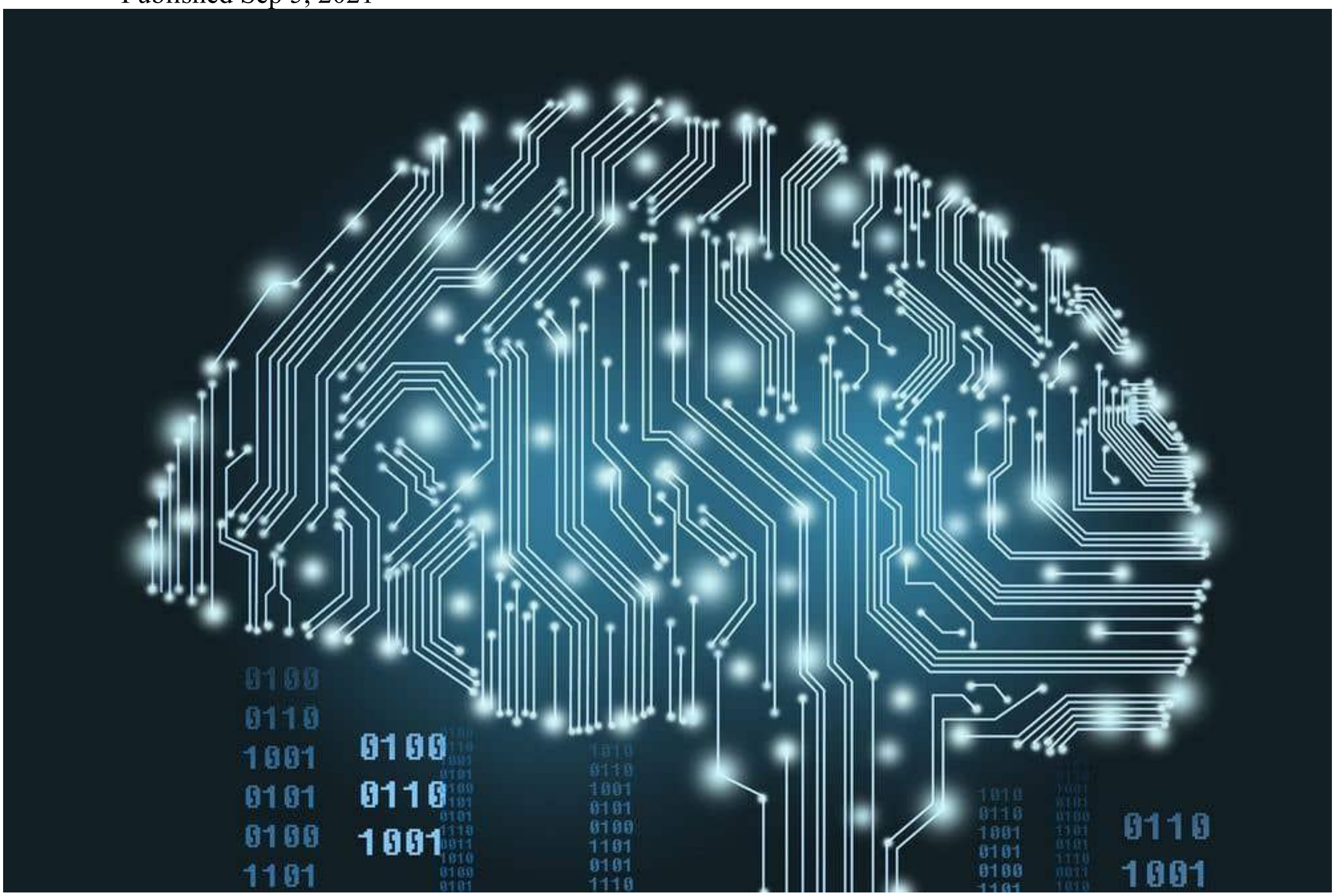
More information: Takuto Yamamoto et al, Emergence of human-like attention and distinct head clusters in self-supervised vision transformers: A comparative eye-tracking study, *Neural Networks* (2025). DOI: 10.1016/j.neunet.2025.107595

Provided by University of Osaka

Researchers develop brain-inspired memory device

The idea of using multiple switching in a single element draws inspiration from how the brain works and fundamentally reimagines the design

Published Sep 5, 2021



[Sept 2, 2021: National University of Singapore]

Many electronic devices today are dependent on semiconductor logic circuits based on switches hard-wired to perform predefined logic functions. Physicists from the National

University of Singapore (NUS), together with an international team of researchers, have developed a novel molecular memristor, or an electronic memory device, that has exceptional memory reconfigurability.

Unlike hard-wired standard circuits, the molecular device can be reconfigured using voltage to embed different computational tasks. The energy-efficient new technology, which is capable of enhanced computational power and speed, can potentially be used in edge computing, as well as handheld devices and applications with limited power resource.

"This work is a significant breakthrough in our quest to design low-energy computing. The idea of using multiple switching in a single element draws inspiration from how the brain works and fundamentally reimagines the design strategy of a logic circuit," said Associate Professor Ariando from the NUS Department of Physics who led the research.

The research was first published in the journal *Nature* on 1 September 2021, and carried out in collaboration with the Indian Association for the Cultivation of Science, Hewlett Packard Enterprise, the University of Limerick, the University of Oklahoma, and Texas A&M University.

Brain-inspired technology

"This new discovery can contribute to developments in edge computing as a sophisticated in-memory computing approach to overcome the von Neumann bottleneck, a delay in computational processing seen in many digital technologies due to the physical separation of memory storage from a device's processor," said Assoc Prof Ariando. The new molecular device also has the potential to contribute to designing next generation processing chips with enhanced computational power and speed.

"Similar to the flexibility and adaptability of connections in the human brain, our memory device can be reconfigured on the fly for different computational tasks by simply changing applied voltages. Furthermore, like how nerve cells can store memories, the same device can also retain information for future retrieval and processing," said first author Dr Sreetosh Goswami, Research Fellow from the Department of Physics at NUS.

Research team member Dr Sreebrata Goswami, who was a Senior Research Scientist at NUS and previously Professor at the Indian Association for the Cultivation of Science, conceptualised and designed a molecular system belonging to the chemical family of phenyl azo pyridines that have a central metal atom bound to organic molecules called ligands. "These molecules are like electron sponges that can offer as many as six electron transfers resulting in five different molecular states. The interconnectivity between these states is the key behind the device's reconfigurability," explained Dr Sreebrata Goswami.

Dr Sreetosh Goswami created a tiny electrical circuit consisting a 40-nanometer layer of molecular film sandwiched between a top layer of gold, and a bottom layer of gold-infused nanodisc and indium tin oxide. He observed an unprecedented current-voltage profile upon applying a negative voltage to the device. Unlike conventional metal-oxide memristors that are switched on and off at only one fixed voltage, these organic molecular devices could switch between on-off states at several discrete sequential voltages.

Using an imaging technique called Raman spectroscopy, spectral signatures in the vibrational motion of the organic molecule were observed to explain the multiple transitions. Dr Sreebrata Goswami explained, “Sweeping the negative voltage triggered the ligands on the molecule to undergo a series of reduction, or electron-gaining which caused the molecule to transition between off and on states.”

The researchers described the behavior of the molecules using a decision tree algorithm with “if-then-else” statements, which is used in the coding of several computer programs, particularly digital games, as compared to the conventional approach of using basic physics-based equations.

New possibilities for energy-efficient devices

Building on their research, the team used the molecular memory devices to run programs for different real-world computational tasks. As a proof of concept, the team demonstrated that their technology could perform complex computations in a single step, and could be reprogrammed to perform another task in the next instant. An individual molecular memory device could perform the same computational functions as thousands of transistors, making the technology a more powerful and energy-efficient memory option.

“The technology might first be used in handheld devices, like cell phones and sensors, and other applications where power is limited,” added Assoc Prof Ariando.

The team in the midst of building new electronic devices incorporating their innovation, and working with collaborators to conduct simulations and benchmarking relating to existing technologies.

Other contributors to the research paper include Abhijeet Patra and Santi Prasad Rath from NUS, Rajib Pramanick from the Indian Association for the Cultivation of Science, Martin Foltin from Hewlett Packard Enterprise, Damien Thompson from the University of Limerick, T. Venkatesan from the University of Oklahoma, and R. Stanley Williams from Texas A&M University.

Robot navigates high-speed parkour with autonomous movement planning

High-speed navigation on complex and discrete terrains. Credit: Hyeongjun Kim

A team of roboticists and AI specialists at the Robotics & Artificial Intelligence Lab in Korea has designed, built and successfully tested a four-legged robot that is capable of conducting high-speed parkour maneuvers. In their paper published in the journal *Science Robotics*, the group describes how they gave their robot a controller capable of both planning and tracking its own movements to allow it to freely traverse a range of environments.

Parkour is an obstacle course type athletic discipline that takes place in unpredictable, real-world, generally urban environments—it involves climbing walls, jumping between buildings, maneuvering around objects and running across difficult, uneven terrain. The objective is to get from one place to another without injury. To give their robot the ability to conduct parkour maneuvers, the team made one change right away—they gave it four legs.

The next thing they did was design and build a special kind of controller, one that was capable of planning the route to be taken and a tracker that told the robot where to place its feet and how to use its body to move forward safely.

The planner was designed using a neural network that was first trained and then used to generate and continuously update a map. Such a map, the team notes, was used to not only plan a route through a given terrain but to figure out where to put the robot's feet in a way that would keep it to the desired route in a safe way. That data was used by the planner in conjunction with data from the camera and feedback sensors.

Testing of the robot, which the team called Raibo, involved first running simulations to ensure the robot's components were working as intended. The next phase involved putting the robot in various lab environments to see not only how well it fared but also to study its mapping and course-plotting abilities.

They found their robot was capable of running vertically on a wall for short distances, jumping over 1.3-meter spans, and running across a course covered in stones. They also found it could walk up ramps and stairs, step up on boxes and step down on the other side.

The team plans to continue their work with the robot. They have already built and started testing Raibo 2, looking for ways to improve its abilities and ensure it behaves safely. They suggest that it could be used in disaster zones or other challenging environments.

More information: Hyeongjun Kim et al, High-speed control and navigation for quadrupedal robots on complex and discrete terrain, *Science Robotics* (2025). DOI: 10.1126/scirobotics.ads6192

JUNE 10, 2025

Debut of LLM-enabled humanoid robot at event met with mixed reviews by human attendees

by Bob Yirka, Phys.org edited by Lisa Lock, reviewed by Robert Egan

Pepper the robot installed at the public event. A mother and toddler interact with the Pepper robot inside a closed dome. Credit: *Scientific Reports* (2025). DOI: 10.1038/s41598-025-04274-z

A team of roboticists at the University of Canberra's Collaborative Robotics Lab, working with a sociologist colleague from The Australian National University, has found humans interacting with an LLM-enabled humanoid robot had mixed reactions. In their paper published in the journal *Scientific Reports*, the group describes what they saw as they watched interactions between an LLM-enabled humanoid robot posted at an innovation festival and reviewed feedback given by people participating in the interactions.

Over the past couple of years, LLMs such as ChatGPT have taken the world by storm, with some going so far as to suggest that the new technology will soon make many human workers obsolete. Despite such fears, scientists continue to improve such technology, sometimes employing it in new places—such as inside an existing humanoid robot. That is what the team in Australia did—they added ChatGPT to the interaction facilities of a robot named Pepper and then posted the robot at an innovation festival in Canberra, where attendees were encouraged to interact with it.

Before it was given an LLM, Pepper was already capable of moving around autonomously and interacting with people on a relatively simple level. One of its hallmarks is its ability to maintain eye contact. Such abilities, the team suggested, made the robot a good target for testing human interactions with LLM-enabled humanoid robots "in the wild."

The researchers watched and recorded the interactions between the deployed robot and festival-goers and also asked each of the people who had engaged with the robot for some feedback, all of which was also recorded.

In studying the recordings, the research team found quite a mix of reactions to the robot—some found the robot with LLM abilities to be quite fascinating. Others found the robot left much to be desired, with some even offering ways to improve the robot and its skills.

The team found that they were able to narrow down the reactions to four major themes: ideas for improvement, emotional responses, expectations, and ideas about the shape of the robot. The researchers suggest that the wildly different reactions to the robot appeared to be tied to preconceptions and robot glitches, such as taking too long to respond.

Some also thought that LLM abilities did not match up with the advanced design of the robot overall. Many also seemed uneasy with a robot that could maintain eye contact but was unable to recognize or respond to human facial expressions.

More information: Damith Herath et al, First impressions of a humanoid social robot with natural language capabilities, *Scientific Reports* (2025). DOI: 10.1038/s41598-025-04274-z
Journal information: Scientific Reports

JUNE 11, 2025

Single-material electronic skin gives robots the human touch

by University of Cambridge edited by Sadie Harley, reviewed by Robert Egan

Scientists have developed a low-cost, durable, highly-sensitive robotic 'skin' that can be added to robotic hands like a glove, enabling robots to detect information about their surroundings in a way that's similar to humans. Credit: University of Cambridge
Scientists have developed a low-cost, durable, highly sensitive robotic "skin" that can be added to robotic hands like a glove, enabling robots to detect information about their surroundings in a way that's similar to humans. The results are reported in the journal *Science Robotics*.

The researchers, from the University of Cambridge and University College London (UCL), developed the flexible, conductive skin, which is easy to fabricate and can be melted down and formed into a wide range of complex shapes. The technology senses and processes a range of physical inputs, allowing robots to interact with the physical world in a more meaningful way.

Unlike other solutions for robotic touch, which typically work via sensors embedded in small areas and require different sensors to detect different types of touch, the entirety of the electronic skin developed by the Cambridge and UCL researchers is a sensor, bringing it closer to our own sensor system: our skin.

Although the robotic skin is not as sensitive as human skin, it can detect signals from over 860,000 tiny pathways in the material, enabling it to recognize different types of touch and pressure—like the tap of a finger, a hot or cold surface, damage caused by cutting or stabbing, or multiple points being touched at once—in a single material.

Scientists have developed a low-cost, durable, highly-sensitive robotic 'skin' that can be added to robotic hands like a glove, enabling robots to detect information about their surroundings in a way that's similar to humans. Credit: University of Cambridge

The researchers used a combination of physical tests and machine learning techniques to help the robotic skin "learn" which of these pathways matter most, so it can sense different types of contact more efficiently.

In addition to potential future applications for humanoid robots or human prosthetics where a sense of touch is vital, the researchers say the robotic skin could be useful in industries as varied as the automotive sector or disaster relief.

Electronic skins work by converting physical information—like pressure or temperature—into electronic signals. In most cases, different types of sensors are needed for different types of touch—one type of sensor to detect pressure, another for temperature, and so on—which are then embedded into soft, flexible materials. However, the signals from these different sensors can interfere with each other, and the materials are easily damaged.

Scientists have developed a low-cost, durable, highly-sensitive robotic 'skin' that can be added to robotic hands like a glove, enabling robots to detect information about their surroundings in a way that's similar to humans. Credit: University of Cambridge
"Having different sensors for different types of touch leads to materials that are complex to make," said lead author Dr. David Hardman from Cambridge's Department of Engineering. "We wanted to develop a solution that can detect multiple types of touch at once, but in a single material."

"At the same time, we need something that's cheap and durable, so that it's suitable for widespread use," said co-author Dr. Thomas George Thuruthel from UCL.

Their solution uses one type of sensor that reacts differently to different types of touch, known as multi-modal sensing. While it's challenging to separate out the cause of each signal, multi-modal sensing materials are easier to make and more robust.

The researchers melted down a soft, stretchy and electrically conductive gelatin-based hydrogel, and cast it into the shape of a human hand. They tested a range of different electrode configurations to determine which gave them the most useful information about different types of touch.

From just 32 electrodes placed at the wrist, they were able to collect over 1.7 million pieces of information over the whole hand, thanks to the tiny pathways in the conductive material.

The skin was then tested on different types of touch: the researchers blasted it with a heat gun, pressed it with their fingers and a robotic arm, gently touched it with their fingers, and even cut it open with a scalpel. The team then used the data gathered during these tests to train a machine learning model so the hand would recognize what the different types of touch meant.

"We're able to squeeze a lot of information from these materials—they can take thousands of measurements very quickly," said Hardman, who is a postdoctoral researcher in the lab of co-author Professor Fumiya Iida. "They're measuring lots of different things at once, over a large surface area."

"We're not quite at the level where the robotic skin is as good as human skin, but we think it's better than anything else out there at the moment," said Thuruthel. "Our method is flexible and easier to build than traditional sensors, and we're able to calibrate it using human touch for a range of tasks."

In the future, the researchers are hoping to improve the durability of the electronic skin, and to carry out further tests on real-world robotic tasks.

More information: David Hardman, Multimodal Information Structuring with Single-Layer Soft Skins and High-Density Electrical Impedance Tomography, *Science Robotics* (2025). DOI: 10.1126/scirobotics.adq2303. www.science.org/doi/10.1126/scirobotics.adq2303
Journal information: Science Robotics
Provided by University of Cambridge

JUNE 12, 2025

Training robots without robots: Smart glasses capture first-person task demos

by Ingrid Fadelli, Phys.org edited by Lisa Lock, reviewed by Robert Egan

Human demonstrations are done with only black ovens (top). The policy transfers zero-shot to the robot with the same oven (middle) and also generalizes to a new oven instance (bottom). The points are color-coded to represent the correspondence. Credit: Liu et al.
Over the past few decades, robots have gradually started making their way into various real-world settings, including some malls, airports and hospitals, as well as a few offices and households.

For robots to be deployed on a larger scale, serving as reliable everyday assistants, they should be able to complete a wide range of common manual tasks and chores, such as cleaning, washing the dishes, cooking and doing the laundry.

Training machine learning algorithms that allow robots to successfully complete these tasks can be challenging, as it often requires extensive annotated data and/or demonstration videos showing humans the tasks. Devising more effective methods to collect data to train robotics algorithms could thus be highly advantageous, as it could help to further broaden the capabilities of robots.

Researchers at New York University and UC Berkeley recently introduced EgoZero, a new system to collect ego-centric demonstrations of humans completing specific manual tasks. This system, introduced in a paper posted to the *arXiv* preprint server, relies on the use of Project Aria glasses, the smart glasses for augmented reality (AR) developed by Meta.

"We believe that general-purpose robotics is bottlenecked by a lack of internet-scale data, and that the best way to address this problem would be to collect and learn from first-person human data," Lerrel Pinto, senior author of the paper, told Tech Xplore.

"The primary objectives of this project were to develop a way to collect accurate action-labeled data for robot training, optimize for the ergonomics of the data collection wearables needed, and transfer human behaviors into robot policies with zero robot data."

EgoZero, the new system developed by Pinto and his colleagues, relies on Project Aria smart glasses to easily collect video demonstrations of humans completing tasks while performing robot-executable actions, captured from the point of view of the person wearing the glasses.

These demonstrations can in turn be used to train robotics algorithms on new manipulation policies, which could in turn allow robots to successfully complete various manual tasks.

"Unlike prior works that require multiple calibrated cameras, wrist wearables, or motion capture gloves, EgoZero is unique in that it is able to extract these 3D representations with only smart glasses (Project Aria smart glasses)," explained Ademi Adeniji, student and co-lead author of the paper.

"As a result, robots can learn a new task from as little as 20 minutes of human demonstrations, with no teleoperation."

Architecture diagram. EgoZero trains policies in a unified state-action space defined as egocentric 3D points. Unlike previous methods, EgoZero localizes object points via triangulation over the camera trajectory, and computes action points via Aria MPS hand pose and a hand estimation model. These points supervise a closed-loop Transformer policy, which is rolled out on unprojected points from an iPhone during inference. Credit: Liu et al.
To evaluate their proposed system, the researchers used it to collect video demonstrations of simple actions that are commonly completed in a household environment (e.g., opening an oven door) and then used these demonstrations to train a machine learning algorithm.

The machine learning algorithm was then deployed on Franka Panda, a robotic arm with a gripper attached at its end. Notably, they found that the robotic arm successfully completed most of the tasks they tested it on, even if the algorithm planning its movements underwent minimal training.

"EgoZero's biggest contribution is that it can transfer human behaviors into robot policies with zero robot data, with just a pair of smart glasses," said Pinto.

"It extends past work (Point Policy) by showing that 3D representations enable efficient robot learning from humans, but completely in-the-wild. We hope this serves as a foundation for future exploration of representations and algorithms to enable human-to-robot learning at scale."

The code for the data collection system introduced by Pinto and his colleagues was published on GitHub and can be easily accessed by other research teams.

In the future, it could be used to rapidly collect datasets to train robotics algorithms, which could contribute to the further development of robots, ultimately facilitating their deployment in a greater number of households and offices worldwide.

"We now hope to explore the tradeoffs between 2D and 3D representations at a larger scale," added Vincent Liu, student and co-lead author of the paper.

"EgoZero and past work (Point Policy, P3PO) have only explored single-task 3D policies, so it would be interesting to extend this framework of learning from 3D points in the form of a fine-tuned LLM/VLM, similar to how modern VLA models are trained."

*Written for you by our author Ingrid Fadelli, edited by Lisa Lock, and fact-checked and reviewed by Robert Egan—this article is the result of careful human work. We rely on readers like you to keep independent science journalism alive. If this reporting matters to you, please consider a donation (especially monthly). You'll get an **ad-free** account as a thank-you.*

More information: Vincent Liu et al, EgoZero: Robot Learning from Smart Glasses, *arXiv* (2025). DOI: 10.48550/arxiv.2505.20290
Journal information: arXiv

China stages first-ever humanoid robot kickboxing match

Battling bots rekindle debate on whether China’s Unitree Robotics or America’s Boston Dynamics is the humanoid robot champion

May 27, 2025

Unitree's G1 robots demonstrated their combat skills at a match on May 25, 2025. Photo: CCTV

In a clash of metal, might and artificial intelligence, Unitree Robotics’ humanoid robots threw punches and kicks in the world’s first kickboxing fight of its kind in China.

The China Media Group (CMG) World Robot Competition – Mecha Fighting Series, the first-ever humanoid robot fighting tournament, kicked off in Hangzhou, Zhejiang province, on May 25.

State-owned Chinese Central Television broadcast the match, which included four Unitree G1 robots and their human trainers. Each fighter robot weighs about 35 kilograms and is 132 centimeters tall.

Each match had two sessions. The first required the robots to perform different actions, while the second involved three rounds of combat, each lasting two minutes.

A robot could score only if it hits its opponent's head or body. A punch scored one point, while a kick scored three. The fighting machines lost five points if they fell. If it couldn't get up within eight seconds, it lost 10 points, and the round ended immediately.

Fight footage showed the robots could punch and kick smoothly, but their attacks were soft and more like pushes than strikes. Some robots lost their balance after kicking or moving backward, but most could stand back up after a few seconds. Trainers controlled their robots remotely with joysticks.

“It is not easy to teach robots different movements,” Wang Qixin, a director at Unitree, told the CCTV. “We used artificial intelligence (AI) technology to train them.”

ROBOTS THAT “FEEL”: BREAKTHROUGH ROBOTIC SKIN COULD REVOLUTIONIZE HUMAN-ROBOT INTERACTIONS

TIM MCMILLAN·JUNE 17, 2025

Researchers at the University of Cambridge have unveiled a new type of robotic skin that could transform how machines interact with humans and their environment.

The development, published in the journal *Science Robotics*, brings us closer to machines that touch and feel, opening doors to more intuitive human-robot interactions and advanced robotics applications.

“Having different sensors for different types of touch leads to materials that are complex to make,” lead author Dr David Hardman from Cambridge’s Department of Engineering said in a press release. “We wanted to develop a solution that can detect multiple types of touch at once, but in a single material.”

For years, scientists have considered human skin the gold standard for building responsive robotic systems. Our skin is incredibly versatile and can detect pressure, temperature, texture, and even damage.

However, mimicking this complexity in artificial materials has been a persistent challenge. Traditional solutions, often built using microelectromechanical systems (MEMS), have faced serious hurdles, including difficulty bonding soft and rigid layers and issues with electrical interference.

Cambridge researchers have introduced an innovative solution to these long-standing challenges, by designing a new type of robotic skin made from a single layer of hydrogel, which is exceptionally responsive to environmental conditions and physical touch.

The key to the skin's success lies in its unique construction. By utilizing electrical impedance tomography (EIT) techniques, the team created over 863,000 conductive pathways across the hydrogel membrane.

These pathways can detect at least six distinct types of stimuli, ranging from human touch to damage, multipoint insulated presses, and localized heating. This multisensory ability means the skin can not only "feel" physical contact but also gauge environmental factors and respond accordingly—much like human skin does.

The potential of this new technology extends far beyond the fields of robotics and AI. With its ability to detect changes in temperature, pressure, and touch, the robotic skin could play a transformative role in improving prosthetics, exoskeletons, and wearable medical devices. This offers users a promising future of greater comfort, functionality, and responsiveness.

For example, prosthetic limbs could become more intuitive, providing users with real-time sensory feedback from the artificial limb, making it easier to perform daily tasks like holding objects or feeling textures.

Researchers also explored how the hydrogel skin could be shaped and used in practical applications. In one particularly impressive demonstration, the team molded the hydrogel into the form of a human hand. This lifelike model highlighted the skin's ability to sense touch and track the position of objects while also hinting at its promise for monitoring environmental conditions.

The hand-shaped skin could localize human touch, sense of the body's position and even respond to the environment in ways that mimic human sensory functions. This could one day lead to prosthetics that allow people to move more naturally and interact with the world in a way that feels more familiar and intuitive.

The researchers took an innovative, data-driven approach to determine which sensory pathways should be actively monitored. By focusing on the most important signals, they've made the system more efficient, avoiding the problem of processing unnecessary data. This ability to filter and organize sensory information in real time paves the way for systems that are smarter and more responsive, making this technology a potential game-changer in functionality and practical use.

This flexibility means it has potential far beyond robotics, including medical diagnostics, wearable devices, and environmental monitoring. Researchers are already exploring how the hydrogel skin could be refined and applied in new areas.

As researchers work to bring the technology closer to real-world use, scaling up production and improving durability are key goals. The material still needs to become more resilient to handle the wear and tear of everyday applications. The researchers also hope to expand the skin's sensory range to detect even more stimuli types, offering a richer, more detailed picture of its surroundings.

Nevertheless, with this breakthrough we could see the introduction of entirely new types of robots and devices that operate with the tactile sensitivity we associate with human skin.

Robots with a true sense of touch could dramatically improve interactions in fields such as healthcare, where precise, sensitive movements are crucial. Take surgical robots, for instance — adding this kind of skin could allow them to sense how much force they're applying to tissue, helping surgeons work with greater precision and care.

In the world of consumer tech, wearables could also take a big step forward, becoming devices that not only monitor health data but also respond to touch and pressure, creating a more interactive and engaging experience for users.

Moreover, the implications of this research extends to the world of artificial intelligence (AI) and machine learning. As the robotic skin gathers vast amounts of sensory data, it could be used to train AI systems that can better understand and predict human behavior.

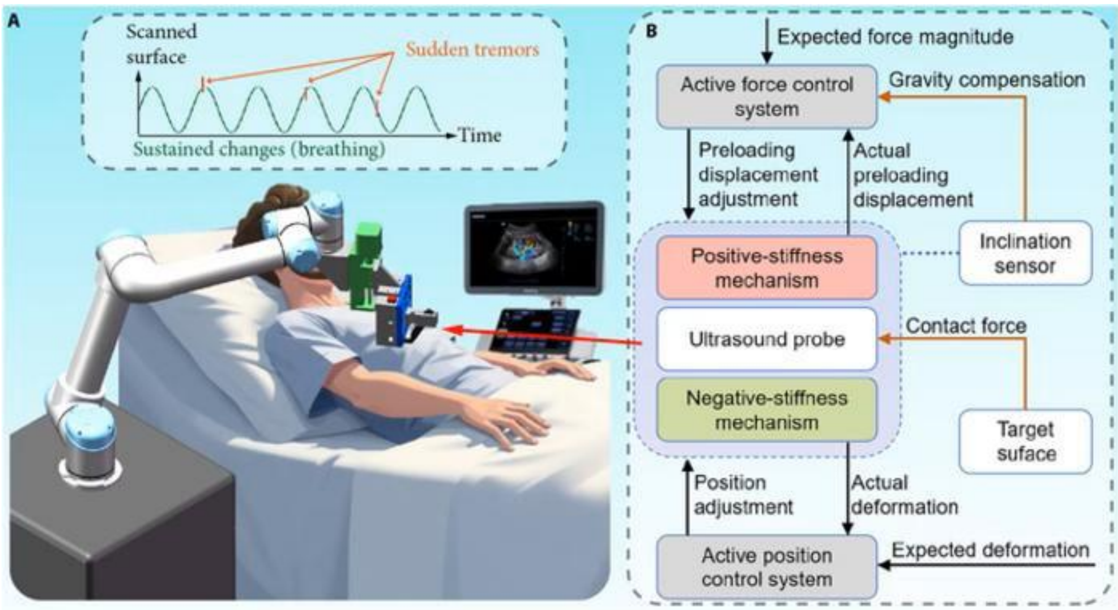
“We’re able to squeeze a lot of information from these materials – they can take thousands of measurements very quickly,” Dr. Hardman explained. “They’re measuring lots of different things at once, over a large surface area.”

Imagine a robot outfitted with this sensory skin. It could pick up on small details, like the firmness of a handshake or the warmth of someone’s hand, and adjust its response in real-time. This kind of technology could pave the way for robots that interact with people in a more intuitive and empathetic way, better tuned to human needs.

Ultimately, this breakthrough in hydrogel-based robotic skin marks a major step toward building machines that are more sensitive and responsive and feel a little closer to humans in how they engage with the world.

“We’re not quite at the level where the robotic skin is as good as human skin, but we think it’s better than anything else out there at the moment,” study co-author Dr Thomas George Thuruthel said. “Our method is flexible and easier to build than traditional sensors, and we’re able to calibrate it using human touch for a range of tasks.”

Ultrasound scanning robotic arm with adjustable constant contact force



University of Macau's innovative system enhances diagnostic imaging by stabilising contact force amidst physiological fluctuations.

From Beijing Institute of Technology Press Co., Ltd 12/06/25 (first released 11/06/25)

(A) Robotic arm for positioning the hybrid active–passive force control end-effector (HFCE) to the target scanned surface of the patient. (B) Flowchart of the working principle of the HFCE. Credit: Qingsong Xu, Department of Electromechanical Engineering, Faculty of Science and Technology, University of Macau

Recent advances in robotic ultrasound systems have shown promise for improving diagnostic imaging consistency.

However, maintaining stable contact force across dynamic physiological changes (e.g., breathing, tremors) without continuous sensor recalibration remains a critical hurdle.

"By integrating a hybrid active-passive force control mechanism, our method decouples force regulation from real-time feedback dependencies while ensuring adaptability across patients," stated corresponding author Qingsong Xu, a professor at the University of Macau.

The tripartite system combines (a) a passive constant-force mechanism (positive/negative stiffness beams) for vibration buffering, (b) strain gauges for real-time deformation monitoring, and (c) active positioning stages for gravity compensation and force adjustment.

“This design guarantees force stability by absorbing high-frequency disturbances passively while actively compensating for sustained displacements,” added lead author Zehao Wu.

The framework was validated in experiments with silicone models and human subjects under simulated physiological vibrations.

The passive mechanism achieved ≤7.20% force variation within its constant-force region (adjustable range: 12.33–21.29 N), isolating tremors of up to 15 Hz frequency and tolerating breathing-induced displacements (0.3 Hz, 6 mm amplitude).

Active control maintained force consistency across inclinations (e.g., 1.11 N gravity compensation at 25° tilt), while robotic operation reduced image oscillation velocities by >50% compared to manual scans (0.55 mm/s vs. >1.0 mm/s).

Compared to pure active force control, the hybrid system eliminated overshoot risks and reduced reliance on high-bandwidth sensors.

“Strain-based feedback enabled precise tuning of the constant-force zone, synchronizing probe contact with tissue compliance,” noted Wu. Limitations include restricted force-range coverage (12–21 N) and mechanism size constraints.

Future work will develop multi-range mechanisms and integrate semi-autonomous path planning.

This study advances medical robotics by fusing mechanical intelligence with adaptive control, enabling robust, operator-agnostic ultrasound imaging.

Authors of the paper include Zehao Wu, Xianli Wang, Yuning Cao, Weijian Zhang, and Qingsong Xu.

T*his work was supported in part by the National Natural Science Foundation of China under grant 52175556; the Macao Science and Technology Development Fund under grants 0004/2022/AKP, 0102/2022/A2, 0078/2023/RIB3, and 0047/2024/ITP2; and the University of Macau under grants MYRG-GRG2024-00222-FST-UMDF and MYRG-CRG2022-00004-FST-ICI.*

The paper, “Robotic Ultrasound Scanning End-Effector with Adjustable Constant Contact Force” was published in the journal Cyborg and Bionic Systems on May 2 2025, at DOI: 10.34133/cbsystems.0251.

Video: Sweater-wearing humanoid robot gets brain upgrade to clean, cook autonomously

The new model unifies motion and control, letting NEO coordinate limbs, brace on surfaces, and handle complex tasks with higher payloads.

Updated: Jun 16, 2025

Redwood lets NEO retrieve items, open doors, and move smoothly at home, built on hardware optimized for safety, compliance, and resilience.

1X Technologies has unveiled Redwood, a new AI model powering its humanoid robot, NEO, to perform household tasks autonomously.

Using real-world data from 1X's EVE and NEO robots, Redwood enables NEO to move, perceive, and interact in home settings. The model supports complex laundry, door answering, and home navigation activities.

With advanced generalization capabilities, Redwood allows NEO to adapt to task variations and unfamiliar objects, making decisions such as hand selection and retrying failed grasps to ensure successful task completion.

In February, the San Francisco Bay-based 1X Technologies launched NEO Gamma, a next-gen humanoid robot for household chores.

Intelligent humanoid control

Redwood is a compact yet powerful 160 million-parameter vision-language model designed for humanoid autonomy in home environments.

Running entirely onboard NEO Gamma's embedded GPU at 5Hz, Redwood enables seamless end-to-end mobile manipulation, combining perception, locomotion, and control. It integrates pre-trained language and vision models with proprioception data to generate robot actions via a diffusion policy, allowing NEO to perform tasks like grasping unfamiliar objects, opening doors, and retrieving items while navigating dynamically around obstacles.

Unlike traditional systems that separate locomotion and manipulation, Redwood handles full-body coordination, simultaneously predicting arm, leg, pelvis, and walking commands. This multi-contact capability lets NEO brace against surfaces and execute complex household tasks with improved payload capacity.

According to 1X Technologies, Redwood also enables mobile bi-manual manipulation, training navigation, and manipulation jointly to optimize positioning for object handling. Its ability to generalize stems from diverse real-world training across offices and homes using both successful and failed demonstrations.

The model is further enhanced through "cognitive" prediction targets, such as tracking hand and object locations in image space, which improve grounding and adaptability.

Voice control is supported via offboard natural language processing that translates user commands into Redwood's action space.

1X claims Redwood's design emphasizes robustness, efficiency, and autonomy, making NEO suitable even in offline or low-connectivity environments like basements or campsites.

Dexterous robot motion

1X Technologies has developed a comprehensive Reinforcement Learning (RL) controller to expand the mobility and dexterity of its humanoid robots.

The controller enables full-body autonomy across complex tasks, supporting walking in any direction, climbing stairs, sitting, kneeling, and getting up from the floor—all crucial for navigating real homes.

Unlike conventional systems that isolate manipulation and movement, this unified controller bridges locomotion with whole-body control, powered by stereo RGB vision for accurate floor-height estimation and terrain adaptation.

The system uses a two-stage architecture: a high-level kinematic planner converts commands into human-like motion trajectories, while a low-level RL controller translates these into precise, contact-aware joint actions.

The architecture ensures fluidity, robustness, and steerability, even during task transitions. It supports side-stepping in tight spaces and climbing irregular stairs using domain-randomized training for real-world robustness.

For tasks near the ground, the controller enables NEO to safely sit, kneel, or lie down, then return to standing, expanding its reach and versatility.

Integrated with Redwood AI, the controller allows vision-driven prediction of joint and pelvis targets for tasks like soccer ball dribbling.

Together, Redwood and the RL controller form a full-stack system that enables NEO to explore and interact with the entire physical state space of a home environment.

JUNE 17, 2025

Engineers develop blueprint for robot swarms, mimicking bee and ant construction

by Ian Scheffler, University of Pennsylvania

edited by Gaby Clark, reviewed by Robert Egan

By following mathematical rules, the simulated robots were able to behave like bees, building complex shapes without instructions, pointing to a new manufacturing frontier, inspired by nature. Credit: Jordan Raney and Mark Yim

Bees, ants and termites don't need blueprints. They may have queens, but none of these species breed architects or construction managers. Each insect worker, or drone, simply responds to cues like warmth or the presence or absence of building material. Unlike human manufacturing, the grand design emerges simply from the collective action of the drones—no central planning required.

Now, researchers at Penn Engineering have developed mathematical rules that allow virtual swarms of tiny robots to do the same. In computer simulations, the robots built honeycomb-like structures without ever following—or even being able to comprehend—a plan.

"Though what we have done is just a first step, it is a new strategy that could ultimately lead to a new paradigm in manufacturing," says Jordan Raney, Associate Professor in Mechanical Engineering and Applied Mechanics (MEAM), and the co-senior author of a new paper in *Science Advances*. "Even 3D printers work step by step, resulting in what we call a brittle process. One simple mistake, like a clogged nozzle, ruins the entire process."

Manufacturing using the team's new strategy could prove more robust—no hive stops construction because a single bee makes a mistake—and adaptable, allowing for the construction of complex structures onsite rather than in a factory.

"We've just scratched the surface," says Raney. "We're used to tools that execute a plan. Here, we're asking: how does order emerge without one?"

A new paradigm for building

From stone tools to space stations, human engineering has relied on planning: imagine the result, then design and build it in steps. Even 3D printing follows the same logic, slicing a model into thousands of precise instructions for the printer to follow.

"What's so different about our approach is that it sidesteps that entire paradigm," says Mark Yim, Asa Whitney Professor in MEAM, Ruzena Bajcsy Director of the General Robotics, Automation, Sensing and Perception (GRASP) Lab and the paper's other co-senior author. "There's no pre-written script, no centralized plan. Each robot just reacts to its surroundings."

Because no single robot needs to understand the big picture, construction can continue even if some robots fail or go off course. And since all robots operate simultaneously, rather than waiting their turn, the process could one day be faster and more robust to individual failures.

Planning behavior, not buildings

While inspired by nature, the researchers didn't try to precisely mimic how bees, ants or other natural builders behave. Unlike artificial intelligence researchers, who often look to the brain for clues about how to design learning algorithms, this team wasn't trying to copy biology.

Instead, they focused on the deeper principle that nature uses: simple behaviors, repeated many times in parallel, can add up to create something complex and useful.

"What we wanted was a system where structure emerges from behavior," says Raney. "Not because the robots know what they're building, but because they're following the right set of local rules."

The hard part was figuring out what those rules should be. "There are countless ways you could program a robot to react to its surroundings," says Yim. "We had to narrow it down to something simple, but still useful."

Just like bees, the individual robots in this simulation have no master plan. Simply by responding to local cues, they are able to construct honeycomb-like structures. The method could presage a new era for manufacturing, inspired by nature. Credit: Jordan Raney, Mark Yim

Finding the right rules

In the end, the team focused on a handful of basic questions: What should a robot do when it bumps into something another robot built? Should it turn left or right, and by how much? How far should each robot go before stopping?

This resulted in a dozen variables—like the robots' speed and the angle at which they turn left or right—that the researchers played with over the course of many simulations. "By simulating the robots' activity," says Raney, "we could focus on fine-tuning which rules mattered the most."

Ultimately, the amount of disorder in the system played a crucial role in the final structure. "The more we varied parameters like the turning angle, the more variation we got in the final structure," says Yim.

As prior work by Penn Engineers has found, adding the right amount of disorder to lattices like honeycombs can actually enhance their toughness. "We essentially found a lever that lets you vary the geometry of the final outcome, which can affect its resistance to cracking," adds Raney.

Building the swarm in reality

While the team created prototypes, actually building a swarm of robots is still a step away. First, they plan to update their simulation to better reflect how tiny robots might work in the real world.

"In our early models, we imagined the robots laying down material in straight lines, like a mini 3D printer," says Yim. "But that may not be the most practical method. A better approach might be to use electrochemistry, where the robots grow metal structures around themselves."

Making that happen will require progress in building tiny robots that can move, sense and interact with materials, but the team believes the concept itself represents perhaps their most important advance.

"We hope this gets people thinking in new ways about how things can be built," says Raney. "Nature doesn't start with a master plan, it starts with lots of small actions that come together into something bigger. Now we're learning how to do that, too."

Additional co-authors include co-first authors Jiakun Lu and Xiaoheng Zhu, as well as Walker Gosrich, all of Penn Engineering.

More information: Jiakun Liu et al, Design of nondeterministic architected structures via bioinspired distributed agents, *Science Advances* (2025). DOI: 10.1126/sciadv.adu8260
Journal information: Science Advances
Provided by University of Pennsylvania

JUNE 17, 2025

Two-actuator robot combines efficient ground rolling and spinning flight in one design

by Bob Yirka, Phys.org edited by Gaby Clark, reviewed by Robert Egan

Weight breakdown of the ATOM prototype. The battery and the frame contribute nearly one-third and one-fourth of the overall weight, respectively. The miscellaneous (misc.) includes the weight contribution of screws, nuts, and PCB connecting the motors to the ESCs. Credit: *The International Journal of Robotics Research* (2025). DOI: 10.1177/02783649251344968
A team of engineers at Singapore University of Technology and Design has created a truly unique robot—one that can roll around like a drum, then take off and fly like a spinning wheel. In their paper published in *The International Journal of Robotics Research*, the group describes their goals in developing the robot and how they were achieved, along with a description of how it works.

The aim of the team was to create a small, lightweight robot with two modes of transport—terrestrial locomotion and rotational aerial flight. They achieved both of these goals by designing a frame that can be used for both types of motion, but in different ways.

The robot, about the size of a basketball, is mostly a wire frame in the shape of a snare drum. Inside, it has a blade-shaped wing that looks a lot like the kind of helicopter maple seeds that spin as they fall to the ground—it provides lift when the robot spins. The team placed intersecting wires across the sides to keep the robot from getting stuck if it turned on its side.

Also inside are two actuators and two very small rotors that serve as thrusters, pushing the robot to roll along the ground or through the air while in flight, and two very small circuit boards and a small battery. The whole thing weighs just 124g.

Another of its achievements is providing both aerial and terrestrial abilities using very little energy, though its terrestrial mode is still considerably more efficient. Most multi-mode robots are only able to be energy efficient in one of their modes. The research team has named their robot Aerial and Terrestrial mode Operating Mono-wing (ATOM) and notes that it achieves all of its feats using just two actuators.

The robot is able to roll straight ahead on a wide variety of surfaces, using its frame as a wheel, and to turn because it has two rotors. It is also capable of self-righting itself. To switch to flight mode, the robot tips itself just enough to allow it to spin its entire frame. Once in the air, it becomes a horizontal spinning wheel with a high degree of control.

Written for you by our author Bob Yirka, edited by Gaby Clark , and fact-checked and reviewed by Robert Egan —this article is the result of careful human work. We rely on readers like you to keep independent science journalism alive. If this reporting matters to you, please consider a donation (especially monthly). You'll get an **ad-free** account as a thank-you.

More information: Hitesh Bhardwaj et al, ATOM: Design and development of a novel two-actuator hybrid land-air robot, *The International Journal of Robotics Research* (2025). DOI: 10.1177/02783649251344968
Journal information: International Journal of Robotics Research

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JUNE 19, 2025

Vision-language model creates plans for automated inspection of environments

by Ingrid Fadelli, Phys.org edited by Gaby Clark, reviewed by Robert Egan

Figure showing the pipeline of the team's method. The input to their method includes a text description and a 3D environmental map, and the output consists of smooth trajectories that conform to the user's text description, which include targets, orders, and spatial relationships. Credit: Sun et al.
Recent advances in the field of robotics have enabled the automation of various real-world tasks, ranging from the manufacturing or packaging of goods in many industry settings to the precise execution of minimally invasive surgical procedures. Robots could also be helpful for inspecting infrastructure and environments that are hazardous or difficult for humans to access, such as tunnels, dams, pipelines, railways and power plants.

Despite their promise for the safe assessment of real-world environments, currently, most inspections are still carried out by human agents. In recent years, some computer scientists have been trying to develop computational models that can effectively plan the trajectories that robots should follow when inspecting specific environments and ensure that they execute actions that will allow them to complete desired missions.

Researchers at Purdue University and LightSpeed Studios recently introduced a new training-free computational technique for generating inspection plans based on written descriptions, which could guide the movements of robots as they inspect specific environments. Their proposed approach, outlined in a paper published on the *arXiv* preprint server, specifically relies on vision-language models (VLMs), which can process both images and written texts.

"Our paper was inspired by real-world challenges in automated inspection, where generating task-specific inspection routes efficiently is critical for applications like infrastructure monitoring," Xingpeng Sun, first author of the paper, told Tech Xplore.

"While most existing approaches use Vision-Language Models (VLMs) for exploring unknown environments, we take a novel direction by leveraging VLMs to navigate known 3D scenes for fine-grained robot inspection planning tasks using natural language instructions."

The key objective of this recent study by Sun and his colleagues was to develop a computational model that would enable the streamlined generation of inspection plans tailored around specific needs or missions. In addition, they wanted this model to work well without requiring further fine-tuning VLMs on large amounts of data, as most other machine learning-based generative models do.

Outputs of our method, where the inspection trajectories are drawn in red. Robot agent viewpoint camera frames of selected POIs are attached on the left side to highlight text conformity, with the corresponding orientations marked along the trajectory. More visual comparison with previous methods are shown in the supplemental video.
Credit: *arXiv* (2025). DOI: 10.48550/arxiv.2506.02917
"We propose a training-free pipeline that uses a pre-trained VLM (e.g., GPT-4o) to interpret inspection targets described in natural language along with relevant images," explained Sun.

"The model evaluates candidate viewpoints based on semantic alignment, and we further leverage GPT-4o to reason about relative spatial relationships (e.g., inside/outside the target) using multi-view imagery. An optimized 3D inspection trajectory is then generated by solving a Traveling Salesman Problem (TSP) using Mix Integer Programming that accounts for semantic relevance, spatial order, and location constraints."

The TSP is a classical optimization problem that aims to identify the shortest possible route connecting multiple locations on a map, while also considering constraints and characteristics of an environment. After solving this problem, their model refines smooth trajectories for the robot performing an inspection and optimal camera viewpoints for capturing sites of interest.

"Our novel training-free VLM-based approach for robot inspection planning efficiently translates natural language queries into smooth, accurate 3D inspection planning trajectories for robots," said Sun and his advisor Dr. Aniket Bera. "Our findings also reveal that state-of-the-art VLMs, such as GPT-4o, exhibit strong spatial reasoning capabilities when interpreting multi-view images."

Sun and his colleagues evaluated their proposed inspection plan generation model in a series of tests, where they asked it to create plans for inspecting various real-world environments, feeding it images of those environments. Their findings were very promising, as the model successfully outlined smooth trajectories and optimal camera-view points for completing the desired inspections, predicting spatial relations with an accuracy of over 90%.

As part of their future studies, the researchers plan to develop and test their approach further to enhance its performance across a wide range of environments and scenarios. The model could then be assessed using real robotic systems and eventually deployed in real-world settings.

"Our next steps include extending the method to more complex 3D scenes, integrating active visual feedback to refine plans on the fly, and combining the pipeline with robot control to enable closed-loop physical inspection deployment," added Sun and Bera.

Written for you by our author Ingrid Fadelli, edited by Gaby Clark , and fact-checked and reviewed by Robert Egan —this article is the result of careful human work. We rely on readers like you to keep independent science journalism alive. If this reporting matters to you, please consider a donation (especially monthly). You'll get an **ad-free** account as a thank-you.

More information: Xingpeng Sun et al, Text-guided Generation of Efficient Personalized Inspection Plans, *arXiv* (2025). DOI: 10.48550/arxiv.2506.02917
Journal information: arXiv

JUNE 19, 2025

Robot eyes are power hungry. What if we gave them tools inspired by the human brain?

by Adam D Hines, Michael Milford, Tobias Fischer, The Conversation edited by Gaby Clark, reviewed by Andrew Zinin

What a regular camera sees (left) compared to a bio-inspired camera (right). Credit: Adam Hines

Robots are increasingly becoming a part of our lives—from warehouse automation to robotic vacuum cleaners. And just like humans, robots need to know where they are to reliably navigate from A to B.

How far, and for how long, a robot can navigate depends on how much power it consumes over time. Robot navigation systems are especially energy hungry.

But what if power consumption was no longer a concern?

Our research on "brain-inspired" computing, published today in *Science Robotics*, could make navigational robots of the future more energy efficient than previously imagined.

This could potentially extend and expand what's possible for battery-powered systems working in challenging environments such as disaster zones, underwater, and even in space.

How do robots 'see' the world?

The battery going flat on your smartphone is usually just a minor inconvenience. For a robot, running out of power can mean the difference between life and death—including for the people it might be helping.

Robots such as search and rescue drones, underwater robots monitoring the Great Barrier Reef, and space rovers all need to navigate while running on limited power supplies.

Many of these robots can't rely on GPS for navigation. They keep track of where they are using a process called visual place recognition. Visual place recognition lets a robot estimate where it's located in the world using just what it "sees" through its camera.

But this method uses a lot of energy. Robotic vision systems alone can use up to a third of the energy from a typical lithium-ion battery found onboard a robot.

This is because modern robotic vision, including visual place recognition, typically relies on power-hungry machine learning models, similar to the ones used in AI like ChatGPT.

By comparison, our brains require just enough power to turn on a light bulb, while allowing us to see things and navigate the world with remarkable precision.

Robotics engineers often look to biology for inspiration. In our new study, we turned to the human brain to help us create a new, energy-efficient visual place recognition system.

Mimicking the brain

Our system uses a brain-inspired technology called neuromorphic computing. As the name suggests, neuromorphic computers take principles from neuroscience to design computer chips and software that can learn and process information like human brains do.

An important feature of neuromorphic computers is that they are highly energy-efficient. A regular computer can use up to 100 times more power than a neuromorphic chip.

LENS display during localization. Credit: *Science Robotics* (2025). DOI: 10.1126/scirobotics.ads3968
Neuromorphic computing is not limited to just computer chips, however. It can be paired with bio-inspired cameras that capture the world more like the human eye does. These are called dynamic vision sensors, and they work like motion detectors for each pixel. They only "wake up" and send information when something changes in the scene, rather than constantly streaming data like a regular camera.

These bio-inspired cameras are also highly energy efficient, using less than 1% of the power of normal cameras.

So if brain-inspired computers and bio-inspired cameras are so wonderful, why aren't robots using them everywhere? Well, there are a range of challenges to overcome, which was the focus of our recent research.

A new kind of LENS

The unique properties of a dynamic vision sensor are, ironically, a limiting factor in many visual place recognition systems.

Standard visual place recognition models are built on the foundation of static images, like the ones taken by your smartphone. Since a neuromorphic sensor doesn't produce static images but senses the world in a constantly changing way, we need a brain-inspired computer to process what it "sees."

Our research overcomes this challenge by combining neuromorphic chips and sensors for robots that use visual place recognition. We call this system Locational Encoding with Neuromorphic Systems, or LENS for short.

LENS uses the continuous information stream from a dynamic vision sensor directly on a neuromorphic chip. The system uses a machine learning method known as spiking neural networks. These process information like human brains do.

By combining all these neuromorphic components, we reduced the power needed for visual place recognition by over 90%. Since nearly a third of the energy needed for a robot is vision related, this is a significant reduction.

To achieve this, we used an off-the-shelf product called SynSense Speck, which combines a neuromorphic chip and a dynamic vision sensor all in one compact package.

The entire system only required 180 kilobytes of memory to map an area of Brisbane eight kilometers in length. That's a tiny fraction of what would be needed in a standard visual place recognition system.

A robot in the wild

For testing, we placed our LENS system on a hexapod robot. Hexapods are multi-terrain robots that can navigate both indoors and outdoors.

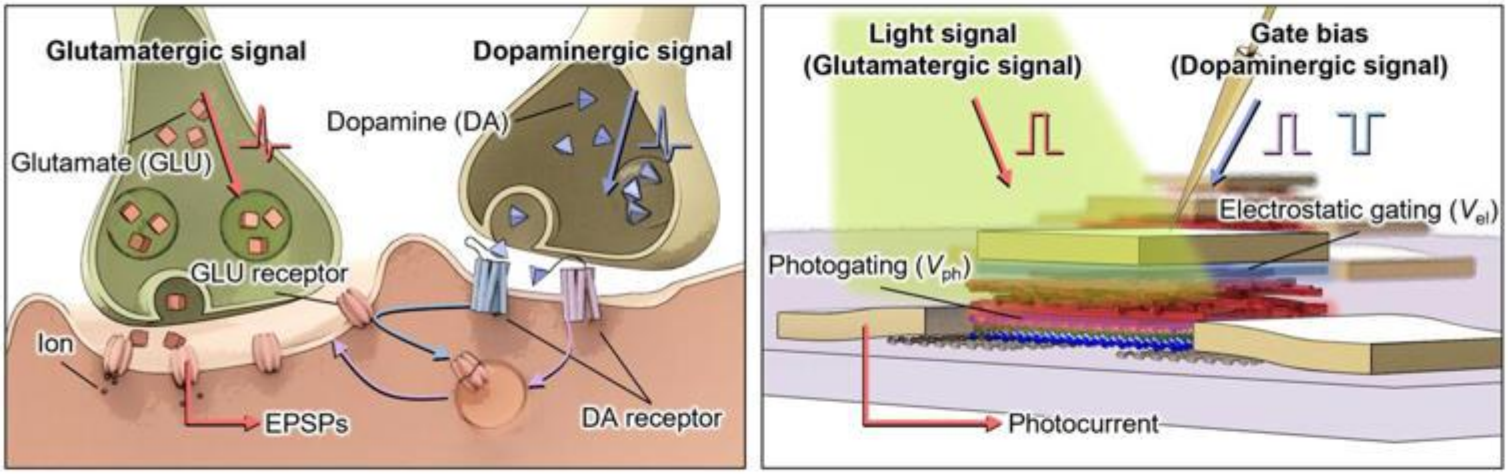
In our tests, the LENS performed as well as a typical visual place recognition system, but used much less energy.

Our work comes at a time when AI development is trending towards creating bigger, more power-hungry solutions for improved performance. The energy needed to train and use systems like OpenAI's ChatGPT is notoriously demanding, with concerns that modern AI represents unsustainable growth in energy demands.

For robots that need to navigate, developing more compact, energy-efficient AI using neuromorphic computing could be key for being able to go farther and for longer periods of time. There are still challenges to solve, but we are closer to making it a reality.

More information: Adam D. Hines et al, A compact neuromorphic system for ultra–energy-efficient, on-device robot localization, *Science Robotics* (2025). DOI: 10.1126/scirobotics.ads3968
Journal information: Science Robotics

Brain-inspired vision sensor enhances object outline extraction in varying lighting conditions



In-sensor multilevel image adjustment enabled by adjustable synaptic phototransistors. (A) Schematic illustration of biological synapses showing glutamatergic response for EPSP accumulation and its dopaminergic regulation. (B) Schematic illustration of adjustable synaptic phototransistors with light-induced photogating effect for photocurrent accumulation and gate bias-driven electrostatic gating effect for photocurrent regulation. Credit: Science Advances (2025). DOI: 10.1126/sciadv.adt6527

A novel vision sensor inspired by the neural transmission mechanisms of the human brain has been developed to efficiently and accurately extract object outlines even under fluctuating lighting environments. This advancement promises to significantly enhance perception capabilities in autonomous vehicles, drones, and robotic systems, enabling faster and more precise recognition of surroundings.

A research team, led by Professor Moon Kee Choi from the Department of Materials Science and Engineering at UNIST, in collaboration with Dr. Changsoon Choi's team at the Korea Institute of Science and Technology (KIST) and Professor Dae-Hyeong Kim's team at Seoul National University, announced the development of this synapse-mimicking robotic vision sensor in an article published in the journal *Science Advances*.

Vision sensors serve as the eyes of machines, capturing visual information that is transmitted to processors—analogous to the human brain—for analysis. However, unfiltered data transfer can lead to increased transmission loads, slower processing speeds, and reduced recognition accuracy, particularly in environments with rapidly changing lighting conditions or regions with mixed brightness levels. To address these challenges, the research team engineered a vision sensor that emulates the dopamine-glutamate signaling pathway found in brain synapses. In the human brain, dopamine modulates glutamate signals to prioritize critical information. Mimicking this process, the newly developed sensor selectively extracts high-contrast visual features, such as object outlines, while filtering out extraneous details.

Professor Moon Kee Choi explained, "By integrating in-sensor computing technology that mimics certain functions of the brain, our system autonomously adjusts brightness and contrast, effectively filtering out irrelevant data. This approach fundamentally reduces the data processing burden for robotic vision systems that manage gigabits of visual information per second." Experimental evaluations showed that the sensor could reduce data transmission volume by approximately 91.8%, while simultaneously improving object recognition accuracy to about 86.7%.

The sensor incorporates a phototransistor whose current response varies with gate voltage, functioning similarly to dopamine by modulating reaction strength. This gate voltage control enables the sensor to adapt dynamically to varying lighting conditions, ensuring clear outline detection even in low-light environments. Furthermore, the sensor's output current responds to brightness differences between objects and backgrounds, amplifying high-contrast edges and suppressing uniform regions. Dr. Changsoon Choi commented, "This technology has broad applicability across various vision-based systems, including robotics, autonomous vehicles, drones, and IoT devices. By simultaneously enhancing data processing speed and energy efficiency, it holds significant potential as a cornerstone for next-generation AI vision solutions."

More information: Jong Ik Kwon et al, In-sensor multilevel image adjustment for high-clarity contour extraction using adjustable synaptic phototransistors, *Science Advances* (2025). DOI: 10.1126/sciadv.adt6527

Provided by Ulsan National Institute of Science and Technology

Humanoid robot combat tournament broadcast live on Chinese national TV

MAY 27, 2025 BY MAI TAO

Organizers say the event kicks off a 'new era in humanoid robot combat sports'

On May 25, 2025, at 8.30pm, the Unitree-sponsored CMG World Robot Tournament – Mecha Combat Arena, co-hosted by CMG's Education & Science Channel, Zhejiang Station, and CMG's Technology Bureau, was officially launched in Hangzhou. (See video below for extended highlights.)

As the world's first combat competition exclusively featuring humanoid robots, the tournament showcased Unitree's G1 humanoid robot as the sole competing model.

The entire event was broadcast live nationwide via CCTV-10 with simultaneous streams on social media platforms, including CCTV News and Yangshipin.

Through real-time commentary and interactive segments, the event delivered an electrifying blend of cutting-edge technology and visual spectacle, highlighting China's latest advancements in robotics.


机甲格斗擂台赛
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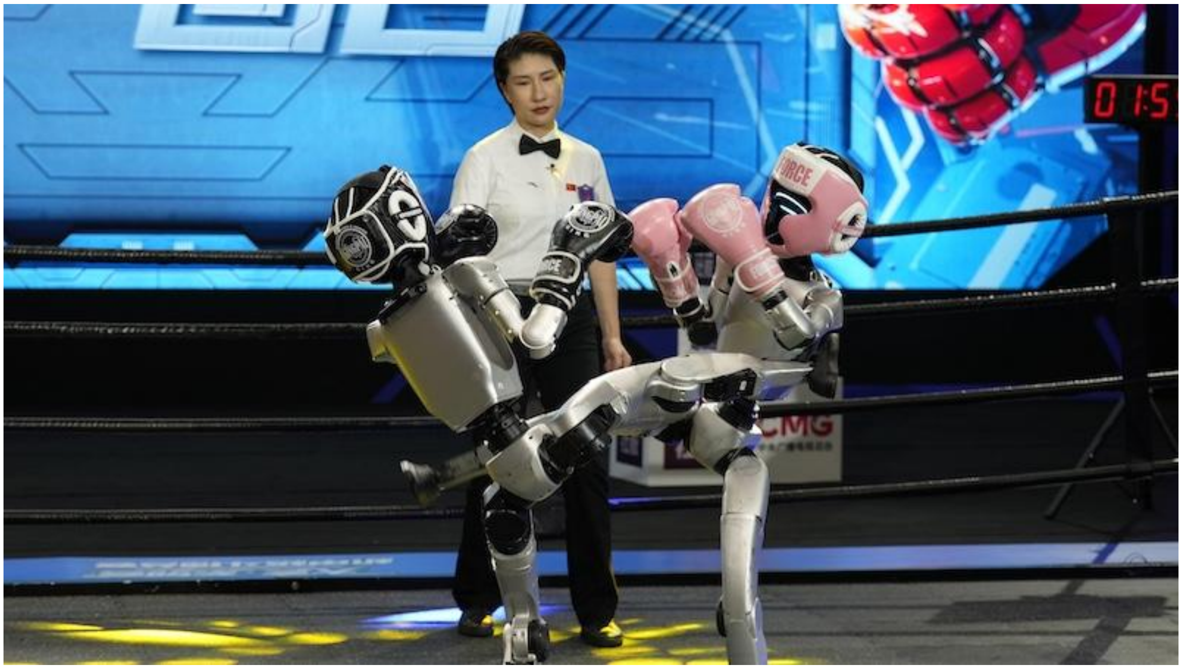


Four teams, one champion: A night of robotic battle royale

This “Mount Hua Summit” of the robot world was thrilling and brought together four uniquely styled teams

1. Black Team – ‘AI Tactician’ Lu Xin (Lu Sanjin)

With sharp AI-like intuition, his “anticipate the enemy, flawless calculation” tactics built impenetrable defenses and made subtle yet decisive moves to stay ahead of the game.

2. Pink Team – ‘The Silk Artisan’ Jiao Tianqi (Bladeform)

His “muscle memory precision” combat style delivered fluid, lightning-fast attacks that often secured victory in seconds.

3. Green Team – ‘Power Core Guardian’ Hu Yunqian (The Electrical Engineer)

Applying methodical engineering thinking, Hu relied on “steady pressure, inch-by-inch advance” tactics to systematically overwhelm his opponents.

4. Red Team – ‘Armored Mulan’ Chen Liangyu (Chen Xiyue)

Pioneering the fusion of intangible cultural heritage with mech combat, her "unexpected moves, creative counters" showcased traditional Chinese wisdom.

The robots performed complex combinations of punches, dodges, kicks and blocks—showcasing exceptional motion control and balance.

Powered by Unitree's proprietary millisecond-response control system, the competition proved that "human-robot interaction can be both thrilling and genuinely fun", as one excited competitor noted.

After fierce competition, the Black Team – "AI Tactician" claimed victory with its robot's superior endurance and tactical execution.

Captain Lu Xin celebrated by embracing his black mech, then this black robot—representing the pinnacle of Chinese innovation—took a victory lap around the arena, and the crowd erupted in cheers. The event perfectly showcased the technical charm of robot combat.

Behind the scenes: The robot's 'B-side' life

If you think these G1 robots are only good at dancing and combat, then you're seriously underestimating them. These "kung fu stars" on the stage are hidden multi-hyphenate talents. With 29 flexible joints and intelligent balance algorithms, they can switch roles anytime, anywhere.

“We are witnessing a groundbreaking crossover in robotics,” said one spectator. The intelligent algorithms and hardware systems demonstrated during the competition have already shown strong potential for industrial applications.

In the near future, humanoid robots may well take the lead in replacing humans in complex tasks across entertainment, manufacturing, and specialized industries. Scenes once seen only in science fiction are now being gradually brought to life by these metal companions.

ROBOTICS & AUTOMATION NEWS

The coming price war in humanoid robotics: From industrial workers to household helpers. How much for each?

APRIL 17, 2025 BY MARK ALLINSON

As the race to commercialize humanoid robots intensifies, companies across the globe are staking their claim in a market that spans industrial powerhouses to everyday household helpers.

Once confined to research labs and sci-fi films, humanoid robots are now inching closer to mainstream reality – and price is emerging as one of the key battlegrounds.

A new generation of robots is being launched at dramatically different price points, reflecting divergent visions for how these machines will integrate into workspaces, homes, and public environments.

From $150,000 industrial-grade humanoids to $10,000 domestic helpers, the humanoid robotics industry is now defined not only by technological ambition but also by economic accessibility.

XPeng's Iron: Premium industrial automation

At the top end of the market is XPeng's Iron, a humanoid robot designed for high-value industrial applications.

Standing 1.73 meters tall and weighing 70 kilograms, Iron is equipped with 60 articulating joints and 200 degrees of freedom – making it capable of executing complex, human-like motions.

Built around XPeng's proprietary Turing AI chip, the robot is expected to perform advanced tasks such as electric vehicle component assembly, warehouse operations, and eldercare support.

XPeng says mass production is targeted for 2026. With an estimated price of around $150,000, Iron is firmly positioned as a premium offering for factories, hospitals, and retail chains seeking flexible automation solutions.

BYD’s BoYoboD: Affordable household assistance

At the other end of the spectrum is BoYoboD, a humanoid robot introduced by EV manufacturer BYD. Designed for the consumer market, BoYoboD is solar-powered and built to help with domestic tasks like laundry, vacuuming, and light cleaning.

With a launch price of around $10,000, BYD aims to make household humanoids an attainable appliance for middle-class families – a bold move that could reshape the robotics adoption curve.

Deliveries are expected to begin in December 2025, with the initial launch focused on the Chinese market. While details on performance specifications are limited, the aggressive pricing signals BYD’s intent to lead in the mass-market personal robot category.

Tesla’s Optimus: The mainstream contender

Tesla, known for disrupting industries with scalable technology, has entered the humanoid robotics fray with Optimus Gen 2.

Elon Musk’s vision includes these robots eventually performing a wide array of household and caregiving tasks – from walking the dog to mowing the lawn.

Optimus stands 1.73 meters tall, weighs 56 kilograms, and features 22 degrees of freedom in its hands. It is reportedly capable of lifting up to 20 kilograms and walking with dynamic balance.

Production is slated for 2026, with the target price estimated between $20,000 and $30,000. While not the cheapest, Optimus is designed for broad consumer appeal and Tesla hopes to scale production in the same way it has with electric vehicles.

Unitree G1: Industrial robotics at a bargain

Also in China, robotics firm Unitree has unveiled the G1, a more compact humanoid robot aimed at the affordable industrial segment.

Standing 1.27 meters (about 4’2’’) tall, the G1 can walk at 4.5 mph and carry up to 7 pounds. It features AI-enhanced motion control and has a reported runtime of two hours.

With a starting price of $16,000, Unitree is positioning the G1 as a budget-conscious option for educational institutions, light industrial tasks, and robotic development labs.

The company's strategy seems to mirror its earlier success in quadruped robots, offering functional machines at a fraction of the cost of competitors.

The market split: Premium utility vs mass appeal

This widening price gap among humanoid robots reveals an industry in the midst of self-definition. Some companies, like XPeng and Tesla, are pursuing high-functionality, high-cost machines suitable for factories and wealthier homes.

Others, like BYD and Unitree, are attempting to undercut the market and seed early consumer demand by offering more affordable – if less capable – robots.

What remains to be seen is whether consumers and businesses will prioritize cost, capability, or convenience.

But with humanoid robots finally stepping into the marketplace at a range of price points, the long-promised age of robotic companions is no longer a theoretical future – it's a commercial one, and the competition is just beginning.

Humanoid era: List of all the most prominent companies building humanoid robots

DECEMBER 30, 2024 BY DAVID EDWARDS

2024 may be remembered as the year humanoid robots proliferated to the point where there can be no question that they will – whether we like it or not – become part of our lives in the not-too-distant future.

While they may still have technical limitations even today, many of the previous obstacles have now been smoothed out.

Such is the interest now in humanoid robots, Honda may even bring Asimo out of its locker or wherever it has been kept past few years.

Unchained malady

One of the main constraints in developing humanoid robotics in the past was that there just wasn't the computing power available to do complex things like walk and talk. But those invisible chains and shackles have been done away with now.

With the quantum leaps made in processing power – both within single microprocessors and in the aggregate – humanoids can add humungous amounts of digestive tracts to their onboard digestion systems and voraciously ingest the vast banquet of brain food in the form of artificial intelligence algorithms and software currently on offer today, and get ready to feed on the even more powerful superfoods of the future.

Add to that Nvidia's recent announcement that it will launch a highly specialised computing system for humanoid robots – called Jetson Thor – and you're looking at a reasonably well-formed ecosystem, or digestive system, in which these slightly disturbing machines can and will thrive and grow to enormous sizes in terms of processing power if not physical dimensions.

At the moment, the science-fiction film humanoids are beyond reach, but for a huge and growing variety of tasks in everyday life – from lifting and moving boxes and items in warehouses to welding and inspecting cars and parts – humanoids have the technology to do what it takes.

The days of the humble robotic arm may be numbered.

Regular malaise

As well as the countless news stories we have covered in recent days, this is the second time we have written a feature about humanoid robots in about a month. My colleague, Mark Allinson, provided an overview of the humanoids robotics sector recently, in which he looked at the general principles of the technology and the market.

But developments in recent days led us to believe the subject is worth revisiting if only to provide ourselves with a list of the most prominent companies currently developing humanoid robots – there's suddenly so many of them that we feel slightly out of touch.

Not too long ago, humanoids were generally thought to be of academic interest only, and not capable of contributing to, say, an industrial enterprise. But now, with BMW and maybe one or two others testing out humanoids in their factories, one cannot ignore the fact that humanoids could potentially become the next wave of "alien" workers entering the market.

Labour shortages are a problem in both manufacturing and logistics. I mean humans – there aren't enough of them to fill the jobs available in industry.

Humanoids could not only fill the jobs that humans have not filled, they could also displace humans that are currently doing similar work.

Be afraid. Be slightly afraid

Like most people who write about these subjects, we've very much enjoyed the doom-mongering we've done past few years about robots doing exactly that – taking our jobs and rendering us all useless – as well as scaring everybody shitless about robots taking over everything and killing us all, like the Terminator films taught us. We've done these things largely in jest, but you know and we know that there is a tiny amount of truth in the fear-mongering we have happily engaged in.

Anyway, whatever happens from here on out, don't say we didn't warn you and don't blame us. We didn't do it. We're just messengers from our robot overlords.

Disclaimers dispensed with, here is as complete a list as you will find on the internet of all the companies developing and commercialising humanoid robots around the world.

List of humanoid robot companies

Tesla (United States)
Robot: Optimus
Overview: Unveiled in 2021, Optimus is designed for general-purpose tasks, aiming to perform duties that are "dangerous, repetitive, and boring". Tesla plans to commence low-volume production by 2025, with a target price between $20,000 and $30,000.

Agility Robotics (United States)
Robot: Digit
Overview: Founded in 2015, Agility Robotics developed Digit, a bipedal humanoid robot designed for logistics and warehouse tasks. Digit has been deployed in facilities such as a Spanx warehouse and is being tested by companies like Amazon for distribution and fulfillment tasks.

Figure AI (United States)
Robots: Figure 01 and Figure 02
Overview: Established in 2022, Figure AI focuses on creating AI-powered humanoid robots for manual labour. In 2024, the company secured $675 million in funding from investors including OpenAI, Microsoft, Nvidia, and Jeff Bezos, valuing the company at $2.6 billion. Figure 02 robots have been deployed in BMW's manufacturing facilities for testing.

Hanson Robotics (Hong Kong)
Robots: Sophia, Albert Hubo, Bina48
Overview: Hanson Robotics is renowned for developing human-like robots capable of human interaction and emotional intelligence. Sophia, one of its most famous robots, was activated in 2016 and has been granted citizenship in Saudi Arabia. Also behind the Ai-Da humanoid robot, which sold its painting for more than $1 million at Sotheby's auction house recently.

UBTech Robotics (China)
Robot: Walker S1
Overview: UBTech has developed Walker S1, a humanoid robot designed for manual labour tasks in manufacturing settings. These robots have been deployed in BYD Auto's factories to address labour shortages and enhance efficiency.

EngineAI (China)
Robot: PM01
Overview: EngineAI's PM01 is a lifelike humanoid robot featuring ultra-acrobatic skills and an "owl-like" waist capable of rotating 320 degrees. Designed for flexibility and speed, PM01 is targeted at businesses, researchers, and developers, with availability expected in early 2025.

1X (Norway)
Robots: Eve and Neo Beta
Overview: Founded in 2014, 1X develops humanoid robots emphasizing safety and affordability. EVE is designed for roles in security, healthcare, and other service-oriented industries, while Neo Beta is a humanoid robot for home use, currently being tested in domestic environments.

Sanctuary AI (Canada)
Robot: Phoenix
Overview: Sanctuary AI focuses on creating humanoid robots with human-like intelligence to assist in various work environments, enhancing safety and efficiency. Phoenix is their general-purpose robot designed to perform a wide range of tasks across different industries.

Fourier Intelligence (China)
Technology of interest: Intelligent Rehabilitation Robots
Overview: Fourier Intelligence specializes in developing intelligent humanoid robots for medical rehabilitation. Their products are deployed in over 2,000 clients across more than 40 countries, providing high-performance rehabilitation solutions.

Boston Dynamics (United States)
Robot: Atlas

Overview: Boston Dynamics' Atlas is a bipedal humanoid robot designed for search and rescue tasks. Unveiled in 2013, Atlas demonstrates advanced athletics and agility, exploring the potential of the humanoid form in dynamic environments.

Guangzhou Automobile Group (GAC) (China)
Robot: GoMate
Overview: GAC has introduced GoMate, a full-sized humanoid robot featuring a variable wheel-foot mobility structure that allows seamless switching between four-wheel and two-wheel modes. This design enhances stability and adaptability in complex environments. GAC plans to achieve small-scale production by 2026, aiming to deploy GoMate in sectors such as security, healthcare, and logistics.

Apptronik (United States)
Robot: Apollo
Overview: Apptronik has developed Apollo, a humanoid robot designed to transform industrial workforces. Standing at 1.73 meters and weighing 73 kilograms, Apollo is engineered for tasks in warehouses and manufacturing plants, with future applications envisioned in construction, retail, and healthcare. Apptronik has partnered with Google DeepMind to integrate advanced AI capabilities into their robotics platform.

Unitree Robotics (China)
Robot: G1
Overview: Unitree Robotics is preparing to mass-produce the G1 humanoid robot, priced at $16,000. The G1 features 23 degrees of freedom, enabling it to perform tasks such as walking, climbing stairs, and manipulating objects with its three-fingered hands. Initially aimed at robotics research, the G1 is expected to be available for purchase soon.

Engineered Arts (United Kingdom)
Robots: Ameca, Mesmer
Overview: Engineered Arts specializes in creating lifelike humanoid robots for entertainment, education, and research. Ameca is known for its realistic human expressions and interactions, making it a popular choice for human-robot interaction studies. Mesmer robots are designed to be highly expressive and anatomically accurate, providing realistic human-like movements and expressions.

Pudu Robotics (China)
Robot: Pudu D9
Overview: Pudu Robotics has launched the Pudu D9, a full-sized bipedal humanoid robot developed by the Pudu X-Lab. Standing at 170 cm and weighing 65 kg, the Pudu D9 features 42 degrees of freedom and is equipped with dexterous hands, enabling human-like walking and dual-hand operational capabilities. It is designed for tasks such as ground cleaning and other service-oriented applications.

China Southern Power Grid (China)
Robot: Name unavailable at this time
Overview: China Southern Power Grid has unveiled a humanoid robot designed to assist in power grid maintenance and operations. This robot is expected to enhance efficiency and safety in managing power grid infrastructure.

AgiBot (China)
Robot: A1 and A2-Max
Overview: AgiBot launched its first embodied "general purpose" humanoid robot last year, and its target market is very much the industrial space. The company also provides traditional robotic arms, so that may help in its endeavour to persuade potential buyers to opt for a humanoid instead.

Clone Robotics (China)
Robot: Alpha
Overview: Technically, Clone Robotics makes "androids", which are designed to look more human than humanoids, weirdly enough. The company is largely in stealth mode, but it is offering potential buyers the chance to purchase one of its first 279 units made.

Robot Era (China)
Robot: Star 1
Overview: The Star 1 is a full-length humanoid, from head to feet, while Robot Era's other humanoids include a half-body (from the waist up) robot as well as a humanoid on wheels. or rather an autonomous mobile robot – one of those things that scurry around carrying shelves in warehouses.

Rainbow Robotics (South Korea)
Robot: Hubo
Overview: Samsung recently became the largest shareholder in Rainbow Robotics, which is a spin-out from the Korea Advanced Institute of Science & Technology (KAIST). Rainbow Robotics has at least two types of humanoids in development, one with feet and another that gets around on wheels.

WorkFar Robotics (United States)
Robot: Syntro
Overview: Highly unusual company in the sense that, while most startups look to be acquired or invested into, WorkFar's stated aim is to acquire other companies. So far, its most notable achievement is to build a humanoid robot and collaborative robots without outside help or investment.

Kawada Robotics (Japan)
Robot: NextAge

Overview: Kawada is an absolutely massive industrial conglomerate which has so many areas of operation that its robotics unit barely gets a mention on its website. The humanoid it has developed was one of the most advanced at the time a few years ago, but probably needs to be updated now.

This is the end

It's worth adding that OpenAI, the company or organisation behind the phenomenally successful ChatGPT application, is also considering building a humanoid robot.

It previously considered building a humanoid in 2021, but decided against it for whatever reason, invested in 1X and Figure, and disbanded its robotics team.

But a number of factors may tempt OpenAI to get the band back together. These factors include the growing interest in the technology, the number of companies entering the market, and the real possibility that there may be a huge market out there for these infernal things.

One research company calculates that the global market for humanoid robots will grow from the $2 billion in 2024 to approximately $13.25 billion in 2029. That's a pretty big jump.

OpenAI is not, as you may have guessed by now, the only company considering their options. BYD, one of China's largest automakers, has also stated its definite intention to build humanoids. A similar idea is taking shape at Li Auto.

Whether it happens in the next few years or many years from now, one thing we feel sure of is that humanoids are definitely going to be part of our lives sooner or later – whether we like it or not.

Are We Nearing the End of the Edge vs. Cloud Debate for Smart Robots?

JUNE 27, 2025 BY SAM FRANCIS

Robots have evolved from isolated, pre-programmed units to intelligent, connected collaborators.

In this new era, one of the biggest questions that engineers, technologists, and robot operators continue to grapple with is: Are we nearing the end of the edge vs. cloud debate for smart robots?

For the longest time, robot design and deployment came down to choosing between edge processing – relying on local hardware for computational needs – and cloud processing, which taps into remote servers for greater data storage and AI capabilities.

Today, thanks to advances in connectivity, storage, and processing, this debate is starting to feel like an old one. What if the future is not about choosing one over the other but merging both paradigms seamlessly?

The Edge-Centric Model

Edge computing has long been the preferred approach when low latency and high reliability matter. An autonomous robot on a factory floor doesn't have the luxury of relying on a remote server when making split-second decisions.

From collision avoidance to precision pick-and-place, the robot needs its processing capabilities nearby, often within its hardware.

Edge deployments reduce delays caused by network latency, making robots more responsive and resilient. This responsiveness can mean the difference between seamless operation and costly downtime in highly dynamic environments like warehouses, farms, or manufacturing plants.

The Allure of the Cloud

Conversely, the cloud has opened the door to a new level of intelligence for robots. Through connectivity to robust platforms, robots can tap into massive databases, sophisticated AI services, and analytics pipelines that would be impractical to embed on-device. The cloud allows for:

- **Data Centralization**: Gathering information from fleets of robots across locations.
- **Machine Learning at Scale**: Training and refining AI models using big data.
- **Seamless Updates**: Distributing software and AI improvements to robots instantly.

With advances like the IoT cloud database, robots can operate within an ecosystem where sensor data from countless global devices is stored, managed, and instantly available.

The Convergence of Edge and Cloud

The best of both worlds approach is gaining ground. In many ways, this convergence is what the future of robotics and automation will be built upon. We are already seeing deployments where robots operate with a dual architecture:

- The edge handles mission-critical and latency-sensitive processing.
- The cloud serves as the long-term data warehouse and AI training hub.

Modern robot platforms increasingly incorporate protocols and middleware that make it seamless for a robot to operate in an edge-first mode when connectivity is unstable and then transition to using cloud resources when available.

The Impact on Robot Development

Developing robots that can straddle both edge and cloud environments means rethinking design. New platforms are making it easier for developers to build and test connectivity-agnostic robot applications, relying on microservices and containerization.

This approach allows robot behavior and intelligence to evolve, regardless of where processing occurs.

Robotics developers can now:

- Push real-time object detection models to robots.
- Maintain global maps and telemetry data in the cloud.
- Quickly adapt robot behavior based on learnings from a global robot fleet.

What This Means for the Industry

For robot manufacturers and operators, this shift has profound implications:

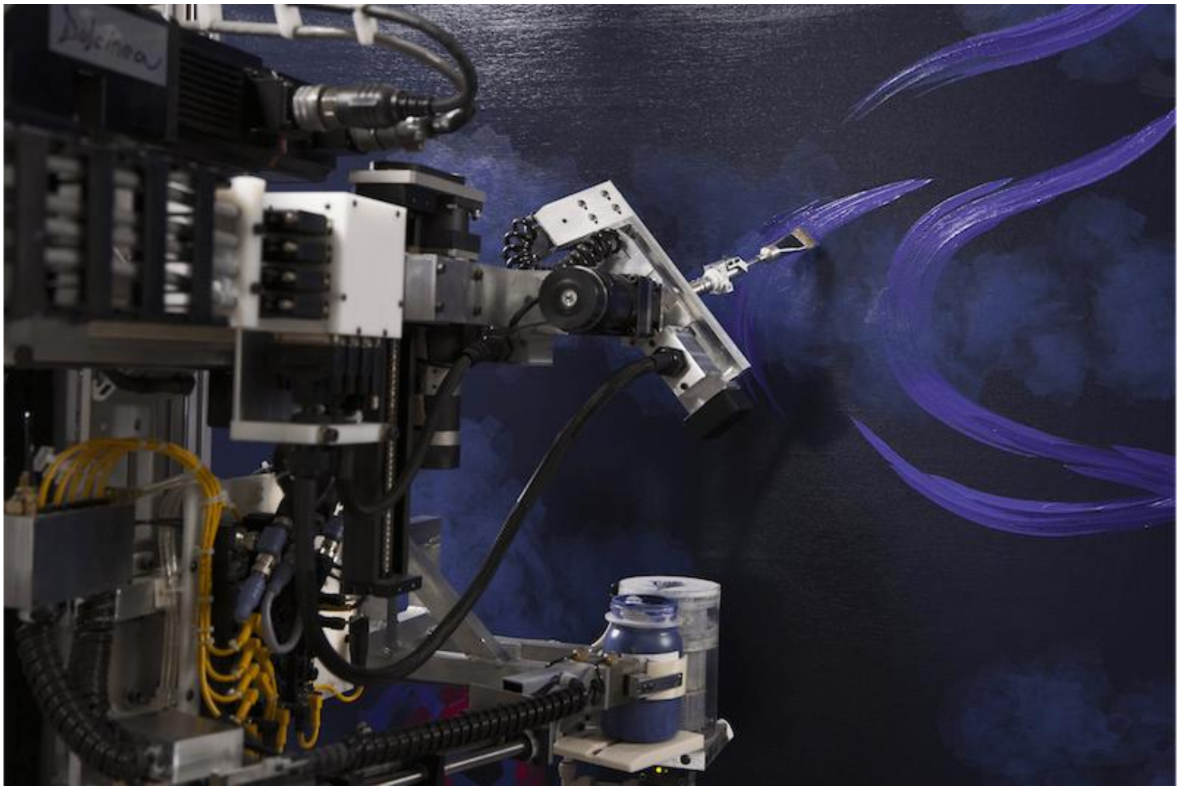
- **Better scalability**: An edge + cloud approach allows robot fleets to grow across facilities and geographies.
- **Improved maintenance**: Predictive maintenance and remote diagnostics become more viable.
- **More advanced AI models**: The cloud can host the training pipelines required for state-of-the-art robot intelligence, while edge devices can run optimized inference.

The line between edge and cloud blurs, making robot platforms more robust, adaptable, and intelligent. What started as a choice between edge and cloud nowresembles a symbiotic relationship that benefits both.

We may be nearing the end of the edge vs. cloud debate for smart robots. The future doesn't lie in choosing one over the other.

Instead, it's about harnessing both – using the edge for rapid, localized decision-making, and relying on the cloud for long-term data storage, sophisticated AI, and connectivity across robot fleets.

In this new era, robots aren't just tools; they're evolving into fully integrated nodes in a global, intelligent network, reshaping how industries operate.



Former US Air Force engineer builds 10-foot tall, fully automated fine art painting robot

JUNE 27, 2025 BY SAM FRANCIS

Meet Paul Kirby, the ex-USAF engineer behind the unique 'robotic artist' Dulcinea. Story by Alexandra Campbell

Paul Kirby is an artist, engineer, and author of The FUSE Pathway: How to Find and Lead a Fulfilling Life. He is also the originator of "Fusioneering", a philosophy and framework for integrating diverse passions into a life of vision and purpose.

From earning an engineering degree at the University of California, Berkeley, to serving as an officer in the US Air Force, completing an MBA at Harvard Business School, and building a successful career in venture capital backing early-stage technology companies, Kirby has walked an interdisciplinary path that reflects the very principles he teaches.

In 1994, inspired by a Leonardo da Vinci exhibit, Kirby felt called to explore an exciting idea: What might it look like if da Vinci were alive today – armed with modern robotics-and wanted to merge his love of machinery with his artistic imagination?

That question, and Kirby's resulting vision, became the creative spark behind Dulcinea, a 10-foot tall, fully automated painting robot.

Dulcinea brings together precision engineering, extensive coding, artificial intelligence, and aesthetic intent. Her physical structure includes seven high-performance servo motors – including a human-like wrist-that enable her to execute thousands of exquisite brushstrokes per canvas.

Operating without human supervision, she produces large-scale, original artworks that blend visual storytelling with machine-driven execution.

But Dulcinea is more than a technical accomplishment. She reflects a personal philosophy: that engineering can be a form of self-expression. Programmed entirely from scratch, her works are not adaptations of existing images, as seen in generative art, but original compositions.

For Kirby, she represents something beyond a technical milestone, but rather a deeply personal and successful fusion of his passions.

Engineering excellence: The technical anatomy of an artistic robot

Dulcinea – a word with Spanish roots, meaning "sweet" – represents a complex integration of mechanical design, artificial intelligence, creative coding, and a fully automated robotic workcell capable of creating paintings.

At her core are seven high-performance servo motors that enable precise motion across multiple axes.

This sophisticated system allows her to manage the full spectrum of the painting operation: from retrieving the next jar of paint and dipping the brush using a precise paint-level sensor, to executing thousands of brushstrokes with control and finesse.

She can operate for hours at a time, including overnight when needed, and upon completing a painting, she returns and seals the paint jar, cleans her brush, moves to her home corner, and powers down – all without human involvement.

Dulcinea's creative process happens in two phases. In the first phase, Kirby codes the painting on a high-powered desktop computer using Lisp, a programming language particularly well-suited for complex coding processes.

It is worth noting that Kirby places deep value on the creative process itself. Rather than relying on photographs, reference images, or dataset-trained models – as is common in many AI-generated art systems – he codes each piece from scratch, making every artwork wholly original.

This approach reflects his belief that true creative fulfillment comes not from imitation, but from the act of building something entirely new.

In the second phase, Dulcinea begins to physically execute the painting onto the canvas, using a workcell also developed by Kirby.

It incorporates an industrial robot controller from Adept Technology, running their proprietary V+ robot programming language, custom-configured operating system, and motor and I/O controls.

This controller manages three concurrent operations in real time: a six-axis gantry-style robot; a second robot providing an axis for vertical up/down motion for the wrist, ensuring precise dipping into the paint; and a pneumatic system that handles brush washing, clean and dirty water flow, and paint jar exchanges.

Notably, in June of 1983, Kirby was a founding venture capital investor and board director at Adept Technology, Inc., which at one point was the largest American robot company in the United States.

As a result of this two-phase process, we have a highly-orchestrated robotic workcell that merges machinery, dexterity, logic, and aesthetics.

Dulcinea gives striking physical form to Kirby's fusioneering vision: a life where engineering and creativity move in harmony – one capable of producing large, impactful paintings, with visual movement, color, texture, and exquisite brushwork.

Beyond mere replication: Dulcinea's distinct place in robotic art

The field of robotic art has grown increasingly diverse, with artists, engineers, and research institutions exploring how artificial intelligence and mechanical systems can participate in creative expression.

Projects like e-David, developed by the University of Konstanz, use visual feedback loops to iteratively replicate existing images.

Ai-Da, a humanoid robot with a wide media profile, leverages camera input and machine learning to generate paintings, poetry, and sculptures that challenge viewers' assumptions about machine authorship.

Many of these systems intersect with market considerations, cultural commentary, or novelty-driven public engagement. Whether designed for gallery sales or conceptual critique, most rely on generative models or neural networks trained on visual datasets.

Their outputs, while often compelling, are typically variations of pre-existing imagery shaped by data input and algorithmic interpretation.

On that front, Dulcinea stands apart in both origin and execution. She was not created in a research lab nor for an exclusively public exhibition.

Rather, Kirby built her in his small Loveland, Colorado studio as a pure expression of creative fusion, embodying the essence of his aptly-named Fusioneering philosophy.

Unlike most robots, Dulcinea was designed from a unique place of creative expression, engineering acumen, and potent curiosity.

Key differentiators include: her fully-automated operation with large canvases and tens-of-thousands of brushstrokes; the ability to wash the brush between colors or after extended idle periods; precise paint exchange and jar sealing to prevent drying; and a highly sensitive system that measures the paint level in each jar to a fraction of a millimeter.

This last feature is essential for accurate and exquisite brushwork, as paint levels fluctuate during use and vary between jars.

Canvas chronicles: Exploring Dulcinea's artistic output

Dulcinea's body of work showcases the convergence of engineering precision and artistic sensibility. Each painting is coded from scratch, with no use of visual data like JPEGs, and brought to life through her fully automated execution.

The results are galleries of large-format paintings – each measuring several feet across – that span genres, techniques, and emotional tones, all created from entirely original code.

Among her most personal and ambitious works is Meditation Upon Death, a 78'' x 68'' painting completed in 2018 and dedicated to the memory of Kirby's late wife, Linda.

Meditation Upon Death, by Dulcinea robot

Structured in three acts – the moment of passing, the spirit's transition through the afterlife, and an unresolved resolution – it unfolds as a visual narrative of grief, transcendence, and reflection.

The painting required 5,796 brushstrokes and is widely regarded as one of Dulcinea's most emotionally resonant creations.

Visitors to Kirby's Virtual Reality Art Gallery and Robotics Studio can zoom in on the delicate, curving purple brushwork, an especially striking example of Dulcinea's fine motor control and artistic finesse.

In contrast, Cappuccino Fluid Dynamic, a 64" x 86" painting, offers a more abstract exploration. Inspired by the swirling foam in a cappuccino, the piece began with a computational fluid dynamics simulation.

Kirby then captured that mathematical swirling energy and translated it into brushstrokes, resulting in a kinetic, layered painting that conveys motion and chaos with visual excitement. It exemplifies how physics and code can be transposed into reinterpreted visual art.

Another standout, Impressionist, a 48" x 54" painting, pays tribute to pointillist technique while showcasing Dulcinea's technical range.

Using a palette of 24 colors – including six warm yellows, six cool yellows, and a combination of 12 warm and cool purples – she applied 44,943 individual brushstrokes to build a luminous, optically vibrant canvas.

The density and variation of strokes expertly mimic the shimmer of light in classical Impressionist works.

Collectively, these artworks, and many others seen on Kirby's website or VR tour of his studio space and galleries, demonstrate that Dulcinea is more than a technical instrument.

She is a partner in artistic expression: one capable of creating works that evoke emotion, provoke thought, and embody the fusioneering ideal – art born from the spirit of convergence.

Broader impact: Reimaging robotics through personal vision

While Dulcinea, at her core, is a robotic painter she's also so much more. Her presence serves as a creative embodiment of Paul Kirby's Fusioneering philosophy.

In his book The FUSE Pathway, Kirby outlines a framework for integrating one's varied passions into a singular vision and fulfilling life. Dulcinea was born from this ethos, fusing Kirby's deep interests in art, engineering, and robotics into an expressive journey of creative joy.

While the book features historical examples of polymaths, inventors, and innovators who exemplified this kind of fusion, Dulcinea serves as a modern, deeply personal illustration.

She brings disciplines often viewed as incompatible: logic and emotion, code and canvas, machine execution and human storytelling. In doing so, she redefines what it means to be creative in a technological age.

Kirby continues to share this vision through multiple channels. The virtual reality tour of his art galleries and robotics studio immerse visitors in Dulcinea's world, offering a 360-degree experience of her paintings and process.

Designed to capture the layout and intimacy of his Loveland, Colorado studio, the VR experience allows people around the world to step inside the artist-engineer's space.

For those local to Colorado, Kirby also offers in-person studio tours, providing a firsthand look at how mechanics, programming, and passion converge.

These experiences are unquestionably educational in nature, but they're also invitations to rethink what's possible. Kirby sees technology not as a substitute for human creativity, but as a means of deepening it.

In a cultural moment dominated by generative AI, productivity for productivity's sake, and rapid content production, Dulcinea stands as a counterpoint: a machine built not for speed or spectacle, but for personal fulfillment – and ultimately, creative inspiration on a larger scale.

Her existence raises a powerful set of questions: What if the future of robotics is not just functional, but also a creative means of self-expression? What if machines could support meaning-making instead of attempting to replace it?

In this vision, technology becomes more than just a tool; it becomes a medium through which we are offered the opportunity to rediscover the joy, curiosity, and purpose that makes the creative process worth pursuing.

And in doing so, it reminds us that fulfillment isn't found only in the final result, but in every step along the way; and that it is entirely possible to live in joy and meaning through every step along the way.

For more insights into Kirby's work and philosophy, visit TheFUSEPathway.com.

Opinion: Brain Corp president outlines how robotics can transform Information overload into operational intelligence

JUNE 27, 2025 BY SAM FRANCIS

By Michel Spruijt, president, Brain Corp International

Here's an uncomfortable truth: we're drowning in data – and it's making us dumber, not smarter.

Global data production is accelerating at a breathtaking pace, from 64 zettabytes (or 64 trillion gigabytes) in 2020 to an estimated 170 ZB by 2025.

To put that in perspective, that's enough data to stream every movie ever made simultaneously on 50 billion devices.

Yet despite this information tsunami, most organizations find themselves in the paradoxical position of being data rich but insight poor.

This challenge becomes particularly visible in robotics deployments. Brain Corp powers the world's largest fleet of autonomous robots operating in public spaces – over 40,000 units deployed across retail, healthcare, and logistics sectors.

These machines can capture millions of images daily, along with collecting terabytes of operational data from sensors, navigation systems, and environmental monitoring. The sheer volume is staggering, but volume without insight is just expensive noise.

The real question isn't how much data we're collecting, it's what we're actually doing with it that creates genuine impact.

More information, less intelligence

The robotics industry offers a unique lens into this problem because robotic systems generate data continuously.

A single autonomous mobile robot can produce detailed logs of its navigation patterns, task completion rates, environmental conditions, obstacle encounters, and system performance metrics, all in real-time, 24/7.

But large-scale deployments reveal a critical insight: having access to comprehensive data doesn't automatically translate to better decision-making.

In fact, without the right infrastructure and strategy, it often has the opposite effect. Teams become paralyzed by choice, chasing metrics that don't matter while missing the signals that do.

Take a typical retail deployment. Robots are scanning shelves, tracking inventory levels, identifying out-of-stock conditions, and monitoring floor cleanliness. Each robot generates thousands of data points per shift.

But without clear frameworks for converting data into decisions, and the right platform functionalities to process that data, leaders can end up overwhelmed with data, or stuck in what industry experts call “dashboard theatre” – impressive-looking displays that make everyone feel data-driven while actual performance remains unchanged.

Lessons from ‘the world’s largest robotic fleet’

Managing 40,000+ autonomous robots (which Brain Corp believes to be the world’s largest robotic fleet) across diverse environments reveals that the gap between data collection and meaningful action can only be resolved by having the right outlook.

In large-scale robotics deployments, the most valuable data insights are those that can be acted upon autonomously or semi-autonomously.

When robots detect unusual patterns, unexpected obstacles, changes in foot traffic, inventory discrepancies, advanced systems don’t wait for human analysis. They immediately adjust behaviour, alert relevant stakeholders, and incorporate the learning into future operations.

Advanced cloud-based platforms allow leaders to act on robotic data immediately. When a robot identifies an out-of-stock condition on a retail shelf, it doesn’t just log the observation – it can trigger an integrated workflow that alerts store associates, updates inventory systems, and adjusts future scanning priorities based on historical patterns. The data becomes operationally valuable within a short period of time.

This immediate action loop is what separates effective data utilisation from mere data accumulation. But creating these loops requires rethinking how organisations conceive their information architecture.

Traditional approaches often separate data collection, analysis, and action into distinct phases managed by different teams with different tools, lacking a unifying platform of any kind. By the time insights reach decision-makers, the operational context has often changed.

The real-world impact of operational intelligence

The difference between data collection and operational intelligence becomes clear when examining specific outcomes. In logistics operations, the intelligence extends beyond individual robot performance to fleet-wide optimisation.

When one robot discovers a more efficient route or identifies a recurring obstacle, that knowledge can propagate across an entire system. The compound effect of shared learning means that operational efficiency improves exponentially rather than linearly as fleet size grows.

Perhaps the most striking example comes from retail environments where robots have fundamentally changed how stores understand customer behaviour.

By analysing millions of daily inventory images, retailers can better predict out-of-stock conditions before they occur, optimize product placement based on actual shopping patterns, and allocate staff resources more effectively.

This intelligence only emerges when data flows freely between systems, made possible by the right architecture; from this point it can bring about timely actions.

Building systems that think, not just collect

The organisations with systems that can successfully sift through masses of data all share common characteristics. They've moved beyond thinking about data as something to be stored and analyzed toward treating it as fuel for immediate operational improvements.

This requires what robotics experts call "closed-loop intelligence" – systems where data collection, analysis, and action happen in integrated cycles rather than separate phases.

In practical terms, this means designing infrastructure where robots can make autonomous decisions, update their own behaviour based on new information, and contribute to collective fleet intelligence without human intervention for routine optimisations. Hardware and software, working in unison.

The technical architecture matters, but the organisational approach matters more. Successful deployments establish metrics that tie directly to business outcomes, and build feedback loops that continuously improve decision-making quality.

From data deluge to competitive advantage

The explosion in data volume is accelerating as more systems become connected and autonomous. Organisations that treat this as something to be passively managed will inevitably find themselves increasingly overwhelmed.

Those that treat it as a capability to be harnessed will almost certainly discover competitive advantages.

When managing tens of thousands of autonomous systems generating continuous data streams, organisations either figure out how to convert information into immediate operational value or they drown in a sea of data.

The lessons are transferable across industries: prioritise actionable insights, design systems that can act on data automatically, and create feedback loops that turn individual learnings into collective intelligence.

The data deluge isn't making us dumber by default, but it will if organisations approach it with analogue-age thinking and don't begin to consciously move away from building systems of information, to creating systems of intelligence.

Richtech Robotics humanoid robot ‘Adam’ appears at Space Force event

JUNE 27, 2025 BY SAM FRANCIS

Richtech Robotics, a Nevada-based provider of AI-driven service robots, says its humanoid robot, Adam, was featured at the Legacy of Launch 75th Anniversary event, which took place on July 24, 2025 in the Kennedy Space Center Shuttle Room, which is located at the Kennedy Space Center Visitor Complex.

This invitation-only VIP event was a “rare and transformative moment that will seamlessly unite history, celebration, and vision”, says Richtech in a statement.

Designed to honor the extraordinary achievements of the past 75 years, the mission of the Legacy of Launch is to ignite a global passion for space by honoring past achievements, celebrating present advancements, and inspiring future exploration.

Through education, preservation, and immersive experiences, it aims to ensure that every generation dares to dream, innovate, and reach beyond our planet.

As part of this landmark celebration of the Legacy of Launch campaign, Richtech Robotics’ AI-driven robot, Adam, was invited to demonstrate the powerful potential of artificial intelligence and robotics in shaping tomorrow’s world.

With real-world deployments already under way in the hospitality and entertainment industries, Adam’s ability to serve space-themed cocktails underscores the company’s commitment to pioneering technologies that enhance human experiences through state-of-the-art innovation.

As robotics and AI technologies continue to evolve, the potential for Adam, and its industrial counterpart Titan, to support space-related applications represents an exciting new vertical for the Company to explore more deeply in the years ahead.

Matt Casella, president of Richtech Robotics, says: “We are honored to participate in such a historic event and showcase how Adam represents the future of intelligent automation – an embodiment of innovation that complements the legacy we are celebrating.”

Richtech Robotics has deployed over 400 robot solutions across the US including in restaurants, retail stores, hotels, healthcare facilities, casinos, senior living homes, and factories. Current clients include Texas Rangers’ Globe Life Field, Golden Corral, Hilton, Sodexo, Boyd Gaming, and more.

Richtech Robotics and Zipphaus to launch robot-operated cafes

MAY 3, 2024 BY MARK ALLINSON

Richtech Robotics, a Nevada company and a provider of AI-driven service robots, today announced a joint venture with Zipphaus to launch robot-operated cafes in hospitals, airports, colleges and universities.

This strategic partnership brings together Richtech's pioneering robotics expertise with Zipphaus's operational proficiency to maximize development opportunities across the United States.

Through this joint venture, Richtech and Zipphaus will form Zipphaus Plus, which will be focused on deploying Richtech's ADAM robot alongside Zipphaus' cafe management expertise.

The JV aims to establish robot-operated flagship cafes in at least two locations at major hospitals as initial launch points.

Matt Casella, Richtech's president, says: "This joint venture represents a significant step forward in our mission to revolutionize the service industry through collaborative robotics.

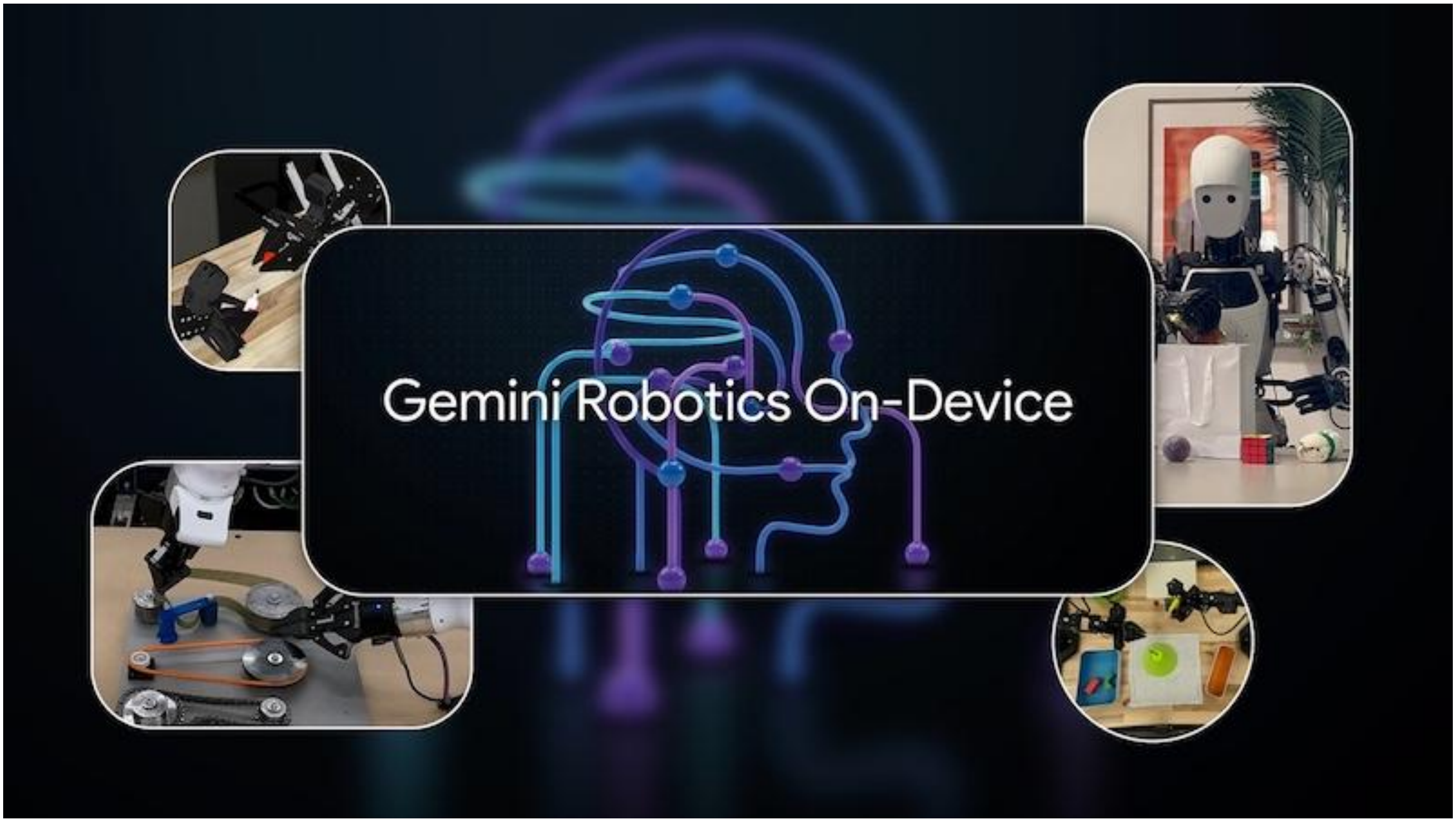
"By combining Richtech's innovative robots with Zipphaus' proven cafe management expertise, we are confident that Zipphaus Plus will deliver an exceptional customer experience while enhancing operational efficiency."

Under the agreement, Richtech will be responsible for providing and maintaining ADAM robots, the company's advanced AI-powered service robots. Richtech will also offer ongoing technical support to ensure the robots operate efficiently.

Zipphaus will leverage its cafe management experience to handle all aspects of daily cafe operations, including staff management, customer service, menu preparation, cost management, and material purchasing.

Lina Lee, Zipphaus Plus's CEO, says: "As pioneers in the service industry, we see immense potential in this partnership with Richtech.

“Together, we hope to redefine customer service standards and drive operational efficiency through our respective experience and management acumen.”



Google DeepMind launches new vision language action model to ‘put AI directly into local robotic devices’

JUNE 26, 2025 BY SAM FRANCIS

Google DeepMind has introduced an efficient, on-device robotics model designed for general-purpose dexterity and rapid task adaptation.

This new offering, known as Gemini Robotics On-Device, is an optimized version of the Gemini Robotics VLA (vision language action) model, which was initially launched in March to integrate Gemini 2.0’s multimodal reasoning into physical applications.

Gemini Robotics On-Device is specifically engineered to operate locally on robotic devices, ensuring robust performance in environments with limited or no network connectivity and providing low-latency inference crucial for sensitive applications.

The model demonstrates strong general-purpose dexterity and task generalization capabilities.

DeepMind is also releasing a Gemini Robotics SDK to facilitate developer evaluation of Gemini Robotics On-Device.

This SDK enables testing within the MuJoCo physics simulator and allows for quick adaptation to new domains with as few as 50 to 100 demonstrations. Developers can gain access to the SDK by enrolling in the trusted tester program.

Model capabilities and performance

Gemini Robotics On-Device serves as a foundational robotics model for bi-arm robots, designed with minimal computational resource requirements. It expands upon the task generalization and dexterity capabilities of the broader Gemini Robotics platform, offering:

- Rapid experimentation with dexterous manipulation.
- Adaptability to new tasks through fine-tuning for improved performance.
- Optimization for local operation with low-latency inference.

The model exhibits robust visual, semantic, and behavioral generalization across various testing scenarios. It can follow natural language instructions and execute highly dexterous tasks, such as unzipping bags or folding clothes, directly on the robot.

Evaluations indicate strong generalization performance in entirely local operations, outperforming previous on-device models and other alternatives in challenging out-of-distribution tasks and complex multi-step instructions.

For developers requiring state-of-the-art results without on-device limitations, the flagship Gemini Robotics model remains available.

Adaptability and generalization across embodiments

Gemini Robotics On-Device is the first VLA model from DeepMind available for fine-tuning. While many tasks can be performed out-of-the-box, developers have the option to adapt the model for enhanced performance in specific applications.

The model demonstrates rapid adaptation to new tasks, requiring fewer than 100 demonstrations, showcasing its ability to generalize foundational knowledge.

The model has been tested on seven dexterous manipulation tasks, including zipping a lunch-box, drawing a card, and pouring salad dressing, where it outperformed existing on-device VLA models after fine-tuning.

Furthermore, DeepMind has successfully adapted Gemini Robotics On-Device to various robot embodiments. Although initially trained for Aloha robots, it has been adapted to a bi-arm Franka FR3 robot and Apptronik's Apollo humanoid robot.

On the Franka, it performs general-purpose instruction following, handling unseen objects and scenes, and executing precision-demanding tasks like folding a dress or industrial belt assembly.

On the Apollo humanoid, the same generalist model can follow natural language instructions and manipulate diverse objects, including previously unseen ones, in a generalized manner.

Responsible development and safety

DeepMind emphasizes responsible development for all Gemini Robotics models, adhering to its AI Principles and employing a holistic safety approach encompassing both semantic and physical safety.

Semantic and content safety are managed through the Live API, while models interface with low-level safety-critical controllers for action execution.

DeepMind recommends evaluating the end-to-end system using its semantic safety benchmark and conducting red-teaming exercises at all levels to identify potential safety vulnerabilities.

The company's Responsible Development & Innovation (ReDI) team analyzes the real-world impact of Gemini Robotics models to maximize societal benefits and minimize risks.

The Responsibility & Safety Council (RSC) reviews these assessments, providing feedback for model development to further enhance benefits and mitigate risks. Gemini

Robotics On-Device is initially being released to a select group of trusted testers to gather feedback and gain a deeper understanding of its usage and safety profile.

Accelerating robotics innovation

Gemini Robotics On-Device represents a significant step towards making powerful robotics models more accessible and adaptable. DeepMind's on-device solution aims to help the robotics community address critical latency and connectivity challenges.

The Gemini Robotics SDK is expected to further accelerate innovation by allowing developers to tailor the model to their specific needs. Interested parties can sign up for model and SDK access through the trusted tester program.

DeepMind anticipates the robotics community's contributions with these new tools as it continues to advance the integration of AI into the physical world.

What is a robot? From mechanical helpers to intelligent agents

JUNE 26, 2025 BY SAM FRANCIS

This is the first in a series of articles in which we ask – and try and answer – the most common questions in robotics

Ask anyone what a robot is, and you'll likely get a confident answer: "A machine that walks and talks like a human."

Some people may offer something slightly more technical – perhaps "a programmable machine that can carry out tasks automatically".

Both are right, to a point. But as we dig deeper, we find that the question “What is a robot?” quickly becomes more complicated than it first appears.

The word “robot” was first used as the word “robota”, to mean “slave”. Karel Čapek coined the term in his 1920 science fiction play R.U.R. – Rossum’s Universal Robots.

In today’s world of AI chatbots, autonomous vehicles, and humanoid assistants, drawing a line around what counts as a robot is no longer so straightforward. And as robotics and artificial intelligence continue to merge, the boundaries blur even further.

A basic definition: Machines that sense, think, and act

Traditionally, a robot is defined as a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer. The key features of a classic robot include:

- **Sensors**: to perceive its environment
- **Processing unit**: to interpret data and make decisions
- **Actuators or effectors**: to interact physically with the world

This definition neatly applies to industrial robots on factory floors – those arm-like machines that weld, screw, lift, and move objects with great speed and precision. They don’t look like humans, but they sense, think (in a limited way), and act. They are undeniably robots.

But what about a vacuum cleaner that maps your living room and avoids obstacles? Or a chatbot that books flights and answers your questions in natural language? Or a self-driving car?

Beyond the hardware: Is software a robot?

As robots have become more sophisticated, so too has our notion of what qualifies as one. The advent of AI has introduced purely digital agents – software with no moving parts – that can carry out tasks once thought to require human intelligence.

Consider ChatGPT or any other advanced conversational agent. It can hold a conversation, compose music, write code, and even generate new ideas. But it has no arms or legs. Is it still a robot?

Some argue that a robot must have a physical body. Others say that’s an outdated notion. After all, a bot that operates a stock-trading platform or automates customer service functions can displace a human worker just as effectively as a mechanical machine can.

This leads us to a broader definition: a robot is any autonomous system that senses its environment, processes information, and performs actions – whether in the physical or digital world.

Under this broader view, yes – chatbots are a type of robot. So are self-driving cars. So are robotic process automation (RPA) systems used in finance or healthcare. Some are physical, some are virtual, but all act independently in pursuit of a goal.

The Turing Test and the illusion of intelligence

Alan Turing, one of the founding figures of computer science, proposed a thought experiment in 1950: if a machine can hold a conversation indistinguishable from that of a human, should we say it is intelligent?

This became known as the Turing Test, and for decades it was a benchmark for machine intelligence. Though never a formal test for robotics, it highlights a subtle but crucial point: we tend to assign agency to machines that appear human-like in behavior.

A robot doesn't need to be humanoid to be effective. But the more a system can mimic human abilities – especially in language – the more we relate to it as if it were alive.

That's part of the reason AI chatbots provoke such strong reactions: curiosity, fascination, even fear. And as these bots become more "real", we edge closer to what psychologists call the Uncanny Valley.

The Uncanny Valley: Almost human, but not quite

The term "Uncanny Valley" describes the uneasy feeling people get when encountering a robot or avatar that looks almost – but not quite – human. The closer it gets to lifelike appearance and behavior without fully crossing the threshold, the more unsettling it becomes.

Humanoid robots like Hanson Robotics' Sophia or Tesla's Optimus push into this territory. So do digital avatars used in customer service or virtual influencers on social media. They are emotionally confusing because they force us to reckon with what it means to be human – and what it means to fake it.

The Uncanny Valley isn't just a psychological oddity. It's a real design challenge for robotics companies. Robots that are too human can backfire, while those that are just human enough – like Pixar's WALL-E or Boston Dynamics' Spot – tend to be more warmly received.

Moravec's Paradox: Why walking is hard, but chess is easy

One of the great ironies of robotics is summed up by Moravec's Paradox: tasks that are easy for humans, like walking, recognizing faces, or catching a ball, are extremely difficult for machines. Meanwhile, activities that seem intellectually difficult – like playing chess or calculating and predicting share price movements – are relatively easy for computers.

This paradox helps explain why we have AI that can outplay grandmasters or write poetry, but still struggle to build robots that can walk up stairs or fold laundry with human-level grace.

It also hints at something deeper: much of human intelligence is subconscious, intuitive, and tied to physical embodiment. This makes building robots that truly replicate human capabilities a massive engineering challenge – especially when those robots are expected to operate safely and reliably in the real world.

Are autonomous vehicles robots?

Autonomous cars have all the hallmarks of a robot:

- Sensors (cameras, radar, lidar)
- Processing units (onboard computers, AI chips)
- Actuators (motors, steering, brakes)

They navigate complex environments, make split-second decisions, and operate without direct human control. By most definitions, an autonomous vehicle is a robot – albeit one disguised as a car.

Yet public perception is often different. Most people don't call Tesla's Full Self-Driving system a robot, even though it fulfills robotic criteria. This illustrates how context, branding, and form factor influence our mental models. If it doesn't look like a robot, is it still one?

A looming disruption: Robots and the future of work

Regardless of how we define them, robots – both physical and virtual – are poised to transform the global economy.

According to a report from Goldman Sachs, AI and automation could eliminate or transform up to 300 million jobs globally in the coming decades. White-collar roles like customer service, paralegal work, and data entry are at especially high risk, while blue-collar sectors will continue to see increased use of physical robots.

Warehouse workers are already sharing space with autonomous mobile robots. In agriculture, robotic harvesters are gaining ground. In healthcare, robotic surgery systems are becoming standard.

Meanwhile, AI-powered systems are replacing human labor in marketing, design, legal analysis, education, and software development.

Whether we call these systems robots, bots, or AI agents, the impact is the same: a fundamental shift in how work is done, who does it, and what it means to be a skilled worker in the age of intelligent machines.

So... what is a robot?

The question “What is a robot?” is not just technical; it’s philosophical. A robot can be a machine on an assembly line, a car that drives itself, a humanoid that smiles, or a disembodied voice in your phone. It can have limbs, wheels, or nothing but code.

At its core, a robot is any autonomous system – physical or digital – that senses the world, processes information, and acts upon it. The form may change, but the function remains: to extend human capabilities through machine agency.

As robots become more intelligent and more integrated into society, we may need to move beyond rigid definitions and accept that the age of machines thinking – and acting – on their own is no longer the stuff of science fiction. It’s here. And it’s only accelerating.

Nvidia and partners highlight 'next-generation' robotics, automation and AI technologies at Automatica

JUNE 26, 2025 BY SAM FRANCIS

From the heart of Germany's automotive sector to manufacturing hubs across France and Italy, Europe is embracing industrial AI and advanced AI-powered robotics to address labor shortages, boost productivity and fuel sustainable economic growth.

Robotics companies are developing humanoid robots and collaborative systems that integrate AI into real-world manufacturing applications.

Supported by a $200 billion investment initiative and coordinated efforts from the European Commission, Europe is positioning itself at the forefront of the next wave of industrial automation, powered by AI.

This momentum is on full display at Automatica, Europe's premier conference on advancements in robotics, machine vision and intelligent manufacturing, taking place this week in Munich, Germany.

Nvidia and its ecosystem of partners and customers are showcasing next-generation robots, automation and AI technologies designed to accelerate the continent's leadership in smart manufacturing and logistics.

Nvidia technologies boost robotics development

Central to advancing robotics development is Europe's first industrial AI cloud, announced at Nvidia GTC Paris at VivaTech earlier this month.

The Germany-based AI factory, featuring 10,000 Nvidia GPUs, provides European manufacturers with secure, sovereign and centralized AI infrastructure for industrial workloads. It will support applications ranging from design and engineering to factory digital twins and robotics.

To help accelerate humanoid development, Nvidia released Nvidia Isaac GR00T N1.5 – an open foundation model for humanoid robot reasoning and skills. This update enhances the model's adaptability and ability to follow instructions, significantly improving its performance in material handling and manufacturing tasks.

To help post-train GR00T N1.5, Nvidia has also released the Isaac GR00T-Dreams blueprint – a reference workflow for generating vast amounts of synthetic trajectory data from a small number of human demonstrations – enabling robots to generalize across behaviors and adapt to new environments with minimal human demonstration data.

In addition, early developer previews of Nvidia Isaac Sim 5.0 and Isaac Lab 2.2 – open-source robot simulation and learning frameworks optimized for Nvidia RTX PRO 6000 workstations – are now available on GitHub.

Robotics developers and solutions providers across the globe are integrating Nvidia's three computers to train, simulate and deploy robots.

- **Neura Robotics**, a German robotics company and pioneer for cognitive robots, unveiled the third generation of its humanoid, 4NE1, designed to assist humans in domestic and professional environments through advanced cognitive capabilities and humanlike interaction. 4NE1 is powered by GR00T N1 and was trained in Isaac Sim and Isaac Lab before real-world deployment. Neura Robotics is also presenting Neuraverse, a digital twin and interconnected ecosystem for robot training, skills and applications, fully compatible with Nvidia Omniverse technologies.

- **Delta Electronics**, a global leader in power management and smart green solutions, is debuting two next-generation collaborative robots: D-Bot Mar and D-Bot 2 in 1 — both trained using Omniverse and Isaac Sim technologies and libraries. These cobots are engineered to transform intralogistics and optimize production flows.
- **Wandelbots**, the creator of the Wandelbots Nova software platform for industrial robotics, is partnering with SoftServe, a global IT consulting and digital services provider, to scale simulation-first automating using Nvidia Isaac Sim, enabling virtual validation and real-world deployment with maximum impact.
- **Cyngn**, a pioneer in autonomous mobile robotics, is integrating its DriveMod technology into Isaac Sim to enable large-scale, high fidelity virtual testing of advanced autonomous operation. Purpose-built for industrial applications, DriveMod is already deployed on vehicles such as the Motrec MT-160 Tugger and BYD Forklift, delivering sophisticated automation to material handling operations.
- **Doosan Robotics**, a company specializing in AI robotic solutions, will showcase its "sim to real" solution, using Nvidia Isaac Sim and cuRobo. Doosan will be showcasing how to seamlessly transfer tasks from simulation to real robots across a wide range of applications – from manufacturing to service industries.
- **Franka Robotics** has integrated Isaac GR00T N1.5 into a dual-arm Franka Research 3 (FR3) robot for robotic control. The integration of GR00T N1.5 allows the system to interpret visual input, understand task context and autonomously perform complex manipulation – without the need for task-specific programming or hardcoded logic.
- **Hexagon**, the global leader in measurement technologies, launched its new humanoid, dubbed Aeon. With its unique locomotion system and multimodal sensor fusion, and powered by Nvidia's three-computer solution, Aeon is engineered to perform a wide range of industrial applications, from manipulation and asset inspection to reality capture and operator support.
- **Intrinsic**, a software and AI robotics company, is integrating Intrinsic Flowstate with Omniverse and OpenUSD for advanced visualization and digital twins that can be used in many industrial use cases. The company is also using Nvidia foundation models to enhance robot capabilities like grasp planning through AI and simulation technologies.
- **Schunk**, a global leader in gripping systems and automation technology, is showcasing its innovative grasping kit powered by the Nvidia Jetson AGX Orin module. The kit intelligently detects objects and calculates optimal grasping points. Schunk is also demonstrating seamless

simulation-to-reality transfer using IGS Virtuous software – built on Omniverse technologies – to control a real robot through simulation in a pick-and-place scenario.

- **Universal Robots** is showcasing UR15, its fastest cobot yet. Powered by the UR AI Accelerator – developed with Nvidia and running on Jetson AGX Orin using CUDA-accelerated Isaac libraries – UR15 helps set a new standard for industrial automation.
- **Vention**, a full-stack software and hardware automation company, launched its Machine Motion AI, built on CUDA-accelerated Isaac libraries and powered by Jetson. Vention is also expanding its lineup of robotic offerings by adding the FR3 robot from Franka Robotics to its ecosystem, enhancing its solutions for academic and research applications.

Learn more about the latest robotics advancements by joining Nvidia at Automatica, running through Friday, June 27.

Realtime Robotics releases cloud-based software to accelerate design of robot cells

MAY 16, 2025 BY MAI TAO

Realtime Robotics, a specialist in automated collision-free motion planning, control, and optimization, has launched Resolver, a new cloud-based solution that dramatically accelerates the design and deployment of robotic workcells.

Robot path planning is traditionally a complex, time-consuming, and brittle process. In most workcells there are multiple robots in use, requiring tedious manual labor to create interference zones and interlock signals that ensure there are no collisions during the manufacturing process.

Manually validating the mechanical design, planning robot paths, determining sequencing to hit optimal cycle time targets, and defining those interlocks can take a team well over 100,000 hours for a single project.

Due to its complex nature, this often leads to failures in hitting cycle time targets, adding expensive rework to 10-15 percent of workcells.

Realtime Robotics' Resolver works by intelligently selecting and testing potential solutions tens to thousands of times faster than any human programmer, quickly generating optimal, collision-free motion paths and interlock signals.

With Resolver, organizations can automatically discover the fastest target order – accelerating workcell design from months to days – all while decreasing engineering effort by 50 percent. Workcell cycle times are reduced, and overall throughput is increased.

Resolver gives users affordable, on-demand, infinitely scalable robotic simulation power that can be used to speed the process of:

- Generating accurate proposals
- Designing optimal tools and fixtures that support cycle time goals
- Producing optimal robot programs
- Adjusting for as-built deviations during commissioning
- Assessing and minimizing the impact of product design changes in the manufacturing phase

Peter Howard, CEO of Realtime Robotics, says: "It is widely understood that the future of the manufacturing industry lies in robotics and automation. However, that future is slow to materialize because of the outdated, time-consuming, and inefficient processes commonplace in the industry.

"Few manufacturers have the time or resources needed to enact real change. We've engineered Resolver to help manufacturers improve their engineering, programming and production processes – and drive greater value from their current and future investments in robots."

How Resolver works

Realtime Robotics' Resolver supports path planning with any number of robots, at any phase of the workflow, generating results in minutes. The solution requires minimal onboarding – and currently allows users to work directly within Siemens Process Simulate.

Support for other leading simulation platforms will be rolled out later in the year, enabling teams to work directly within their preferred simulation tool.

Howard says: "Resolver has the computational power to generate better motion paths than human programmers in both simple and complex workcells.

“This is because Resolver searches the possibilities open to robotic arms, while humans tend to stay within the possibilities of the human arm.”

Organizations need only upload the workcell information into a new project, configure their sequencing and conditions, and execute a run. In minutes, Resolver will generate motion paths, including interlocks, with a superhuman cycle time.

The longer Resolver runs, the more options it provides, shortening the cycle time until the desired outcome is reached. The paths and interlocks can then be easily imported back into the simulation software for validation and operation.

Marco Bizjak, head of competence center digital factory and technical manager, digitalisation, at FFT, says: “Resolver eliminates the most time-consuming aspects of industrial robotics – the programming and optimization of the robots. What used to take months to accomplish can now be measured in hours.

“We believe this can be a real competitive advantage as we strive to help our customers establish the most efficient and effective manufacturing processes possible.”

Additional uses

Resolver also has enhanced features, allowing it to be used at any point in the project lifecycle, from proposal to workcell design. Resolver can accelerate project timelines by generating collision-free motion paths and enabling more accurate cycle time estimates – giving organizations the opportunity to outbid the competition during proposal.

It also shortens the design phase by streamlining manual path planning into simple steps, automatically defining interlock signals and minimizing mechanical design iterations.

Beyond its ability to determine optimal motion plans and interlocks, Resolver can help with fixture design, reachability validation, target sequencing, and robot task allocation.

It can also be used to design the paths and interlocks for an entire manufacturing line from the start, giving an organization a comprehensive view of their entire operation. Optimization can then be achieved at an early stage – meaning more time can be spent on less tedious tasks.

Realtime Robotics partners with Siemens to simplify integration of robotic workcells

JUNE 25, 2020 BY DAVID EDWARDS

Realtime Robotics is partnering with Siemens to simplify the integration of robotic workcells into industrial facilities. (See video below.)

Realtime Robotics, which specialises in autonomous motion planning for industrial robots, says the initiative is part of its strategic partnership with Siemens Digital Industries Software division.

Realtime's technology is being seamlessly integrated into the Tecnomatix portfolio, simplifying robot programming and workcell coordination by automating motion programming.

Manufacturers and integrators can now easily program, simulate, and validate automation, significantly simplifying the digital commissioning process.

Currently, multi-robot workcells take prohibitive amounts of calendar and scarce engineering time in the simulation phase before going to production.

Realtime Robotics unveils new robot controller computer

MAY 1, 2020 BY DAVID EDWARDS

Realtime Robotics, which specialises in motion planning for industrial robots and autonomous vehicles, has launched what a robot controller solution it calls "Realtime Controller".

The solution dramatically reduces and simplifies the programming required to safely integrate robotic workcells, speeding up the time to deployment.

As the pressure intensifies to improve margins it will accelerate the adoption of robotic automation.

However, integrating robotic operating systems currently is complex, time-consuming, and cost-prohibitive, which has limited where and how the technology is deployed.

With the Realtime Controller, multi-robot cells are much more flexible, as it automates many core processes and can dynamically adjust to variable production conditions.

Using Realtime's Controller, manufacturers can now quickly and easily plan, simulate, and validate automation through the entire deployment.

The Realtime Controller connects with the customer's PLC and robot controller so that they can autonomously calculate, communicate, and execute collision-free motions.

Both development time and cycle time are significantly reduced with automated interlocks and interference zone-free multi-robot workcells enabling robots to be deployed more quickly and expand into new areas that were previously cost-prohibitive.

The Realtime Controller is an industrial hardware computing platform with proprietary hardware and software that supports both off-line programming and run-time operation of single and multi-robot work cells.

The software toolkit and API enable easy integration with PLCs, picking systems, robot controllers, simulation software, and other task planning solutions.

Its web-based interface allows companies to configure and monitor robot workcells, including visualizing robot motions and managing fault conditions.

In addition, Realtime's motion planning enables immediate and autonomous fault recovery solutions for multi-robot workcells.

The Realtime Controller will be commercially available in North America, Europe, Japan and China beginning in May 2020.

Peter Howard, CEO, Realtime Robotics, says: "Our vision is to reduce the friction associated with deploying robots in industrial settings.

“The Realtime Controller is a catalyst for accelerating and simplifying robotic automation across the globe, enabling manufacturers to finally benefit from the power of industrial robots working together.”

Gurpreet Ghataore, advanced research engineer, The Manufacturing Technology Centre, says: “Realtime’s RapidPlan technology and the new Realtime Controller provides the power to transform how we deploy and operate industrial robots.

“The solution dramatically reduces time for motion planning and eliminates interlocking, so our engineers can focus their efforts on designing fully capable work-cells and efficient multi-robot deployments.”

Samsung, LG eye first-mover edge in robotics camera modules

Published : June 24, 2025 - 10:53:11

Figure AI's humanoid robot (Figure AI)

Korea's top two electronics parts makers — Samsung Electro-Mechanics and LG Innotek — are accelerating their efforts to gain an early foothold in humanoid robot camera modules, which is seen as a blue ocean market with no clear leader yet.

LG Innotek is in talks with US-based humanoid robotics startup Figure AI to supply camera modules for its robots, according to industry sources on Tuesday. The two firms are expected to finalize supply volumes and pricing in the second half, with mass production likely to begin in early 2026.

Figure AI, backed by Amazon founder Jeff Bezos, aims to produce 100,000 humanoid robots over the next four years. If the negotiations are successful, LG will become the official camera module supplier for the US startup, marking its first major achievement in its new robotics business.

LG has been strengthening its presence in the sector, signing a partnership last month with Boston Dynamics to jointly develop a custom vision sensing system for the company's Atlas humanoid robot. The system will be tailored to Atlas' specifications to enhance its visual perception capabilities.

The Korean parts maker is reportedly collaborating with more than half of the 14 humanoid robotics firms that appeared during Nvidia CEO Jensen Huang's keynote speech at CES 2025 in January. These firms include Boston Dynamics, Agility Robotics, Figure AI, Apptronik and Unitree.

According to Eugene Investment & Securities, LG's deals with Figure AI and Boston Dynamics could contribute about 19 billion won ($13.9 million) to operating profit by 2028 and more than 90 billion won by 2029. While it represents a small portion of LG's 2023 operating profit of 706 billion won, the figure is expected to rise significantly as the firm expands its client base in the robotics sector.

Samsung Electro-Mechanics is also engaging with multiple humanoid robotics firms as it looks to expand into the field. At a press conference during CES 2024, CEO Chang Duk-hyun identified robotics as a key focus for future growth.

"Samsung has yet to supply camera modules for any dedicated robotics firms, but its technological expertise and mass production capabilities in smartphone and automotive camera modules are well-established," said an industry source who requested anonymity. "As the humanoid robot market enters mass production, interest in Samsung's camera modules is likely to rise."

Industry watchers predict the market for robotic camera modules will experience explosive growth. Eugene Investment & Securities projects the market will grow from 40 billion won in 2026 to 4.7 trillion won by 2029.

“With the smartphone camera module market reaching saturation, the robotics sector presents a rare growth opportunity. Early movers will have a significant advantage in what promises to be a fiercely competitive landscape,” the anonymous source said.

Apptronik Announces Creation of Elevate Robotics, a New Subsidiary Focused on Superhuman Industrial Automation

Elevate will bring new technology breakthroughs to market, taking automation beyond human limits

June 24, 2025 09:00 ET | Source: Apptronik

AUSTIN, Texas, June 24, 2025 (GLOBE NEWSWIRE) -- Apptronik, the AI-powered robotics company, today announced the creation of Elevate Robotics Inc., a wholly owned subsidiary that will focus on automating industrial tasks beyond the limits of the human form.

Apptronik's flagship humanoid robot Apollo is the result of a decade of development, during which the company built more than 15 robotics systems and made numerous significant technological advancements. While Apptronik will continue to focus on Apollo and push the boundaries of humanoid robotics, Elevate will reshape the future of heavy-duty industrial-scale work. Apptronik is establishing Elevate to commercialize a unique multipurpose automation solution outside of the humanoid form factor with enormous potential to transform the way humans live and work.

"We founded Apptronik to build general purpose robots that empower humans. On our path to realizing this mission we've developed all kinds of groundbreaking robotics technology for humanoid robots and beyond," said Jeff Cardenas, Apptronik co-founder and CEO. "Elevate shares Apptronik's core, human-centered DNA and vision of building robots to help humanity, and they're applying novel technology to tackle heavy-duty tasks in various sectors."

Elevate will operate independently and be led by CEO Paul Hvass, previously Co-founder at Plus One Robotics. Elevate's founding team includes skilled roboticists from the group that designed numerous robotic systems culminating with Apollo, and passionate and experienced builders from across the industrial automation landscape.

"With a world-class team assembled, Elevate Robotics is well positioned to expand the possibilities of industrial-scale work with superhuman robotics," continued Cardenas. "The Apptronik team is excited to see the world-changing impact of Elevate's innovations."

About Apptronik

Apptronik is a human-centered robotics company developing AI-powered humanoid robots. Our goal is to create human helpers to support humanity in every facet of life. Our robot, Apollo, is designed to collaborate thoughtfully with humans—initially in critical industries such as manufacturing and logistics, with future applications in healthcare, the home, and beyond. Apollo is the culmination of nearly a decade of development, drawing on Apptronik's extensive work on 15 previous robots, including NASA's Valkyrie robot. Apptronik started out of the Human Centered Robotics Lab at the University of Texas at Austin and has over 150 employees. Learn more at apptronik.com.

Amazon deploys its one millionth robot, and it's bad news for its human workers

Amazon has now deployed its one-millionth warehouse robot and announced that every machine in its fleet will run on a new generative AI model. The move comes as many technology firms are trimming staff and warning that automation could replace human roles.

Scott Dresser, vice president of Amazon Robotics, said in a press release on Monday that the milestone spread across more than 300 sites worldwide, underscores Amazon's leadership in designing and operating mobile warehouse robots.

Amazon is fully committed to automation

By hitting the one-million mark, the company has confirmed its position at the forefront of robotics in logistics.

Amazon also introduced a system called DeepFleet, which will direct how its robots move inside fulfillment centers. According to Dresser, DeepFleet cuts the machines' travel distances by about 10%. He added that this change will help packages move more swiftly and lower the overall cost of deliveries.

The company first began using robots in its warehouses back in 2012 to shift storage shelves around the floor. Over the years, their roles have expanded greatly.

Today, some robots can lift up to 1,250 pounds of stock, and others navigate pick-and-pack aisles on their own, pulling carts loaded with customer orders.

Factory workers are most vulnerable to AI automation

Humanoid robots that are built to walk and work more like people could arrive later this year at Tesla's factories.

Despite these advances, there is growing worry about the impact on jobs. A Pew Research survey published in March found that both AI specialists and the general public view factory workers as among the most likely to lose employment to automation.

Dresser sought to ease those concerns by pointing out that Amazon's robots handle heavy lifting and routine chores, freeing up employees to learn new technical skills.

He highlighted Amazon's "next-generation fulfillment center" in Shreveport, Louisiana, which opened late last year and now employs 30% more workers in roles like reliability, maintenance and engineering.

However, the announcement came shortly after Amazon CEO Andy Jassy said that rolling out generative AI will mean "fewer people doing some of the jobs that the technology actually starts to automate." Jassy said the company would still hire in areas such as AI and robotics, but in a memo to staff in early June, he warned that overall headcount is likely to shrink in the years ahead as automation grows.

Signs of that shift are already visible. Amazon cut over 27,000 jobs in 2022 and 2023, and continues to trim staff in various departments.

Other tech leaders have voiced similar concerns. Shopify CEO Tobi Lutke wrote in a memo posted on X that employees must justify why they "cannot get what they want done using AI" before asking for more people or resources. He encouraged teams to imagine what this area would "look like if autonomous AI agents were already part of the team?" saying such ideas can spark "really fun discussions and projects."

Lutke also noted that AI has served as a "multiplier" of productivity for Shopify staff who have adopted it.

This trend of automation-driven layoffs extends beyond a few companies.

Layoffs.fyi, which tracks cuts in the tech industry, shows that 551 firms eliminated roughly 153,000 positions last year. Meanwhile, a World Economic Forum report released in February found that 48% of U.S. employers plan to reduce their workforces because of AI.

JUNE 30, 2025

Using generative AI to help robots jump higher and land safely

by Alex Shipps, Massachusetts Institute of Technology

edited by Lisa Lock, reviewed by Robert Egan

Byungchul Kim (left) and Tsun-Hsuan "Johnson" Wang applied generative AI to improve robots designed by humans. Credits: MIT CSAIL
Diffusion models like OpenAI's DALL-E are becoming increasingly useful in helping brainstorm new designs. Humans can prompt these systems to generate an image, create a video, or refine a blueprint, and come back with ideas they hadn't considered before.

But did you know that generative artificial intelligence (GenAI) models are also making headway in creating working robots? Recent diffusion-based approaches have generated structures and the systems that control them from scratch. With or without a user's input, these models can make new designs and then evaluate them in simulation before they're fabricated.

A new approach from MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) applies this generative know-how toward improving humans' robotic designs. Users can draft a 3D model of a robot and specify which parts they'd like to see a diffusion model modify, providing its dimensions beforehand. GenAI then brainstorms the optimal shape for these areas and tests its ideas in simulation. When the system finds the right design, you can save and then fabricate a working, real-world robot with a 3D printer, without requiring additional tweaks.

The researchers used this approach to create a robot that leaps up an average of roughly 2 feet, or 41% higher than a similar machine they created on their own. The machines are nearly identical in appearance: They're both made of a type of plastic called polylactic acid, and while they initially appear flat, they spring up into a diamond shape when a motor pulls on the cord attached to them. So what exactly did AI do differently?

A closer look reveals that the AI-generated linkages are curved, and resemble thick drumsticks (the musical instrument drummers use), whereas the standard robot's connecting parts are straight and rectangular.

Credit: MIT CSAIL

Better and better blobs

The researchers began to refine their jumping robot by sampling 500 potential designs using an initial embedding vector—a numerical representation that captures high-level features to guide the designs generated by the AI model. From these, they selected the top 12 options based on performance in simulation and used them to optimize the embedding vector.

This process was repeated five times, progressively guiding the AI model to generate better designs. The resulting design resembled a blob, so the researchers prompted their system to scale the draft to fit their 3D model. They then fabricated the shape, finding that it indeed improved the robot's jumping abilities.

The advantage of using diffusion models for this task, according to co-lead author and CSAIL postdoc Byungchul Kim, is that they can find unconventional solutions to refine robots.

"We wanted to make our machine jump higher, so we figured we could just make the links connecting its parts as thin as possible to make them light," says Kim. "However, such a thin structure can easily break if we just use 3D printed material. Our diffusion model came up with a better idea by suggesting a unique shape that allowed the robot to store more energy before it jumped, without making the links too thin. This creativity helped us learn about the machine's underlying physics."

The team then tasked their system with drafting an optimized foot to ensure it landed safely. They repeated the optimization process, eventually choosing the best-performing design to attach to the bottom of their machine. Kim and his colleagues found that their AI-designed machine fell far less often than its baseline, to the tune of an 84% improvement.

The diffusion model's ability to upgrade a robot's jumping and landing skills suggests it could be useful in enhancing how other machines are designed. For example, a company working on manufacturing or household robots could use a similar approach to improve their prototypes, saving engineers time normally reserved for iterating on those changes.

The balance behind the bounce

To create a robot that could jump high and land stably, the researchers recognized that they needed to strike a balance between both goals. They represented both jumping height and landing success rate as numerical data, and then trained their system to find a sweet spot between both embedding vectors that could help build an optimal 3D structure.

The researchers note that while this AI-assisted robot outperformed its human-designed counterpart, it could soon reach even greater new heights. This iteration involved using materials that were compatible with a 3D printer, but future versions would jump even higher with lighter materials.

Co-lead author and MIT CSAIL Ph.D. student Tsun-Hsuan "Johnson" Wang says the project is a jumping-off point for new robotics designs that generative AI could help with.

"We want to branch out to more flexible goals," says Wang. "Imagine using natural language to guide a diffusion model to draft a robot that can pick up a mug, or operate an electric drill."

Kim says that a diffusion model could also help to generate articulation and ideate on how parts connect, potentially improving how high the robot would jump. The team is also exploring the possibility of adding more motors to control which direction the machine jumps and perhaps improve its landing stability.

More information: Paper: Generative-AI-Driven Jumping Robot Design Using Diffusion Models
Provided by Massachusetts Institute of Technology

JULY 2, 2025

Robots could one day crawl across the moon, and undergrads are laying the groundwork

by Daniel Strain, University of Colorado at Boulder

edited by Stephanie Baum, reviewed by Robert Egan

The Armstrong robot. Credit: Network for Exploration and Space Science
The future of moon exploration may be rolling around a nondescript office on the CU Boulder campus. Here, a robot about as wide as a large pizza scoots forward on three wheels. It uses an arm with a claw at one end to pick up a plastic block from the floor, then set it back down.

To be sure, this windowless office, complete with gray carpeting, is nothing like the moon, and the robot, nicknamed "Armstrong," wouldn't last a minute on its frigid surface.

But the scene represents a new vision for space exploration—one in which fleets of robots working in tandem with people crawl across the lunar landscape, building scientific observatories or even human habitats.

Xavier O'Keefe operates the robot from a room down the hall. He wears virtual reality goggles that allow him to see through a camera mounted on top of Armstrong.

"It's impressively immersive," said O'Keefe, who earned his bachelor's degree in aerospace engineering sciences from CU Boulder this spring. "The first couple of times I used the VR, the robot was sitting in the corner, and it was really weird to see myself using it."

He's part of a team of current and former undergraduate students tackling a tricky question: How can humans on Earth get the training they need to operate robots on the hazardous terrain of the lunar surface? On the moon, gravity is only about one-sixth as strong as it is on our planet. The landscape is pockmarked with craters, some cast in permanent darkness.

In a new study appearing in *Advances in Space Research*, O'Keefe and fellow CU Boulder alumni Katy McCutchan and Alexis Muniz report that "digital twins," or hyper-realistic virtual reality environments, could provide a useful proxy for the moon—giving people a chance to get the hang of driving robots without risking damage to multi-million-dollar equipment.

The study is part of a larger research effort led by Jack Burns, astrophysics professor emeritus in the Department of Astrophysical and Planetary Sciences (APS) and the Center for Astrophysics and Space Astronomy (CASA).

"There was a lot of room to make mistakes with Armstrong since it wasn't a million-dollar piece of hardware going to space," said McCutchan, who earned her master's degree in aerospace engineering sciences from CU Boulder in 2025. "It was a good sandbox to mess around in."

Credit: University of Colorado at Boulder

Digital twin

For Burns, a co-author of the study, Armstrong and its VR digital twin represent a big leap forward, despite the robot's humble appearance. Burns is part of a team working to design a futuristic scientific observatory on the moon called FarView—which would be made up of a web of 100,000 antennas stretching over roughly 77 square miles of the lunar surface.

Daniel Szafir of the University of North Carolina, Chapel Hill was also a co-author of the new study.

"Unlike the Apollo program, where human astronauts did all the heavy lifting on the moon, NASA's 21st century Artemis Program will combine astronauts and robotic rovers working in tandem," Burns said. "Our efforts at CU Boulder are intended to make lunar robots more efficient and recoverable from errors, so precious astronaut time on the lunar surface will be better utilized."

The space group's first hurdle: Creating a digital twin for Armstrong to roam around in. To do that, the researchers began by creating a digital replica of their office using a video game engine called Unity—right down to the beige walls and drab carpet.

"We had to get the digital twin as close to the real thing as possible," said O'Keefe, who's now a master's student in the Ann and H.J. Smead Department of Aerospace Engineering Sciences at CU Boulder. "For example, we timed how fast the robot moved over one yard. Then we did the same test in the virtual environment and got the robot's speed to be the same."

Next, the team ran an experiment. In 2023 and 2024, they recruited 24 human participants to operate Armstrong while sitting in a room down the hall. Donning VR goggles, the subjects took the robot through a simple task: They picked up and adjusted a plastic block that represented one of the antennas in FarView.

Half of the participants, however, got a head start. They first practiced the same task in the digital version of the office.

Humans who got the chance to operate Armstrong's digital twin before driving the real thing completed the task roughly 28% faster than participants who only got the chance to operate the physical robot. They also reported that they felt less stress during the task.

"That's what is really exciting about this—you're able to simulate everything in the environment, from the shadows to the texture of the dirt, and then train operators on conditions that are as close to real as possible," O'Keefe said. "That way, once you get to the moon, you have a higher chance of success."

Digital twin of the Armstrong robot. Credit: Network for Exploration and Space Science

Real-world experience

McCutchan, who also joined the project as an undergrad, added that the study gave her and her fellow students a grounding in how research works in the real world.

For example, when the researchers began the experiment, they discovered that the human subjects kept making the same mistake. When they went to pick up the fake antennas with Armstrong, they often flipped the blocks over by accident. The group hadn't anticipated that.

"Whenever you get people involved, they do things in ways you wouldn't expect them to," said McCutchan, who recently started work as a mechanical solutions test engineer at BAE Systems, an aerospace company.

Today, Burns' team is moving onto a new goal: They're recreating the much more complex environment of the lunar surface. The researchers are working with the Colorado-based company Lunar Outpost to build a digital twin of a rover on the moon in the same game engine. The hardest part, O'Keefe said, is getting the lunar dust just right.

"The rover will kick up dust with its wheels as it drives, and that could possibly block sensors or cameras," O'Keefe said. "But it's really hard to know exactly how dust moves on the moon because you can't just go outside and measure it."

For now, he is happy being a part of the future of lunar exploration, albeit from the safety of campus.

"It's awesome to be part of this, even if it is a small part of getting people on the moon."

More information: Xavier O'Keefe et al, Practice makes perfect: A study of digital twin technology for assembly and problem-solving using lunar surface telerobotics, *Advances in Space Research* (2025). DOI: 10.1016/j.asr.2025.05.048
Provided by University of Colorado at Boulder

Chinese humanoid robot cooks steak by remote control from 1,118 miles away

Chinese humanoid robot cooks steak by remote control from 1,118 miles away

Chinese robot maker Dobot Robotics has showcased its humanoid 'Atom' robot preparing a delicious steak. Although impressive enough, the real feat was the fact that the robot was remotely operated from 1,118 miles (1,800 km) away using virtual reality (VR).

The company published footage of the event on Friday (4th July) on the firm's WeChat account. In the video, an engineer based in Guangdong is seen wearing a VR headset that captures his hand gestures.

According to the four-minute footage, the robot, located several miles away in the eastern province of Shandong, was able to flawlessly mirror the engineer's gestures in real time. The robot's movements were precise enough to perform delicate tasks, such as patting the steak with a paper towel and pouring cooking oil into a pan.

Atom was also able to flip the steak with ease and even sprinkle salt with its fingers, mimicking human dexterity. According to Dobot, Atom has an accuracy of 0.05 millimeters. However, developers are currently only capable of controlling the upper body of the robot.

Teleoperation over long distances

The company released the Atom model in March of this year at the cost of around $27,500 (199,000 yuan) a piece. Dobot celebrated the release of Atom with a similar culinary-themed video showing the robot preparing a nutritious breakfast.

The humanoid has 28 degrees of freedom and is equipped with five-fingered hands that enable it to perform tasks such as preparing breakfast (placing toast, lettuce, and fruit) and pouring milk. It is also reportedly capable of walking with a human-like gait. At present, only the upper body is controllable via VR; while walking remains autonomous or limited.

The latest demonstration is crucial for the company to exhibit that teleoperation with high precision is possible over long distances. To this end, it serves as proof of concept for using humanoid robots in environments that are dangerous (e.g., nuclear plants) and inaccessible (e.g., outer space).

It also serves to show that teleoperation is possible for tasks that require precision (e.g., surgery, housework). NASA has similar tech with its Valkyrie humanoid, but the space agency is yet to address network challenges for long-range control the way Dobot just did.

Beyond just cooking steak

Founded in 2015, Dobot specializes in collaborative robot (cobot) arms, SCARA arms, desktop robot arms, and educational robot arms. Following the release of the video, Dobot's stock price reportedly soared over 3%. The company has also already begun global shipments, with Japan receiving the first batch.

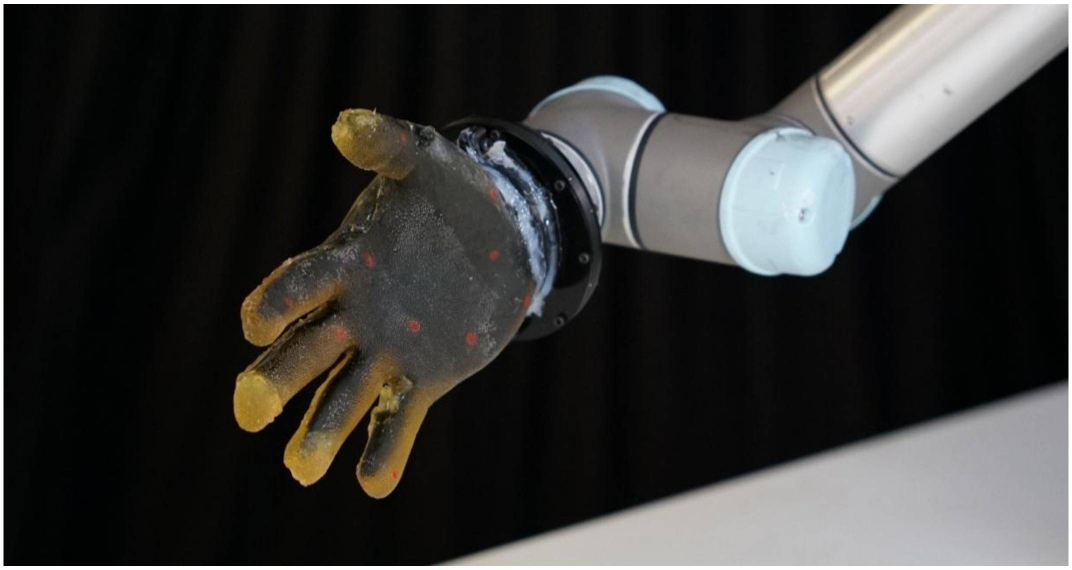
Dobot is one among 11 Chinese firms which entered mass production of humanoid robots in 2024, taking an important step toward VR-controlled labor over vast distances.

The newest development could not only lead to the possibility of replacing human presence in high-risk environments; but could also open doors to integrating humanoid robots as part of everyday life through telepresence and AI augmentation.

Looking at the bigger picture, Atom is a milestone for teleoperated robotics and potentially a foreshadowing of future work, where humans could control robots across cities, continents, or even in orbit.

Scientists burned, poked and sliced their way through new robotic skin that can 'feel everything'

New, gelatin-based material could let robots feel everything from a light poke to a deep cut.



Scientists have developed a low-cost, durable, highly-sensitive robotic ‘skin’ that can be added to robotic hands like a glove, enabling robots to detect information about their surroundings in a way that’s similar to humans. (Image credit: University of Cambridge)

Scientists have developed a new type of electronic "skin" that could give robots the ability to "feel" different tactile sensations like pokes, prods and temperature changes — and even the feeling of being stabbed.

The skin is made from an electrically conductive, gelatin-based material that can be molded into different shapes. When equipped with a special type of electrode, the material can detect signals from hundreds of thousands of connective pathways that correspond to different touch and pressure sensations.

The scientists said the material could be used in humanoid robots or human prosthetics where a sense of touch is vital, in addition to having broader applications in the automotive sector and in disaster relief. They published their findings June 11 in the journal Science Robotics.
Tactile sensing has emerged as the next big milestone for robotics, as scientists look to build machines that can respond to the world in a manner akin to human sensitivity. Electronic skins typically work by converting physical information — like pressure or temperature — into electronic signals. In most cases, different types of sensors are needed for different types of sensation; for example, one to detect pressure, another to detect temperature and so on.

However, signals from these different sensors can interfere with each other, and the materials they are embedded in — traditionally soft silicones or stretchy, rubber-like materials called elastomers — are easily damaged, the scientists said.
This new electronic skin uses a single type of "multi-modal" sensor that is capable of detecting different types of stimuli like touch, temperature and damage.

While it's still challenging to reliably separate and pinpoint the cause of each signal, multi-modal sensing materials are easier to fabricate and more robust, the scientists said. They're also less expensive to produce, making them suitable and cost-effective for widespread use.

That's handy

To test their synthetic flesh, the researchers melted down a soft, stretchy and electrically conductive gelatin-based hydrogel, and cast it into the shape of a human hand. They then equipped the hand with different electrode configurations to see which captured the most useful data from physical interactions, subjecting it to a series of tests to find out.
This rather brutal process involved blasting it with a heat gun, poking it with their fingers and a robotic arm, and cutting it open with a scalpel.

In total, the researchers said they collected more than 1.7 million pieces of information from the skin's 860,000-plus conductive pathways. They used data gathered from these tests to train a machine learning model that, if integrated into a robotic system, could enable it to recognize different types of touch.

"We're not quite at the level where the robotic skin is as good as human skin, but we think it's better than anything else out there at the moment," study co-author Thomas George Thuruthel, a lecturer in robotics and artificial intelligence (AI) at University College London (UCL), said in a statement.
"Our method is flexible and easier to build than traditional sensors, and we're able to calibrate it using human touch for a range of tasks."

Self-healing 'living skin' can make robots more humanlike — and it looks just as creepy as you'd expect published June 25, 2024

A combination of cultured cells and silicone could help robots appear more human in future thanks to realistic skin elasticity. And they can smile like us too.

Researchers have pioneered a method that involves injecting artificially grown skin into tiny holes in a robot's skeleton, so the skin can extend v-shaped hooks known as "perforation-type anchors" and bind to the surface without drooping away. (Image credit: Shoji Takeuchi, Institute of Industrial Science (IIS), the University of Tokyo)

Robots of the future could be wrapped in lifelike skin that can repair itself, in a similar way to the way human skin heals, thanks to a novel approach involving cultured skin cells.

The skin will also appear more lifelike thanks to a new way of attaching it to the robot's skeleton as well the fact that it can repair any cuts or scrapes by itself — researchers said. They published their findings June 25 in the journal Cell Reports Physical Science.
Artificial skin has long been touted as a way to make robots appear more human-like — and cultured skin appears more lifelike than synthetic materials such as latex. But without the right kind of adhesive approach, artificial skin can sag off a robot's frame in a visually disturbing manner.

Robotics researchers have previously tried to solve the problem of artificial skin sagging off the metallic frame by pinning it down with "anchors", hooked or mushroom-shaped structures. This prevents the skin from shifting around atop the robot's frame, but the adhesive structures can stick out as lumps under the skin — compromising its human-like appearance.
In the new study, researchers pioneered a method whereby the robot's skeleton contains tiny holes into which the artificially grown skin can extend v-shaped hooks known as "perforation-type anchors". These keep the artificial skin stuck to the robot while maintaining a smooth and flexible surface.

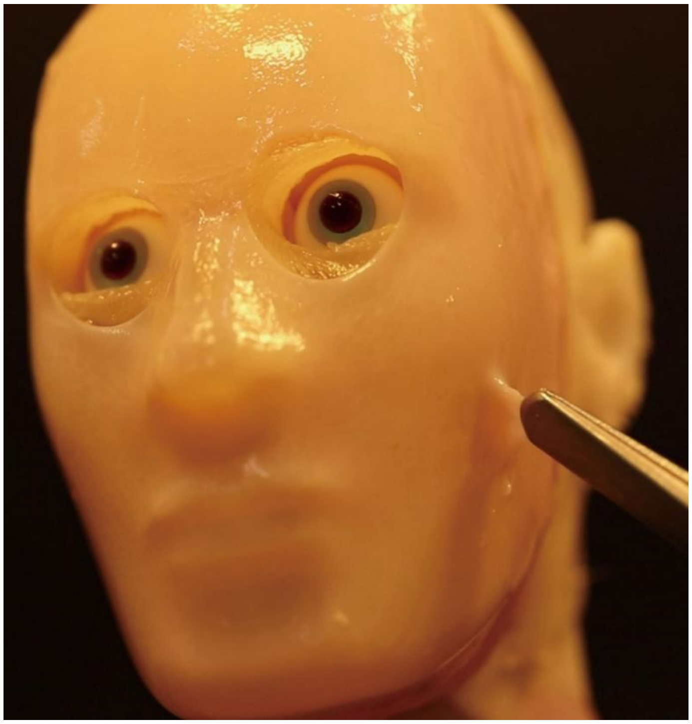
Making robotic skin more lifelike

The artificial skin is layered on top of a robot treated with a water-vapor plasma to make it hydrophilic — in other words, to ensure that liquids are attracted to the surface. This means the cultured skin's gel is pulled deeper into the holes to cling more closely to the surface of the robot.

One of the main benefits of this new skin is that it would allow robots to operate alongside humans without experiencing undue wear and tear. Small tears or similar defacements could be repaired without needing to manually repair the robots, the team said. They did not, however, measure how quickly the artificial skin healed after sustaining damage.

In one demonstration, researchers recreated the way skin changes when a human smiles. This involved connecting the artificial skin to the robotic face with a sliding layer of silicone underneath. This leads to"inflating cheeks", as the muscles tighten and cause the skin to push up at either corner of the mouth. With the perforation anchors, the skin could seamlessly fit the 3D mold of a face, with no protruding bolts or hooks.

The researchers also compared the artificial skin applied to a surface with and without the perforation-based anchors. On anchorless surfaces, the skin shrank by as much as 84.5% over the course of seven days, compared with 33.6% on a surface with 0.04-inch (1 millimeter) anchors. Skin contraction on a robot would separate the skin from the robot's inner frame, ruining its lifelike appearance and potentially causing damage to the skin layer. Skin on surfaces with larger 0.1-inch (3 mm) and 0.2-inch (5 mm) anchors lasted even longer, at 26.4% and 32.2% respectively).



Artificial skin has long been touted as a way to make robots appear more human-like — and cultured skin appears more lifelike than synthetic materials such as latex. (Image credit: Shoji Takeuchi, Institute of Industrial Science (IIS), the University of Tokyo)

The path to building humanlike androids

Shoji Takeuchi, a researcher on the study at the Institute of Industrial Science (IIS), the University of Tokyo, told Live Science several steps will still need to be taken before robots are likely to be wearing skin using the team's methods.

"Firstly, we need to enhance the durability and longevity of the cultured skin when applied to robots, particularly by addressing issues related to nutrient and moisture supply," he said. "This could involve developing integrated blood vessels or other perfusion systems within the skin."

"Secondly, improving the mechanical strength of the skin to match that of natural human skin is crucial. This involves optimizing the collagen structure and concentration within the cultured skin."

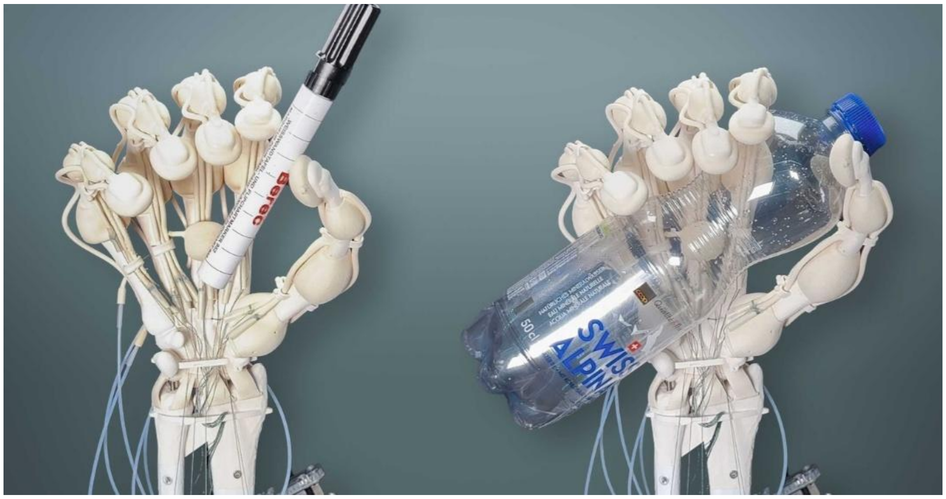
Takeuchi also noted that to be truly functional, artificial skin will eventually have to convey sensory information such as temperature and touch to any robot wearing it, as well as be resistant to biological contamination.

The scientists said that research into the field could further our understanding of how facial muscles convey emotion — which could, in turn, drive breakthroughs in surgery to treat conditions like facial paralysis or expand the capabilities of cosmetics and orthopedic surgery. A better grasp of skin adhesion could also prevent needing any v-shaped holes in future robotic frames.

Robot hand exceptionally 'human-like' thanks to new 3D printing technique

published November 28, 2023

The hand was printed using a technique called slow-curing, which gives plastics more time to set and makes them more durable.



An image montage of the soft robotic hand holding a marker pen and a water bottle. (Image credit: ETH Zurich/Thomas Buchner)

Scientists have created the most human-like robotic hand ever, complete with 3D-printed bones, ligaments and tendons.

The breakthrough — the 3D printing of a mixture of hard and soft parts by cross-layering up to four plastics — could be used to create more complex and durable robots, according to the researchers who developed it.

The result is a firm but soft robotic part that can scale, unlike other soft robots that struggle to maintain their physical properties at larger sizes, according to their findings published Nov. 15 in the journal Nature.
The technique, known as vision-controlled jetting (VCJ), probably won't be used to create the life-like Androids we know from shows like "West World" anytime soon. But they could make automated industries much safer.

"Robots made of soft materials, such as the hand we developed, have advantages over conventional robots made of metal," first author Robert Katzschmann, a professor of robotics at ETH Zurich, said in a statement. "Because they're soft, there is less risk of injury when they work with humans, and they are better suited to handling fragile goods."
Although the robots that work alongside humans in factories malfunction rarely, they can be deadly when they do. On Nov. 8, a South Korean man was crushed to death on a conveyor belt when an industrial robot mistook him for a box of bell peppers.
Robots today are also inflexible and lack the intricate internal structures needed to perform complex movements and tasks humans can easily perform, according to the researchers. Many, such as metal implants, are ill-suited for use in medical contexts too — causing inflammation when human bodies detect a difference between their stiffness and that of the surrounding tissue.
To solve this problem, the scientists set about 3D printing a range of devices (including a six-legged robot, a functional heart pump and a material that absorbs vibrations from its surroundings) that mimic the complexity of nature's biomechanics.

To do so, they developed a way to 3D print slow-curing plastics. Unlike fast-curing polyacrylates used in traditional 3D printing, VCJ gives each layer of the robotic part more time to set — resulting in a more durable and elastic printed component. Cameras and lasers guide the printer so that each layer is built up with the correct thickness.

"We wouldn't have been able to make this hand with the fast-curing polyacrylates we've been using in 3D printing so far," Thomas Buchner, a doctoral student at ETH Zurich, said in the statement. "We're now using slow-curing thiolene polymers. These have very good elastic properties and return to their original state much faster after bending than polyacrylates [the standard polymers used in 3D printing]."

Humanoid 'girlfriend' maker loads robot with 15 languages to boost hospitality, care

Humanoid 'girlfriend' maker loads robot with 15 languages to boost hospitality, care

Realbotix has announced a major advancement for its AI-powered humanoid robot, which can now speak 15 languages fluently and access an additional 147 languages and dialects through cloud-based support.

In a press release, the company stated that this multilingual capability allows the robot to "connect with people across a wide range of industries and cultural contexts."

Designed for various people-centric industries such as travel, tourism, and health care, the lifelike humanoid would fill a critical gap between staff and patients or visitors and improve the overall consumer experience by providing immediate assistance in natural speech.

A humanoid is ready to talk to us

The US-based company Realbotix wants to integrate humanoid robots into the world to improve human experiences through connection, companionship, and intelligent interaction. Now, with an expanded capacity to accommodate more people in their native tongue, humanoids might soon be popping up to help us instead of a real human.

Intriguing and perhaps a little frightening, the question on everyone's minds is: does it really act like a human, or like a robot trying to be human? As they say, "you gotta start somewhere."

Realbotix has updated the software to improve the robot's reach. With additional language support and an ability to integrate most third-party AI platforms, the humanoid is gearing up to service airports, hotels, museums, and tourist attractions such as Disneyland.

Officially, the world has entered a new phase of life: robots that look and act human will easily inform, help, and engage consumers with natural dialogue to ensure that they are satisfied with their experience overall.

In healthcare settings, the robot would serve as "a communication bridge between patients and medical staff," as stated in a news relase.

The robots can express their faces, so as a patient communicates their questions, symptoms, or concerns, they can feasibly respond as if they were a person receiving the information. They would then relay the information to the healthcare teams. It would support healthcare teams in reaching patients more quickly, where they typically meet a lack of support.

Humanoids are definitely coming

As *EE News Europe* reports, a report by Research and Markets anticipates that the global market for humanoid robots will grow from USD 2.93 billion in 2025 to USD 243.40 billion by 2035. Industries will integrate humanoids into the workforce in the next ten years with a price tag of $20k to $175k per robot.

The report by Research and Markets details that technology has rapidly advanced, so the functionalities of humanoid robots have increased. The demand for automation is high. Labor shortages and the demand for more efficient systems are “driving the market forward,” *EE News Europe* continues.

“Adding multilingual support to our humanoid robot is a meaningful step toward more human-centred technology,” says Andrew Kiguel, CEO of Realbotix. “Whether in a hospital or a hotel, understanding and responding in someone’s native language builds trust and makes the experience more personal.”

Consumers have grown used to engaging with a robot on the phone or online now— typically to just get to a person — so they’re accustomed to communicating with a program. Now, a robot dressed like a human will amaze people by its sheer existence and its ability to handle complex conversations.

Imagine getting to the airport, and instead of approaching a real-life attendant for information about the flight, a humanoid robot would provide customer service in practically every language, with limbs that can demonstrate where the gate is.

China’s Humanoids Emerge in SF Robot Fight Club as Tech Advances Rapidly

July 8, 2025

After months of training for battle, China’s humanoid robots are popping up everywhere in the West.

They just proved they don’t need help from humans to play football in Beijing. And now, they’re emerging in clandestine arenas to bring it on. The first rule is to pretend it’s just a demo.

Meanwhile, back in the mainland, leading robotics firms are sharing shocking progress. As they move toward mass deployment, they’re enhancing their humanoids to walk, think, and train with a level of sophistication that was unthinkable just a year ago.

SF’s Robot Fight Club

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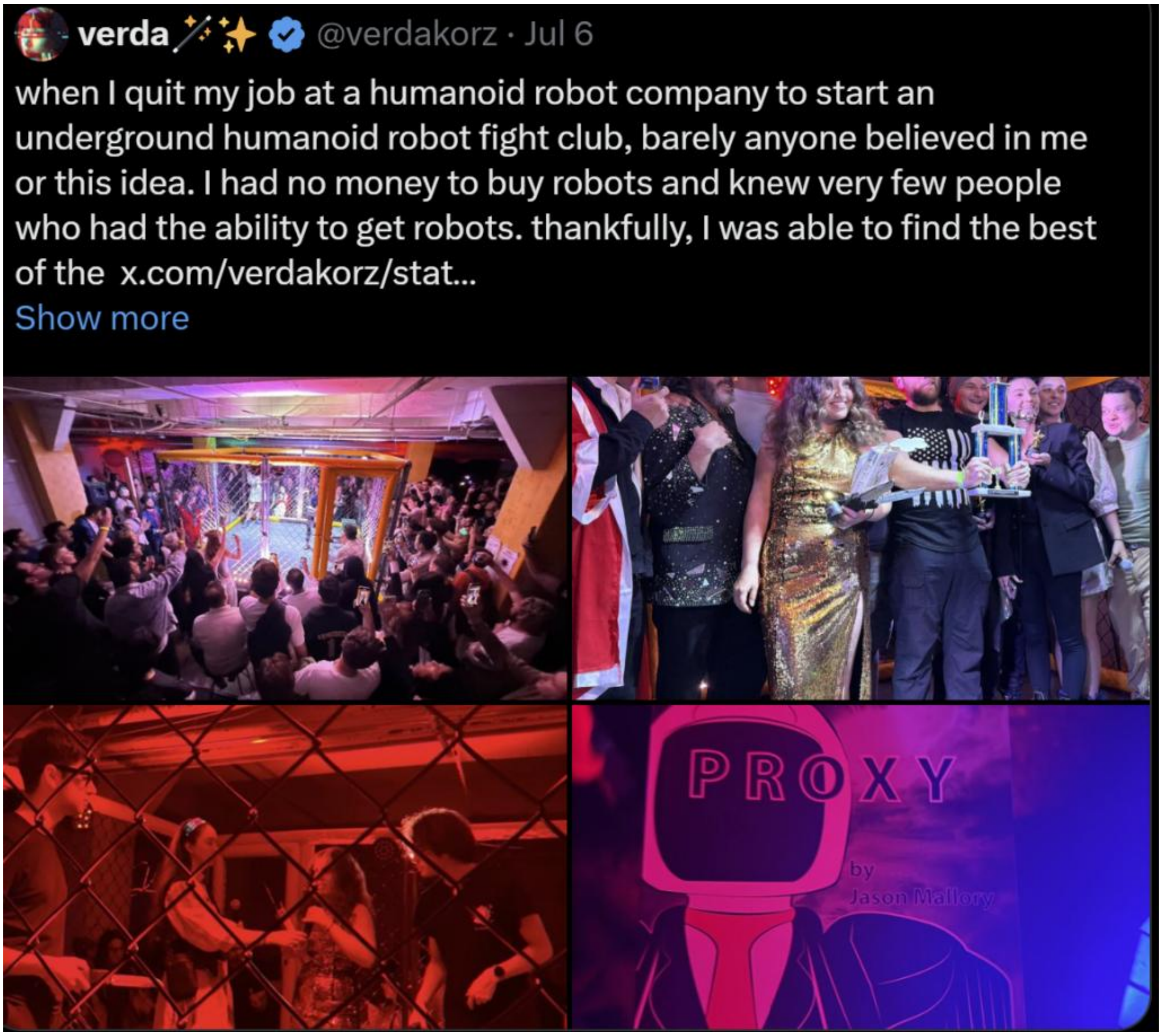
In San Francisco, an underground fight club for robots has emerged, featuring high-end humanoid cage matches. Viral clips circulating on social media show short humanoids from the Chinese companies Unitree Robotics and Booster Robotics participating.

Two Booster T1 humanoid robots by the Chinese company Booster Robotics battle during an underground fight club tournament in San Francisco (Source: UFB)

Hangzhou-based Unitree recently reached unicorn status after disrupting the humanoid robotics market with its G1 robot, which has become popular among researchers, developers, and increasingly, content creators, thanks to its relatively low price, starting at $16K.

Unitree's robotic dogs, which are even more popular, also appeared in videos from the event. Booster's T1 humanoids, which are priced starting around $34K, have become widely adopted in robot competitions like RoboCup and Beijing's recent fully autonomous three-on-three robot football match.

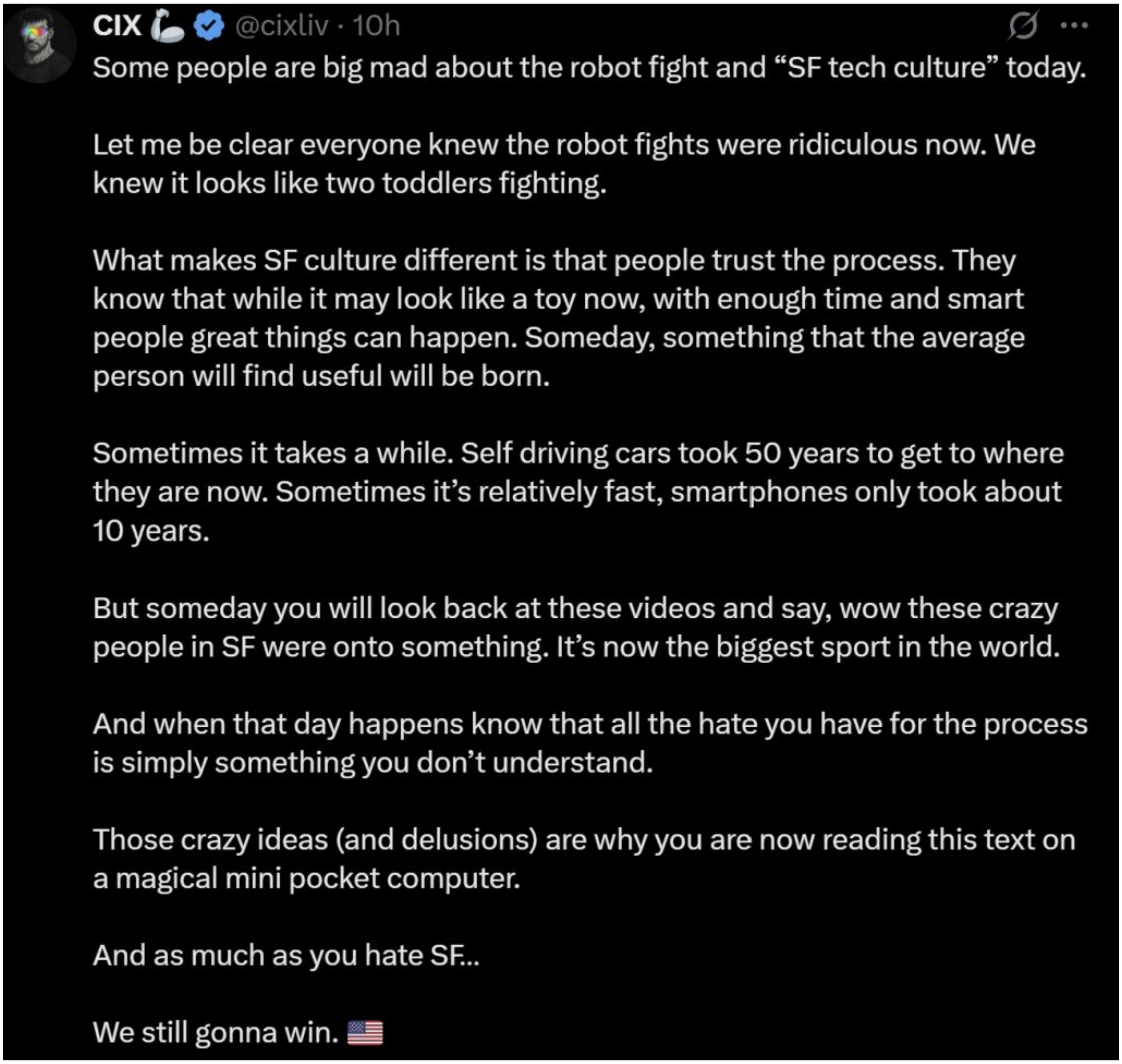
The San Francisco event, called the Automata Ultimate Fighting Bots (UFB) tournament, reportedly took place in a secret basement venue with a cyberpunk rave-like atmosphere. On social media, the event's organizers teased that the tournament was just a glimpse of what's coming.



Source: @verdakorz on X
The night's winner is known as @cixlilv on X, an entrepreneur who's gone viral while jogging with his G1 humanoid on the streets of San Francisco. He's also the co-founder of REK, which is developing a VR game where players train to pilot virtual robots with movement mechanics mirroring real humanoids. Top players will have the chance to control full-sized humanoids in real-world fights.

The founder has been sharing clips of himself training full-sized Unitree H1 robotic humanoids for battle. On the X social media platform, CIX said backlash is brewing over the event and San Francisco's evolving tech culture. He acknowledged that the robots look like toddlers during combat, but the technology is advancing rapidly.

"What makes SF culture different is that people trust the process," he wrote. "They know that while it may look like a toy now, with enough time and smart people great things can happen. Someday, something that the average person will find useful will be born."


CIX 💪 @cixliv · 10h

Some people are big mad about the robot fight and “SF tech culture” today.

Let me be clear everyone knew the robot fights were ridiculous now. We knew it looks like two toddlers fighting.

What makes SF culture different is that people trust the process. They know that while it may look like a toy now, with enough time and smart people great things can happen. Someday, something that the average person will find useful will be born.

Sometimes it takes a while. Self driving cars took 50 years to get to where they are now. Sometimes it’s relatively fast, smartphones only took about 10 years.

But someday you will look back at these videos and say, wow these crazy people in SF were onto something. It’s now the biggest sport in the world.

And when that day happens know that all the hate you have for the process is simply something you don’t understand.

Those crazy ideas (and delusions) are why you are now reading this text on a magical mini pocket computer.

And as much as you hate SF...

We still gonna win. 🇺🇸

Source: @cixliv on X

The tournament’s organizers are among the first movers in a niche market that’s emerging amid the humanoid robotics craze. They’re appealing to the same demographic that previously grew up playing Rock ’Em Sock ’Em Robots and aggressively modifying remote-control cars for combat. The idea is similar to the 2011 movie *Real Steel*, which was inspired by a 1963 *Twilight Zone* episode based on a short story by Richard Matheson, the author of *I Am Legend*.

BattleBots aired before The Daily Show with Jon Stewart when it began in August 2000.

In Detroit, a G1 humanoid robot named Zion made headlines for strolling around 7 Mile like a real person. According to reports, it's promoting an upcoming event called RoboWar, Art Cartwright's Interactive Combat League.

A G1 humanoid robot went viral strolling on 7 Mile in Detroit (Source: @metrodetroitnews on TikTok)
Earlier this year, Ultimate Fighting Bots teamed up with Booster Robotics and Singapore-based Frodobots to launch an online platform that allows anyone in the world to control real humanoids in live combat matches.

Also this year, Unitree Robotics held its first-ever mixed martial arts match between humanoid robots in Hangzhou, near its new 10,000-square-meter factory. Four Unitree G1 humanoids competed in one-on-one matches consisting of three two-minute rounds, with points awarded for effective strikes and penalties for knockdowns.

CCTV coverage of Unitree's upcoming Iron Fist robot MMA event
During the inaugural event, called *Iron Fist King: Awakening*, human controllers operated the robots in real-time using voice commands and remote controls.

The G1 robot introduced itself to the world in March 2024 wielding a baton. It was notable for its record low price, which Shenzhen's EngineAI beat in December 2024 with its short king called the PM01. Like the G1, the $14K PM01 is mostly intended for researchers and developers today. The two robots are bound to fight at some point, as Engine is planning its own spectacle.

The startup says it will hold the world's first full-sized humanoid robot boxing tournament, called *Mecha King*, in December 2025.

LimX CL-3 Update

Also in Shenzhen, LimX Dynamics just shared footage of its next-generation humanoid robot showing off its improved strut. The startup, known for its agile biped and quadruped robots, teased that a full reveal is coming soon.

LimX's CL-3 humanoid robot shows off improved walking gait (Source: LimX Dynamics)

Standing 64 cm tall, the CL-3 sports a sleek metallic silver and black finish for a futuristic, high-tech aesthetic. It perceives its surroundings with its sensor-equipped head unit, which houses cameras, LiDAR, and depth sensors for real-time terrain mapping and obstacle detection.

The robot's hollow high-torque-density actuators provide full-body balance and smoother movements. In another recent video, a CL-3 robot showcased its fluidity by performing office-style stretches. According to LimX, the stretching routines are enabled by 31 degrees of freedom.

LimX introduced its first CL-series humanoid, the CL-1, in late 2023. The robotics firm has grown swiftly since its founding just a few years ago. Earlier in 2025, Alibaba-backed LimX announced it had raised nearly $70 million in a Series A funding round as it aggressively moves its advanced prototypes to commercial products.

LimX Dynamics quadrupedal biped robot (LimX Dynamics)
LimX has previously demonstrated its flagship humanoid's potential in logistics. The startup's other platform is the Tron 1, which it calls the world's first multimodal bipedal robot. The Tron 1, first introduced in October 2024, switches between walking, point-foot balancing, and high-speed wheeled locomotion in real time.

LimX is pitching the platform as a gateway into humanoid reinforcement learning research. It's designed for academia, AI, robotics labs, and industrial R&D teams. Its pricing starts at $15K.

Shenzhen's Humanoids

LimX's CL-3 is among a truly staggering number of AI-powered humanoids emerging from Shenzhen, the booming tech hub often called the Chinese Silicon Valley.

Shenzhen-based Dobot, which rose from a Kickstarter campaign to become an industrial automation leader, says its first robotic humanoid, Atom, has entered mass production. Priced around $27K, Atom boasts a human-like walking gait and fine motor control precise enough to pick up a cherry by the stem without crushing it.

Shenzhen Dobot’s Atom makes US debut at Automate 2025 (Source: Dobot)

Another major player, Pudu Robotics, is commercializing its wheeled and bipedal humanoids using its sizable commercial base. Its flagship humanoid, the Pudu D9, is built to serve in places like warehouses, retail stores, and hotels. Pudu, which recently shipped its 100,000th service robot, has priced a full-sized humanoid at between $20K and $30K.

A newer firm, AI² Robotics, recently raised hundreds of millions of yuan to rush its wheeled AlphaBot general-purpose humanoid to market. An even younger Shenzhen startup, Lumos Robotics, has reportedly raised nearly $28 million in angel funding to develop a full-stack humanoid robotics platform.

The first Lumos prototype, called the LUS1, debuted in early 2025. The second-generation iteration emerged in June, demonstrating the ability to get up from the ground in just a second. According to Lumos, the LUS2 robotic humanoid served as a welcome ambassador during a recent visit by the Austrian Council.

Other notable Shenzhen humanoid robotics companies include:

- DIGIT, which has unveiled multiple lines of sci-fi-inspired humanoids just a year after its launch.
- UBTECH, the leading Chinese robotics firm, which recently introduced its first hyper-realistic android named Una and is mass-producing its Walker S industrial humanoids, reportedly helping assemble iPhones for Foxconn.
- Xpeng, an EV manufacturer planning to mass-produce its IRON humanoid robots in 2026.

PNDbotics Office Assistant

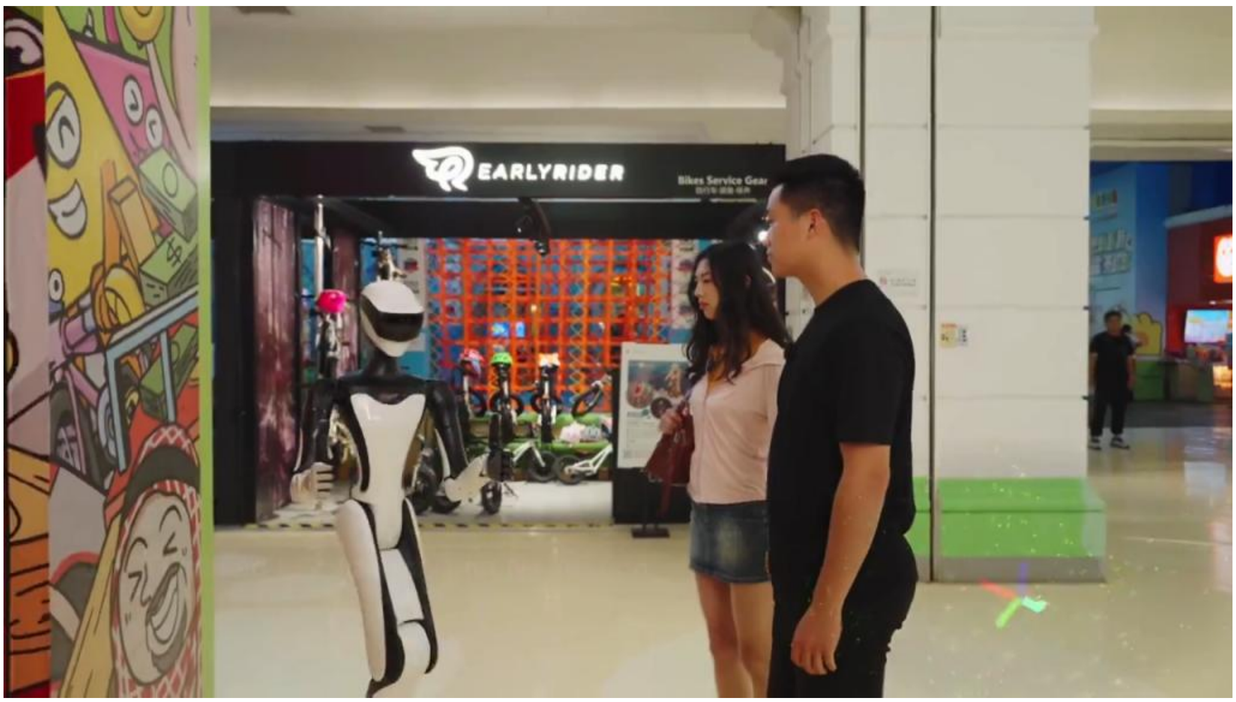
In Beijing, the rising startup PNDbotics just shared a demo showcasing its flagship humanoid robot Adam's potential as an office assistant. The startup emphasizes the humanoid's biomimetic torso and modular actuators that unlock humanlike body motions.

PNDbotics' Adam humanoid robot demonstrates potential as office assistant (Source: PNDbotics)

Standing around 1.6 meters tall and weighing 60 kilos, Atom now has enhanced precise manipulation capabilities. The robotic humanoid also has an improved walking gait, which PNDbotics says is thanks to its proprietary reinforcement learning algorithm. PNDbotics' mission is to create a general-purpose fake human capable of operating effectively in any scenario.

ROBOTERA’s Slim-Waisted Humanoid

Also in Beijing, the startup ROBOTERA recently unveiled its sleek service humanoid with a compact waist design that’s narrower than an iPhone. Standing 165 cm tall, the wheeled Q5 humanoid boasts 44 DoF, including 11 in each hand.



ROBOTERA’s Q5 humanoid robot in its introductory video (Source: ROBOTERA)

According to ROBOTERA, the Q5 fuses LiDAR and stereo vision for smooth navigation. Its AI-powered dialogue system understands 37 languages. ROBOTERA says the slim-waisted design empowers the Q5 to maneuver tight indoor spaces and avoid obstacles.

The Q5 humanoid is powered by the startup’s foundational model called ERA-42, which supports human-in-the-loop learning, closed-loop iteration, and continuous self-improvement. Capable of speeds up to 1.5 meters per second, the Q5 is intended for hospitality, retail, tourism, and healthcare.

ROBOTERA says it's already received more than 110 orders. Launched in August 2023, the company was incubated by the Institute for Interdisciplinary Information Sciences at Tsinghua University. ROBOTERA previously gained attention with its bipedal humanoids that broke records for speed and for being the first to climb the Great Wall of China.

ROBOTERA's Star1 humanoid robot demonstrating dexterous hand
Source: ROBOTERA

AgiBot’s Lingxi X2-N

An AgiBot X2-N humanoid robot carries a box in a new demo video (Source: AgiBot)

Meanwhile in Shanghai, Aabot just shared footage of its new short humanoid robot, putting its unique hybrid locomotion system to the test. The Lingxi X2-N bipedal robot can walk, roll, and dynamically switch between modes within seconds.

Its feet work kind of like Heelys, those sneakers that switch to roller skates. The robot can walk and slide at the same time. Standing 1.3 meters, or about the height of an average 8-year-old, the Lingxi around 34 kg and boasts 28 DoF.

JULY 16, 2025

Robot hand 'feels' pain and ignores harmless touch with new sensory system

by The Korea Advanced Institute of Science and Technology (KAIST)

edited by Gaby Clark, reviewed by Andrew Zinin

MASNS-implemented robot arm having habituation and sensitization characteristics. Credit: *Nature Communications* (2025). DOI: 10.1038/s41467-025-60818-x
In the midst of the co-development of artificial intelligence and robotic advancements, developing technologies that enable robots to efficiently perceive and respond to their surroundings like humans has become a crucial task. In this context, Korean researchers are gaining attention for newly implementing an artificial sensory nervous system that mimics the sensory nervous system of living organisms without the need for separate complex software or circuitry. This breakthrough technology is expected to be applied in fields such as in ultra-small robots and robotic prosthetics, where intelligent and energy-efficient responses to external stimuli are essential.

KAIST announced on July 15 that a joint research team led by Endowed Chair Professor Shinhyun Choi of the School of Electrical Engineering at KAIST and Professor Jongwon Lee of the Department of Semiconductor Convergence at Chungnam National University developed a next-generation neuromorphic semiconductor-based artificial sensory nervous system. This system mimics the functions of a living organism's sensory nervous system, and enables a new type of robotic system that can efficiently respond to external stimuli.

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

In nature, animals—including humans—ignore safe or familiar stimuli and selectively react sensitively to important or dangerous ones. This selective response helps prevent unnecessary energy consumption while maintaining rapid awareness of critical signals. For instance, the sound of an air conditioner or the feel of clothing against the skin soon become familiar and are disregarded.

However, if someone calls your name or a sharp object touches your skin, a rapid focus and response occur. These behaviors are regulated by the "habituation" and "sensitization" functions in the sensory nervous system. Attempts have been consistently made to apply these sensory nervous system functions of living organisms in order to create robots that respond efficiently to external environments like humans.

The response of the robot arm with a conventional low-order memristor-based MASNS according to the applied stimuli. Credit: *Nature Communications* (2025). DOI: 10.1038/s41467-025-60818-x

However, implementing complex neural characteristics such as habituation and sensitization in robots has faced difficulties in miniaturization and energy efficiency due to the need for separate software or complex circuitry. In particular, there have been attempts to utilize memristors, a neuromorphic semiconductor.

A memristor is a next-generation electrical device which has been widely utilized as an artificial synapse due to its ability to store analog value in the form of device resistance. However, existing memristors had limitations in mimicking the complex characteristics of the nervous system because they only allowed simple monotonic changes in conductivity.

To overcome these limitations, the research team developed a new memristor capable of reproducing complex neural response patterns such as habituation and sensitization within a single device. By introducing additional layer inside the memristor that alter conductivity in opposite directions, the device can more realistically emulate the dynamic synaptic behaviors of a real nervous system—for example, decreasing its response to repeated safe stimuli but quickly regaining sensitivity when a danger signal is detected.

Using this new memristor, the research team built an artificial sensory nervous system capable of recognizing touch and pain, and applied it to a robotic hand to test its performance. When safe tactile stimuli were repeatedly applied, the robot hand, which initially reacted sensitively to unfamiliar tactile stimuli, gradually showed habituation characteristics by ignoring the stimuli.

(From left) Ph.D candidate See-On Park, Professor Jongwon Lee, and Professor Shinhyun Choi. Credit: KAIST

Later, when stimuli were applied along with an electric shock, it recognized this as a danger signal and showed sensitization characteristics by reacting sensitively again. Through this, it was experimentally proven that robots can efficiently respond to stimuli like humans without separate complex software or processors, verifying the possibility of developing energy-efficient neuro-inspired robots.

See-On Park, researcher at KAIST, stated, "By mimicking the human sensory nervous system with next-generation semiconductors, we have opened up the possibility of implementing a new concept of robots that are smarter and more energy-efficient in responding to external environments.

"This technology is expected to be utilized in various fusion fields of next-generation semiconductors and robotics, such as ultra-small robots, military robots, and medical robots like robotic prosthetics."

More information: See-On Park et al, Experimental demonstration of third-order memristor-based artificial sensory nervous system for neuro-inspired robotics, *Nature Communications* (2025). DOI: 10.1038/s41467-025-60818-x
Journal information: Nature Communications
Provided by The Korea Advanced Institute of Science and Technology (KAIST)

This humanoid robot can run, cartwheel and fist-fight – and it costs just $6K

The latest humanoid robot on the market can purportedly run across a grassy lawn, do cartwheels and even fist-fight – and it costs less than $6,000.

In a promotional video from China's Unitree Robotics on Friday — which provoked skepticism from some on social media whether it was legit or instead a product of CGI — the new R1 robot is seen doing cartwheels and handstands, as well as throwing combination punches and spin-kicking the air.

It weighs about 55 pounds, has 26 joints to allow for flexible movement and is equipped with multimodal artificial intelligence, including voice and image recognition, according to Unitree.

Unitree's new humanoid R1 robot. Unitree Robotics

The humanoid's price tag – just 39,900 yuan, or $5,900 – is drastically lower than the typical entry point for this burgeoning tech market.

Some users online, however, said they would rather spend their money on a helpful household robot over one with tumbling tricks and "security" capabilities.

“Can it vacuum? Can it run the washing machine? Can it fold clothes? Can it iron? Can it cook?” one user wrote in a post on X.

Another user wrote: “My daughter does gymnastics all day. i don’t need a robot for that.”

Some joked about the robot’s fighting capabilities, asking if the humanoid could protect owners from bullies, while others questioned whether AI and computer graphics were used to make the marketing video.

US firms, like Boston Dynamics and its Atlas robots, have helped pioneer the humanoid robot market.

But an advanced human-like bot for just $6,000, if done successfully, would mark a major milestone for China in the robotics and AI race.

The robot has 26 joints to allow for flexible movement. Unitree Robotics

Unitree already has several models available, including robotic arms, quadrupeds and other humanoid bots – like a boxing robot complete with gloves and a helmet.

The firm, which was founded by Wang Xingxing in 2016, started to gain more recognition earlier this year after its founder and CEO joined big names in tech like Alibaba’s Jack Ma and Tencent’s Pony Ma at a summit with Chinese President Xi Jinping.

Its latest R1 reveal comes as China is prepared to kick off its World Artificial Intelligence Conference in Shanghai this weekend, gathering together state officials, tech founders and deep-pocketed investors.

Chinese firms have been pushing ahead in the robotics race as they aim to bring robotics into everyday use in households, factories and even the military.

Unitree's older G1 humanoid, which has a $16,000 price tag, grew popular for use in research labs and schools.

The G1 has dozens of flexible joint motors, can simulate human hands and its technology is accelerated by AI "upgrading and evolving every day," according to the Unitree website.

Unitree's larger, more advanced humanoid robot H1 sells for more than $90,000.

Unitree's R1 robot doing a handstand. Unitree Robotics

It weighs more than 100 pounds with the highest levels of speed, power, maneuverability and flexibility, able to walk and run on complex terrain, according to Unitree.

The H1 is equipped with a 3D LiDAR and depth camera.

For its qualifications, the latest R1 model comes at a shockingly low entry point.

Chinese rival UBTech Robotics Corp. is planning a humanoid robot to serve as a household companion, which is expected to have a $20,000 price tag.

Morgan Stanley Research estimates that the cost of the most-sophisticated humanoid last year was about $200,000.

Robots That "Eat" Each Other to Survive Could Evolve Into Machines and Conquer Our Planet

In a world where **robotics** are becoming an integral part of everyday life, we're starting to see innovations that are as surprising as they are fascinating. Recently, researchers from **Columbia University** have introduced a concept that sounds almost like science fiction: **robots that "eat" each other to survive, evolve, and grow**. These robots are designed with a unique feature known as **"robotic metabolism,"** which allows them to adapt, self-repair, and form entire **ecosystems**. The question is—could this breakthrough lead to **autonomous robots** capable of transforming industries, or even exploring new frontiers on other planets?

A New Approach to Robot Design

When you think of a robot, you might imagine a complex, humanoid machine designed to replicate human tasks. But researchers are shifting away from this traditional idea. Instead of designing intricate machines, they're embracing a **minimalist approach** that focuses on simplicity. The **Truss Link robots**, for example, are small, modular units that look nothing like the advanced humanoid robots we've seen in movies. These robots can connect together to create larger, more complex structures, much like **building blocks**. Their design isn't meant to impress with complexity but to function in an adaptable, modular way—almost like an evolutionary leap in robotics.

This approach might seem counterintuitive at first, but it makes sense when you think about how nature works. Living organisms don't need to be overly complex to survive and thrive; they **evolve**, **adapt**, and **grow** based on their environment. By taking inspiration from this process, these robots could perform a wide range of tasks and even change shape depending on what they're needed for. It's a bold idea, but it could open up new possibilities for robots in areas ranging from industrial applications to **space exploration**.

How Robots Could "Eat" Each Other to Grow

One of the most groundbreaking aspects of this new robot design is its ability to "eat" other robots to survive. It might sound a little odd, but the concept is actually quite brilliant. When a module within a robot's structure runs out of power, the system doesn't just stop—it discards the dead unit and replaces it with a fully charged one. This allows the robot to keep functioning, even if individual parts fail. This **self-repairing feature** is one of the reasons these robots could be revolutionary for missions where human intervention is limited, such as **deep-sea exploration** or **space missions**.

But it doesn't stop at just survival. These robots can evolve over time. By linking together, they can form more complex shapes and structures. The robots don't just replace broken parts—they actually grow and adapt based on the environment they're placed in. Imagine robots on a distant planet **building infrastructure** or repairing themselves autonomously in the harshest conditions. It's a vision of robotics that doesn't require constant human input—making these machines capable of performing tasks we once thought were beyond their reach.

A New Era for Autonomous Robotics in Space and Beyond

The idea of robots that can evolve and grow brings to mind some exciting possibilities for space exploration. If robots can self-repair and evolve, they could play a key role in missions to **Mars** or even other planets.

Traditional space missions rely heavily on human intervention, especially when dealing with technical issues or repairs. But with autonomous robots, the need for human presence could be minimized, making it possible for machines to manage tasks like **building habitats**, maintaining equipment, or even conducting scientific experiments—without waiting for a human to show up and fix things.

These robots could also be used in **extreme environments** here on Earth. Think about using them for **search and rescue** operations in disaster zones, where conditions are too dangerous for humans. Or, envision them exploring the deepest parts of the ocean, where no human could go. By evolving and adapting, these robots could help us explore places that were previously inaccessible, expanding our reach both on Earth and in space.

‘Robot skin’ beats human reflexes, transforms grip with fabric-powered touch

Robots have become remarkably advanced, capable of executing complex tasks with impressive accuracy, speed, and coordination. Yet, despite these leaps, they often struggle with something fundamental like sensing and responding to touch.

That limitation may soon change.

A team from the University at Buffalo has developed an electronic textile (E-textile) that mimics how human skin senses pressure, slippage, and movement.

This innovation enables robotic fingers to react in real time, tightening or loosening grip as needed, a significant upgrade in dexterity.

The breakthrough could transform how robots interact with physical objects in collaborative environments like manufacturing, surgery, and prosthetics.

It represents a notable step toward more sensitive and responsive machines, especially in settings that demand fine motor control.

“The applications are very exciting… The technology could be used in manufacturing tasks like assembling products and packaging them – basically any situation where humans and robots collaborate,” said Jun Liu, assistant professor in UB’s Department of Mechanical and Aerospace Engineering and the study’s corresponding author. “It could also help improve robotic surgery tools and prosthetic limbs.”

Faster-than-human response times

The textile sensor generates electricity through the tribovoltaic effect, a process where friction between materials produces a direct-current (DC) signal.

Researchers mounted this sensor onto 3D-printed robotic fingers and connected them to a compliant gripper developed at UB.

The system proved exceptionally responsive. Depending on the experiment, it reacted in as little as 0.76 milliseconds, with a maximum of 38 milliseconds.

Human touch receptors typically respond within 1 to 50 milliseconds.

“The system is incredibly fast, and well within the biological benchmarks set forth by human performance,” Liu said. “We found that the stronger or faster the slip, the stronger the response is from the sensor – this is fortuitous because it makes it easier to build control algorithms to enable the robot to act with precision.”

Real-time grip adjustments

In one test, researchers attempted to pull a copper weight from the robot’s grip. The system sensed the movement and automatically increased its grip to secure the object without crushing it.

“The integration of this sensor allows the robotic gripper to detect slippage and dynamically adjust its compliance and grip force,” said Ehsan Esfahani, associate professor at UB and co-author of the study. “This sensor is the missing component that brings robotic hands one step closer to functioning like a human hand.”

PhD candidate Vashin Gautham, the study’s first author, added: “Our sensor functions like human skin — it’s flexible, highly sensitive, and uniquely capable of detecting not just pressure, but also subtle slip and movement of objects.”

The researchers plan to further test the system by integrating reinforcement learning to refine control algorithms.

Potential use cases include advanced prosthetics, precision robotic tools for surgery, and enhanced human-machine interaction systems.

The team is also exploring the sensor’s adaptability to different robotic platforms.

The study received funding from the University at Buffalo’s Center of Excellence in Materials Informatics.

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

New Machine Vision Is More Energy Efficient—and More Human

Topographic neural networks develop familiar spatial biases

MATTHEW S. SMITH08 JUL 2025

All-topographic neural networks, which allow artificial intelligence to “see” more similarly to humans than other methods, were developed by Tim Kietzmann’s team at the Institute of Cognitive Science in Osnabrück, Germany.
SIMONE REUKAUF

AI-vision models have improved dramatically over the past decade. Yet these gains have led to neural networks that, though effective, don’t share many characteristics with human vision. For example, convolutional neural networks (CNN) are often better at noticing texture, while humans respond more strongly to shapes.

A paper recently published in *Nature Human Behaviour* has partially addressed that gap. It describes a novel All-Topographic Neural Network (All-TNN) that, when trained on natural images, developed an organized, specialized structure more like human vision. The All-TNN better mimicked human spatial biases, like expecting to see an airplane closer to the top of an image than the bottom, and operated on a significantly lower energy budget than other neural networks used for machine vision.

“One of the things you notice when you look at the way knowledge is ordered in the brain, is that it’s fundamentally different to how it is ordered in deep neural networks, such as convolutional neural nets,” said Tim C. Kietzmann, professor at the Institute of Cognitive Science in Osnabrück, Germany and cosupervisor of the paper.

All-TNN networks learn humanlike spatial biases

Most machine vision systems used today, including those found in apps like Google Photos and Snapchat, use some form of convolutional neural network. CNNs replicate identical feature detectors across many spatial locations (which is known as “weight sharing”). The result is a network that, when mapped, looks like a tightly repeating fractal pattern.

The structure of an All-TNN network is much different. It instead appears smooth, with related neurons organized into clusters but never replicated. Images that map the spatial relationships in the All-TNN network look like the topographic view of a hilly region, or a group of microorganisms viewed under a microscope.

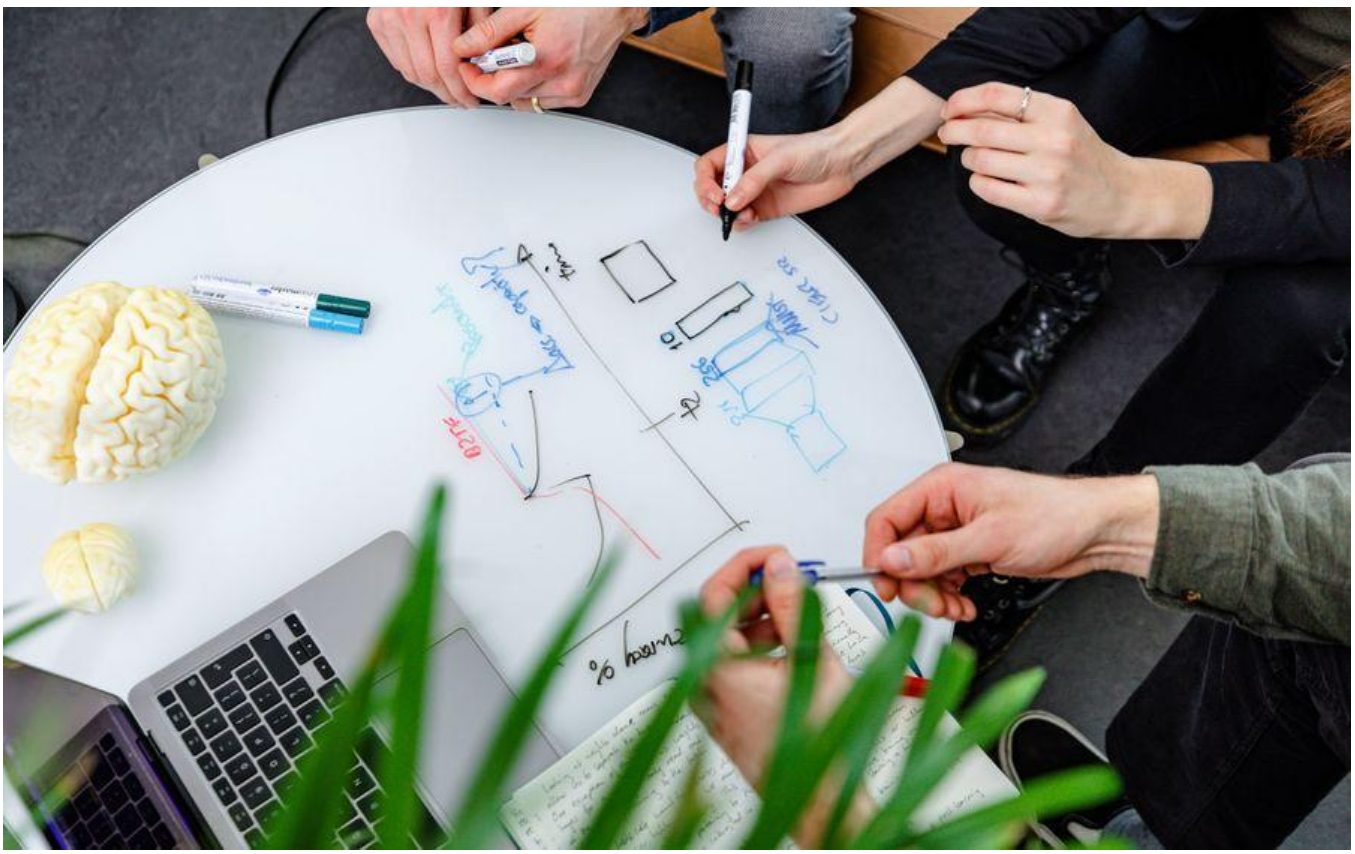
This visual difference is more than just a comparison of pretty pictures. Kietzmann said the weight sharing used by CNNs is a fundamental deviation from biological brains. “The brain can’t, when it learns something in one location, copy that knowledge over to other locations,” he said. “While in a CNN, you can. It’s an engineering hack to be a bit more efficient at learning.”

The All-TNN network avoided that characteristic through a fundamentally different architecture and training approach.

Instead of weight sharing, the researchers gave each spatial location in the network its own set of learnable parameters. Then, to prevent this from creating chaotic, unorganized features, they added a “smoothness constraint” in training that encouraged neighboring neurons to learn similar (yet never identical) features.

To test whether that translated to machine vision with more humanlike behavior, the researchers asked 30 human participants to identify objects flashed briefly in different screen locations. While the ALL-TNN still wasn’t a perfect analog for human vision, it proved three times as strongly correlated with human vision as the CNN network.

Zejin Lu, a coauthor on the paper, said the All-TNN's improved correlation with human vision was driven by how the network learned spatial relationships. "For humans, when you detect certain objects, they have a typical position. You already know the shoes are usually at the bottom, on the ground. The airplane, it's at the top," he explained.



Members of the team working on all-topographic neural networks theorized that their approach would result in more humanlike machine vision. SIMONE REUKAUF

Humanlike behavior doesn't mean better performance, but it does reduce energy

The stronger correlation between the All-TNN network and human vision shows how machines can be taught to see the world in a manner more similar to humans, but it doesn't necessarily result in a network that's better at image classification.

CNNs remained the king of image classification with an accuracy at 43.2 percent. The All-TNN achieved classification accuracies ranging from 34.5 to 36 percent, depending on the network's configuration.

What it lacked in accuracy, though, it gained in efficiency. The All-TNN consumed significantly less energy than tested CNN, with the CNN using over ten times as much energy in operation. Remarkably, this was achieved despite the fact the All-TNN was roughly 13 times the size of the CNN tested (at roughly 107 million parameters for the All-TNN versus roughly 8 million for the CNN).

The All-TNN's efficiency is thanks to the network's novel structure. Though larger overall, the network can focus on the most important parts of images rather than processing everything uniformly. “You’ve got a whole lot of different neurons that could respond, but only a fraction is responding,” said Kietzmann.

The All-TNN’s efficiency could have implications for machine vision on low-power devices. However, Kietzmann and Lu emphasized that energy efficiency wasn’t their primary goal or what they found more interesting in the paper’s results. Instead, they hope that new network architectures, like the All-TNN, will provide a more complete framework for understanding intelligence—both artificial and human.

Kietzmann remarked that the pursuit of scale seems inconsistent with what’s known about how real brains (which have access to far less data and use far less energy) develop. Networks that try to mimic humanlike behaviors could provide an alternative to the pursuit of scale (through the use of more training data and training larger models with more parameters) at all costs.

“There’s this trend, a feeling that scale is just too boring of an answer to the fundamental question of how cognition comes about,” said Kietzmann.

World's first robot 'could give birth to human baby'

The world's first humanoid robot surrogate could give birth to a live baby, scientists have claimed.

Experts are developing technology that will mimic a pregnancy from conception to delivery, with the infant growing inside an artificial womb and receiving nutrients through a tube.

After nine months, a live baby will be born, according to Dr Zhang Qifeng, who founded the company Kaiwa Technology, in the city of Guangzhou.

Dr Zhang, a PHD graduate from Nanyang Technological University in Singapore, has claimed the technology is already in a "mature stage".

He added: "Now it needs to be implanted in the robot's abdomen so that a real person and the robot can interact to achieve pregnancy, allowing the fetus to grow inside".

A prototype of the humanoid is set to be sold for around £10,000 (100,000 yuan) next year.

Reports in the Chinese media said that the humanoid has been designed to mimic the entire process of pregnancy, from the moment of conception to birth.

However, the specifics on exactly how the egg and sperm are fertilised are currently unclear.

For the entire gestation period, the infant will live inside the robot's body, although experts have not yet stated how the foetus will be implanted in the tech womb.

The developing babies will be surrounded by artificial amniotic fluid to create a womb-like environment.

'Biobag'

Dr Zhang said the technology is not an entirely new concept, as scientists in the past have successfully kept premature lambs alive inside a “biobag” for weeks.

The innovation has already prompted a legal and ethical debate. Dr Zhang said he had already been in talks with Guangdong Province authorities to prepare drafts for policy and legislation.

If successful, the science could revolutionise medical science and our notions of family and fertility.

The humanoid could be seen as a tool to tackle rising rates of infertility in China, which has gone up from 11.9 per cent in 2007 to 18 per cent in 2020.

‘Problematic’ technology

But some critics have condemned the “problematic” technology, arguing that depriving a foetus of maternal connection is unethical and cruel.

Chinese News outlet The Standard reported that some medical experts are sceptical over the technology’s ability to replicate human gestation.

The experts have allegedly stated that complex biological processes, such as maternal hormone secretion, cannot be duplicated by science.

‘Pathologise’ pregnancy

Andrea Dworkin, the radical feminist writer, has previously hit out at artificial womb technology for fears that it would result in “the end of women”.

Researchers from The Children’s Hospital of Philadelphia published an article in 2022 in which they said that such technology might “pathologise” pregnancy.

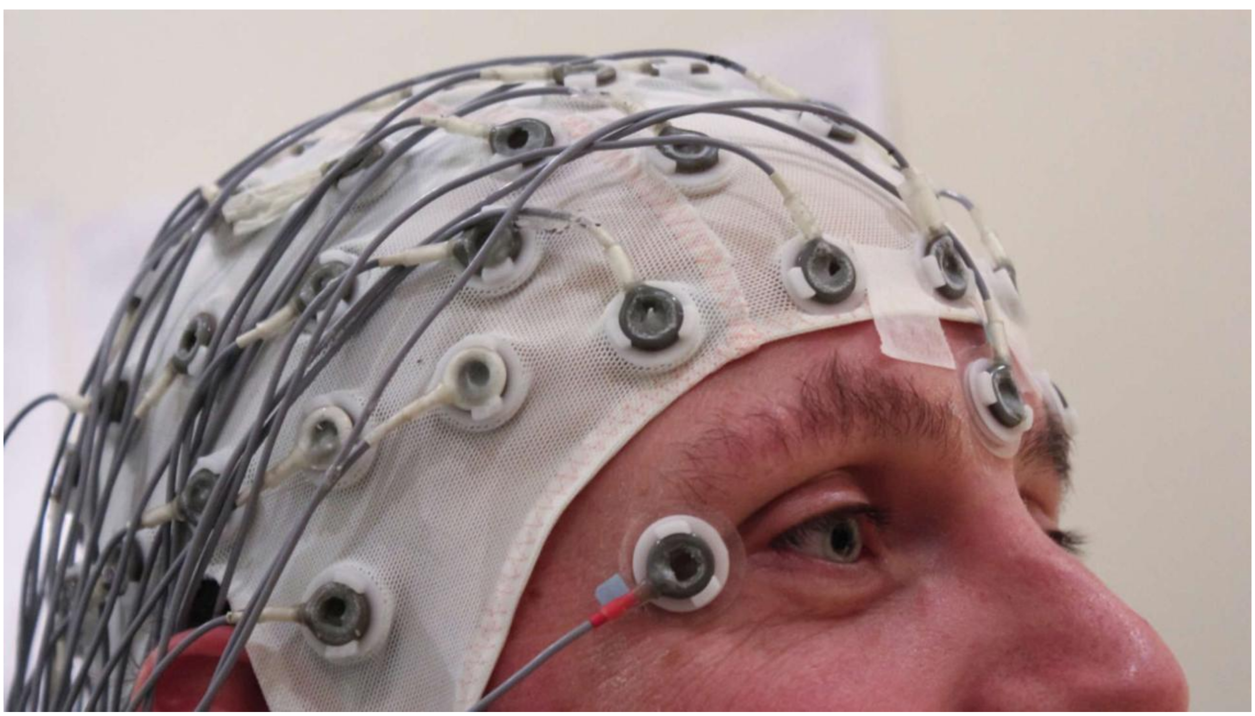
However, some argue that artificial wombs could liberate women from pregnancy risks so that they would no longer have to endure the physical burden of carrying a baby.

Researchers build prosthetic limbs controlled by thoughts

Researchers build prosthetic limbs controlled by thoughts

Recent advancements in neuroscience and engineering have led to the development of prosthetic limbs that can be controlled by thoughts, marking a significant leap in the field of assistive technology. This breakthrough not only enhances the functionality of prosthetic devices but also improves the quality of life for individuals with amputations. By integrating brain-computer interfaces (BCIs) and sophisticated algorithms, researchers are paving the way for more intuitive and responsive prosthetics.

The Science Behind Thought-Controlled Prosthetics



Challenges and Innovations in Development

The Impact on Users' Lives

Future Prospects and Research Directions

A humanoid robot is now on sale for under US$6,000 – what can you do with it?

Published: August 18, 2025 12:23pm EDT

You might have noticed that humanoid robots are having a bit of a moment. From Tesla's Optimus to Figure AI's Figure 02, these machines are no longer just science fiction – they're walking, and in some cases, cartwheeling into the real world.

Now China's Unitree Robotics, best known for its nimble quadruped robots, has unveiled something that's turning heads: the Unitree R1.

For one thing, it's a humanoid robot priced at under US$6,000 (£4,400). That's not pocket change, but it's orders of magnitude cheaper than most robots in its class, which can run into tens or even hundreds of thousands of dollars.

The R1 packs serious mobility, sensors and AI potential into a package that could fit in a university lab, a workspace – or even, if you're adventurous, your living room.

Unitree R1.

What can the R1 do?

The Unitree R1 is around 1.2 metres tall and weighs roughly 25kg (similar to a packed suitcase). This makes it compact and relatively easy to move around. It's equipped with 24 to 26 degrees of freedom (think of these as "joints" that allow it to bend, twist and rotate), giving it a surprisingly human-like range of motion. It can walk, squat, wave, balance, kick and – according to Unitree's own demos – pull off athletic tricks like cartwheels.

It's loaded with sensors: cameras to see in 3D, microphones to hear where sounds are coming from, and wireless connections to talk to other devices. Its built-in computer can handle both what it sees and hears at the same time, and you can even give it extra computing power if you buy Nvidia's Jetson Orin, a high-performance computer often used in AI projects which retails for about £180. It's like adding a "turbo boost" that lets the robot handle more demanding tasks such as advanced image recognition, real-time decision-making or running complex software like real-time 3D graphics platform Unreal Engine.

Battery life is about an hour, with a quick-release system that lets you swap in a fresh battery. That's not a full day's work, but it's enough for short bursts of training, testing or demonstration. At least for most research teams, that's plenty.

Here's the thing: while the R1's hardware is impressive, the software is still finding its feet. For example, Unitree's website says that users need to "understand the limitations" of humanoid robots before making a purchase, reflecting constraints to the robot's autonomy.

This is not unique to Unitree; it's the state of the humanoid robotics field as a whole. The challenge isn't just making a robot move; it's making it understand, adapt and interact safely in unpredictable real-world environments.

Right now, much of what we see in humanoid demos is either scripted routines or teleoperation (remote control). But in research labs, there's exciting work happening to bridge that gap - from task-specific AI such as teaching a robot to sort packages, to fundamental skills like maintaining balance, responding to uneven terrain, and fine-tuning finger dexterity for delicate object handling.

Humanoid robots like the R1 provide a platform where all these capabilities can be tested in one body. The hardware says: "I can do it." The software still has to figure out how.

Why a humanoid form?

Why is it necessary to have humanoid robots at all? Why not just make machines purpose-built for specific tasks? The truth is, there's a strong argument for both approaches. The humanoid form has a big advantage in social acceptance. People are used to seeing other humans, so a machine with two arms, two legs and a head tends to feel more relatable than a box on wheels or an industrial arm.

In settings like elderly care, hospitality or public assistance, a humanoid robot might be easier for people to interact with – especially if it can use gestures, facial cues or natural conversation.

On the practical side, humanoids are designed to operate in environments built for humans – climbing stairs, opening doors, using tools. In theory, this means you don't have to rebuild your home, office or factory for these robots to work there.

But are they always the most practical solution? Not necessarily. A robot with wheels can be faster and more energy-efficient on flat surfaces. A specialised arm can be stronger and more precise in a factory. Humanoids often sacrifice peak efficiency for versatility and familiarity. For many applications, that trade off might be worth it. For others, maybe not.

The Unitree R1 isn't about replacing people – it's about making humanoid robotics more accessible. By lowering costs, it opens the door for universities, small companies and even hobbyists to explore everything from AI vision and balance control to dexterous hand movements and creative performances.

Imagine students developing a robot that can walk around a care home, carrying out small helpful tasks. Or a research team teaching it to work alongside humans in a warehouse without needing elaborate safety cages to protect the humans. Or even artists and performers using it to take part in a show.

The whole robotics community is in a golden age of experimentation. Different AI modes are being tested – some focused on single, repetitive tasks; others on general adaptability. Some robots are learning to squat and maintain balance under sudden pushes. Others are developing precise finger movements for tool use. It's a worldwide collaborative puzzle, and humanoids like the R1 give researchers a flexible piece to work with.

For now, the R1 is not "the robot that will change everything." But it's a signpost pointing toward a future where robots like it are much more common, much more capable, and perhaps … a little more human.

In another AI push, China holds the world's first sports event for humanoid robots

BEIJING — They aren’t the most graceful athletes, or the fastest. But they’re learning.

From Friday to Sunday, human handlers from 16 countries put about 500 bipedal robots through various motions to showcase the promise and limits of embodied artificial intelligence at what was billed as the first-ever World Humanoid Robot Games in Beijing.

The robotic participants came in all shapes, sizes and structures and competed in 26 different sports events ranging from running to kickboxing to soccer. The unusual state-backed sports tournament at the National Speed Skating Oval, a Beijing Olympic venue, came as the United States and China race against each other to shape the future of AI.

Humanoid robots playing soccer at the World Humanoid Robot Games in Beijing on Friday.

There were no speed records being set, and many of the athletes were prone to fizzling and face plants. Some robots broke down unexpectedly while competing, while others didn't complete their tasks as planned. One viral video showed a running robot veering off course and accidentally knocking over a person on the track.

But for the robots' developers, the games were less about winning or losing and more about testing their agility, endurance and battery life, all of which have made great advances in recent years.

Some humanoids were also competing in more practical job skills, such as sorting medicine and hotel concierge duties.

A team from StarBot, a California-based tech company that specializes in developing robots skilled in customer service, said they were "really excited" to be part of the games.

"We thought it was a really good opportunity to come to China and be in an environment where everything is so modern and up to date," company representative Gregorio Velasco told NBC News.

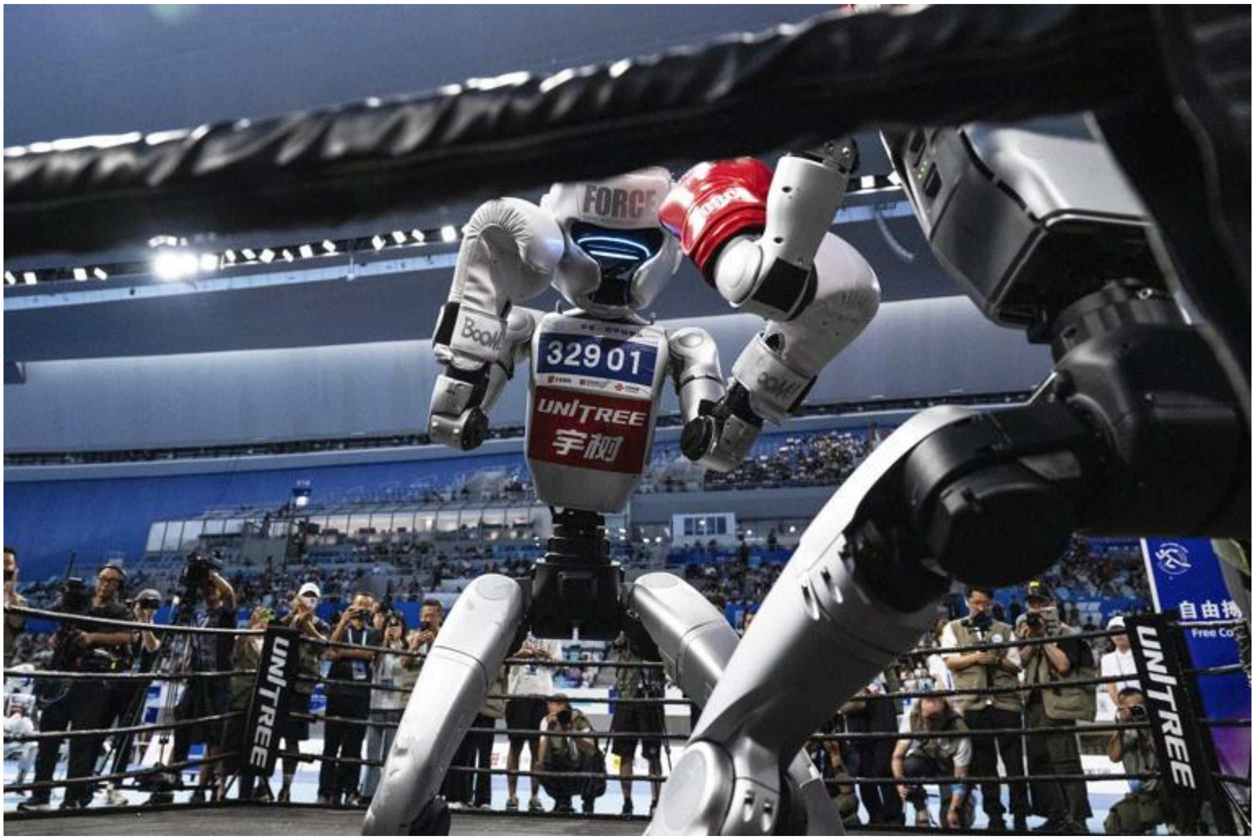
StarBot's machines, developed based on the Chinese-made Unitree model, competed in service-related races as they excel at restaurant scenarios such as taking orders and delivering food to tables, he said.

Going forward, Velasco said, "we hope to be in people's homes and restaurants, hotels, and I think in the future, many people will have robots involved in their life."

The venue was packed with spectators who laughed, clapped and rooted for the robot athletes as the games kicked off Friday.

During the tai chi event, a group of judges watched carefully as the robot competitors moved gracefully to the rhythm of soft music in the background, jotting down notes and scoring the performances with the seriousness of an Olympic panel.

“For robots, a single movement needs to be repeated many times before they can perform it with stability,” martial arts judge Zhang Jidong told Chinese state newspaper The Beijing News. “Considering the very short preparation time, the robots’ upper-body movements were impressively smooth.”



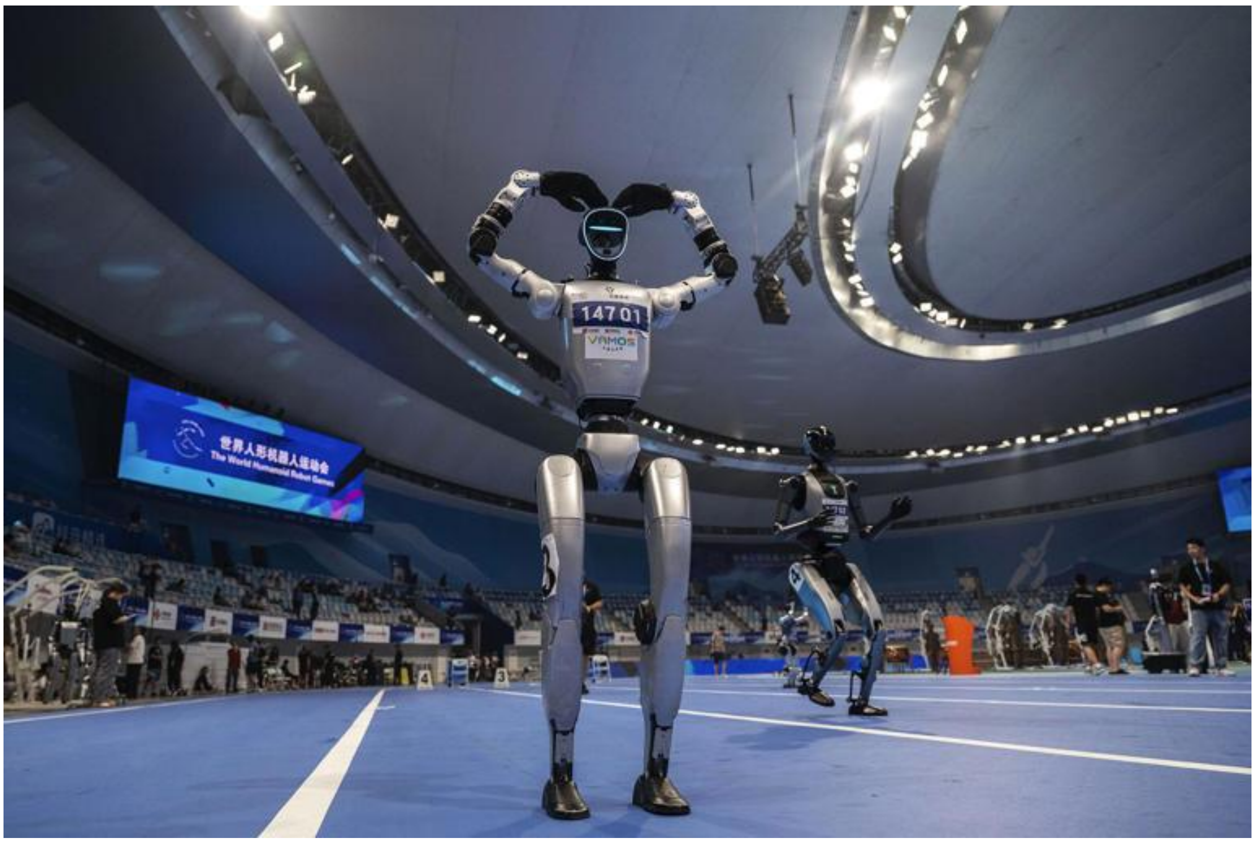
Humanoid robots fighting at the World Humanoid Robot Games on Saturday. (Kevin Frayer / Getty Images)© Kevin Frayer

The games did not just showcase how far robotics have come and how humanoids might one day be integrated into daily life. They also revealed how heavily China’s government has been backing the development of these technologies, to close the artificial intelligence gap with the United States.

In July, China announced its global action plan for AI just days after the Trump administration released the U.S. version, which experts note is “no coincidence” as the two countries race to win others over to their respective visions for AI governance. Both countries consider AI a national security issue, and the U.S. has sought to restrict China’s access to the advanced semiconductor chips needed to train AI models.

While the U.S. backs market-driven AI in alignment with liberal norms, China promises to help developing countries with AI as a means to promote state control, according to the Atlantic Council, a think tank based in Washington.

Videos of robots dancing, punching and performing have been all over Chinese social media and state TV as Beijing has deepened its AI investment and promotion. In April, the Chinese government organized a half-marathon in Beijing where robots and human runners raced against each other.



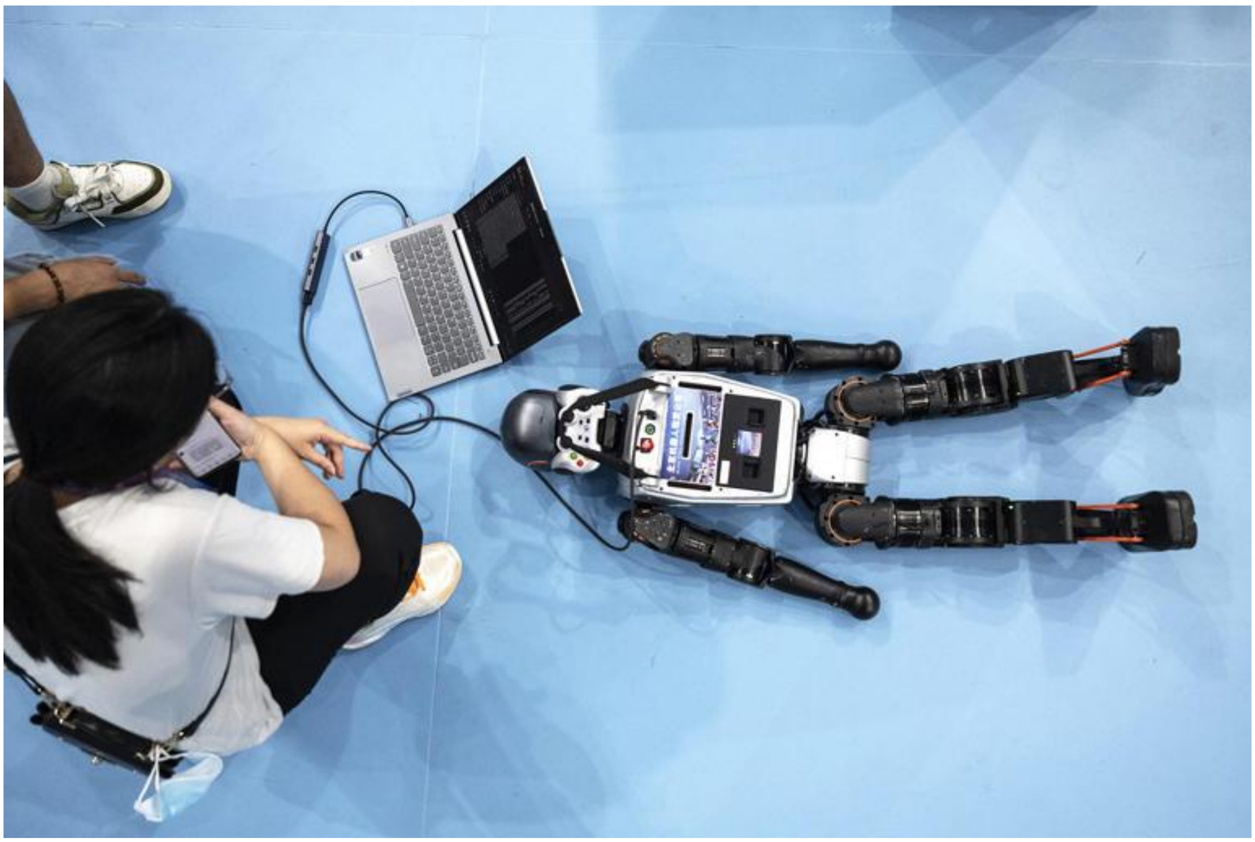
A humanoid robot reenacting runner Mo Farah's "Mobot" victory dance at the World Humanoid Robot Games on Thursday. (Kevin Frayer / Getty Images)© Kevin Frayer

For years, Beijing has been funneling tens of billions of dollars into AI research and state subsidies, just as it did with the electric vehicle industry, drawing accusations of unfair competition from Western critics.

While American robot developers such as Boston Dynamics still dominate high-end research and innovation, Chinese companies, spurred by government policy, are focused on mass-producing affordable robots, according to Information Technology and Innovation Foundation, a think tank based in Washington.

Research published by Morgan Stanley predicts that by 2050, China will have 302.3 million humanoid robots in use, well ahead of the U.S. projection of just 77.7 million.

Although the production disparity between the two countries may grow larger, experts said the U.S. will maintain its advantage in total compute capacity, a metric more likely to be the key in deploying and integrating AI systems at scale.



A technician checking a humanoid robot on the sidelines during a soccer competition on Sunday. (Kevin Frayer / Getty Images)© Kevin Frayer

Wang Xiaoyin, a representative from China-based robot developer NexAurora, said robots today still lack a "robust AI brain."

The "real AI age," he said, will begin only when robots like the ones competing in Beijing can think and behave independently after training.

While the robots' performance over the weekend showed that day is still a long way off, the games were part of China's larger goal: getting ahead in the global race for AI domination, one clunky step at a time.

From daily news and career tips to monthly insights on AI, sustainability, software, and more—pick what matters and get it in your inbox.

[INNOVATION]

Unitree dominates inaugural humanoid robot games with four golds in track events

Unitree captured four gold medals at the inaugural World Humanoid Robot Games in Beijing, including the 400m dash and 1,500m race.

Aug 19, 2025

Humanoid robots from Unitree Robotics win the first place in the 4x100m Relay of Track and Field event on day three of the World Humanoid Robot Games.

Unitree has made history at the inaugural World Humanoid Robot Games in Beijing, capturing four gold medals across key track events.

The Hangzhou-based robotics company's H1 humanoids stormed the 400-metre dash, 1,500-metre race, 100-metre hurdles, and 4×100-metre relay.

The Games drew 280 teams from 16 countries competing in 26 sports, including football, gymnastics, and even kickboxing. Unitree topped the medal table with 11 in total, four of them gold, solidifying its leadership in humanoid performance.

The fastest speed logged during competition was 4.78 metres per second, but Unitree said recent internal tests had already exceeded 5 metres per second.

Independent teams using its G1 platform also picked up one gold, one silver, and one bronze, underscoring the versatility of its hardware.

Chinese dominance on display

Unitree was not the only standout.

X-Humanoid, also known as the Beijing Humanoid Robot Innovation Centre, secured 10 medals, including two golds. Its machines triumphed in the 100-metre sprint and in a materials handling contest designed to simulate factory work.

X-Humanoid's chief technology officer Tang Jian told the *South China Morning Post* that the Unitree H1's performance came from its mechanical design.

The robot is powered by the company's self-developed M107 joint motor, which delivers torque of 360 newton metres. This allows longer strides and a stronger kick for racing. Tang also highlighted X-Humanoid's own Tien Kung robot. The model won a half-marathon in April against human runners and is being developed into an all-around competitor. "Tien Kung robots were built not only to run fast, but to operate steadily and reliably, which made them suitable for real-world applications," Tang said. He added that Tien Kung is the only robot that currently runs entirely on its own, without remote control.

On the sidelines of the Beijing event, Unitree founder and CEO Wang Xingxing told local media he expected future models to run autonomously. Most competitors today still rely on remote human input.

Growing market and future games

Analysts noted the scale of China's progress. IDC analyst Li Junlan told SCMP, "China has grown from a follower to a leader in this area." The firm credited advances in AI software and sensors that improved robotic vision and hearing.

IDC projected the global robotics market to hit US$400 billion by 2029, with China accounting for almost half. State-backed demand and manufacturers entering mass production have accelerated growth in humanoids.

China's dominance at the games extended beyond Unitree and X-Humanoid. Neotix Robotics and Booster Robotics, both founded by Tsinghua University alumni, claimed golds in gymnastics, football, and the long jump.

Not every contest ran smoothly. Kickboxing robots flailed wildly before falling over, and some sprinters crashed into rivals. "Everything from the events' rules to on-site judging were established from scratch," referee Zhang Jidong of Tsinghua University said. He called the games "an explorative process for humans and robots."

Organisers plan to hold the next event in Beijing in August 2026. They will also form a World Humanoid Robotics Games Federation to foster collaboration in this new sporting frontier.

WIRobotics Unveils 'ALLEX,' a General-Purpose Humanoid w/ Human-Like Responsiveness

CHEONAN, South Korea, Aug. 18, 2025

Implements human-like whole-body force sensing and compliance across arms, fingers, and waist; introduces a new high-DOF compliant hand, a low-friction backdrivable arm, and a gravity-compensated upper body

CHEONAN, South Korea, Aug. 18, 2025 /PRNewswire/ --Global robotics leader WIRobotics (Co-CEOs Yong-Jae Kim, Professor at KOREATECH, and Younbaek Lee) today unveiled the upper body of its first general-purpose humanoid robot, ALLEX, at the Robot

Innovation Hub (RIH) located on the First Campus of the Korea University of Technology and Education (KOREATECH).

ALLEX stands for "ALL-EXperience." Beyond visual recognition and position control, it responds to physical stimuli such as force, contact, and impact in the real world. By delivering humanlike interaction capabilities, ALLEX sets a new standard for humanoid robots, surpassing the limitations of current robotics.

Developed with WIRobotics' proprietary mechanisms and control technologies, the newly unveiled ALLEX comprises a new high-degree-of-freedom (DOF) robotic hand that senses reaction forces like a human and yields compliantly to external loads; a highly backdrivable robot arm with more than 10 times lower friction and rotational inertia than conventional collaborative robot arms; and a upper body with a gravity compensation mechanism. With precise force control and flexible motion, ALLEX significantly expands applicability in fields that require direct interaction with people, including services, manufacturing, and household tasks.

Technical Highlights

High–DOF compliant robotic hand. A human-hand-sized end-effector with 15 DOF enables precise motions and diverse tasks. With inherent human-like compliance, it detects and responds to forces as small as 100 gf even without tactile sensors; fingertip repeatability is 0.3 mm or less. It delivers 40 N fingertip force and over 30 kg hook grip—world-class grasping performance among high-DOF, human-sized robotic hands.

New actuation and control technologies. A newly developed ultra-low-friction, high-load actuator achieves human-level adaptability and force-control performance. A motor-control algorithm integrating precise position control with force and stiffness control is applied to the actuator. Together with a gravity-compensated waist, the whole-body design enables safe interaction, high-load operation, and precision control.

Lightweight structure with high payload capacity. The hand is approximately 700 g, and the assembly from the shoulder down is about 5 kg, enabling agile, safe, and human-like motion. Across the full workspace, more than 3 kg can be handled with one hand, corresponding to the work capability of mid-size collaborative robots weighing over 20 kg.

Whole-body force control and interaction. As the first inherently compliant humanoid capable of force-based responses across the arms, fingers, and waist without force sensors, ALLEX enables safe yet dynamic interactions with people. By minimizing the sim-to-real gap, it is optimized for machine-learning-based training and also ensures autonomy and scalability.

WIRobotics places the establishment of technical leadership in the field of general-purpose humanoid platforms as a top priority based on ALLEX. Going forward, the company will expand ALLEX into a modular platform—supplying arms, hands, body, and leader systems individually or in combination—and build a foundation for commercialization through field demonstrations in various industries.

To promote the convergence of robotics and AI, the company is building an open innovation ecosystem. WIRobotics has formed a strategic partnership with RLWRLD, a physical AI startup, to develop ALLEX's intelligence, and is collaborating with leading domestic and overseas research institutions and companies, including MIT, UIUC, UMass, KIST, and Maxon. The company plans to expand the distribution of research platforms and broaden global commercialization partnerships in stages.

"ALLEX goes beyond merely replicating human movement —it is the first robot that truly experiences and responds to the real world," said Yong-Jae Kim, Co-CEO and CTO of WIRobotics. "From day one, we've developed technology for people. Building on the wearable robotics we introduced two years ago, our goal is to deliver by 2030 a general-purpose humanoid platform that anyone can use in everyday life. We will open a new era of general-purpose robotics where precision and flexibility coexist,"

About WIRobotics

Founded in June 2021 by four former engineers from Samsung's Robotics Development Team, WIRobotics is a startup specializing in wearable and humanoid robots. Guided by the vision "Technology for People, Enhancing Quality of Life," the company aims to realize the everyday adoption of robots beyond laboratories and industrial sites. WIRobotics developed the WIBS industrial back-support robot and the WIM daily mobility-assist robot, winning CES Innovation Awards in Robotics for two consecutive years (2024 and 2025). The company established Korea's first Wearable Robot Gait Training Center and operates walking-health programs for the public. In March 2024, it raised KRW 13 billion in Series A funding to accelerate the popularization of wearable robots. Continuing R&D on safe, flexible robotic arms and hands and on bipedal locomotion, WIRobotics opened the Robot Innovation Hub in June 2024 to collaborate with research institutions in Korea and abroad.

View original content to download multimedia:https://www.prnewswire.com/news-releases/wirobotics-unveils-allex-a-general-purpose-humanoid-with-human-like-responsiveness-302532078.html

Real-life Transformers! Incredible four-wheeled robot can drive at speeds of up to 14mph or stand up on two legs

- **The agile automaton was developed by Swiss Mile, a spin-off from ETH Zürich**
- **It is the latest iteration of the 'ANYMal' concept, which can get up after falling**
- **The robot's car-meets-quadruped design allows it to handle stairs with ease**
- **Its developers say the bot could find application in 'last-mile' delivery solution**

Swiss experts have developed a four-wheeled robot that can rear up on its hind legs and spin like a performing poodle. Developed by ETH Zürich spin-off **Swiss-Mile**, the agile bot that can reach speeds of up to 14 mph (23 kph) is the latest iteration of the 'ANYMal' robot concept. The design — which superficially resembles Boston Dynamics' robot dog, Spot — has previously been shown **using its AI to get back up** after being kicked over.

In a newly-released **video**, the robot is shown not only performing its standing trick, but also wheeling along and taking ascending and descending steps in its stride.

Forget about Optimus Prime and Megatron! Swiss experts have developed a four-wheeled robot that can rear up on its hind legs and spin like a performing poodle (as pictured)

Developed by ETH Zürich spin-off Swiss-Mile, the automaton (pictured here on the road) that can reach speeds of up to 14 mph (23 kph) is the latest iteration of the 'ANYMal' concept. 'It's a car, quadruped, and humanoid!' explained roboticist and ANYmal developer Marko Bjelonic of ETH Zürich. Pictured: ANYMal feels like the spiritual successor to Optimus Prime (pictured) and his fellow Transformers from the popular cartoon/film/toy franchise, many of which could also switch from being vehicles to humanoid figures and back again

ANYmal STATISTICS

Developers: ETH Zürich / Swiss-Mile , **Speed:** 14 mph (23 kph) , **Dimensions:** 24' on 4 legs, 71' on 2 legs

Weight: 110 lbs , **Max. payload:** 110 lbs

'It's a car, quadruped, and humanoid!' explained roboticist and ANYmal developer Marko Bjelonic of ETH Zürich. 'Our wheeled-legged robot performs exceptional locomotion skills with reinforcement learning driving at speeds of up to 6.2 m/s (22.32 km/h or 13.87 miles/h), overcoming obstacles and standing up on two legs.'

According to Swiss-Mile, their ANYMal robot is expected to find application in so-called 'last mile' delivery challenges. This is the movement of goods from a large-scale transport hub to a recipient at a specific destination. 'With both legs and wheels, our robot outperforms state-of-the-art wheeled delivery platforms as well as lightweight delivery drones,' Dr Bjelonic added. The team claims that ANYMal is up to 83 per cent more efficient than comparable legged robots. The robot, Swiss-Mile continued, can carry a maximum payload of 110 lbs (50 kg). 'It is the only solution capable of carrying tools, materials, goods, and sensors over long distances with energy efficiency and speed while overcoming challenging obstacles like steps and stairs.' ANYmal's design, he added, also enables 'seamless navigation in indoor and outdoor urban environments.'

'It is the only solution capable of carrying tools, materials, goods, and sensors over long distances with energy efficiency and speed while overcoming challenging obstacles like steps and stairs.'

'The urban population [ratio] is 74 per cent in Switzerland and 56 per cent worldwide,' Swiss-Mile explained on their website. 'This share will increase even more in the future, requiring smart solutions to make life in cities more liveable. 'With this growth, more goods are being moved from place to place than ever before,' they continued — leading, they noted, to an increase in carbon dioxide emissions and traffic congestion unless better solutions can be developed. 'This last-mile delivery challenge requires electric, small-scale autonomous solutions,' just like ANYMal, they concluded.

Using both wheels and legs helps robots adapt to different situations and terrain.

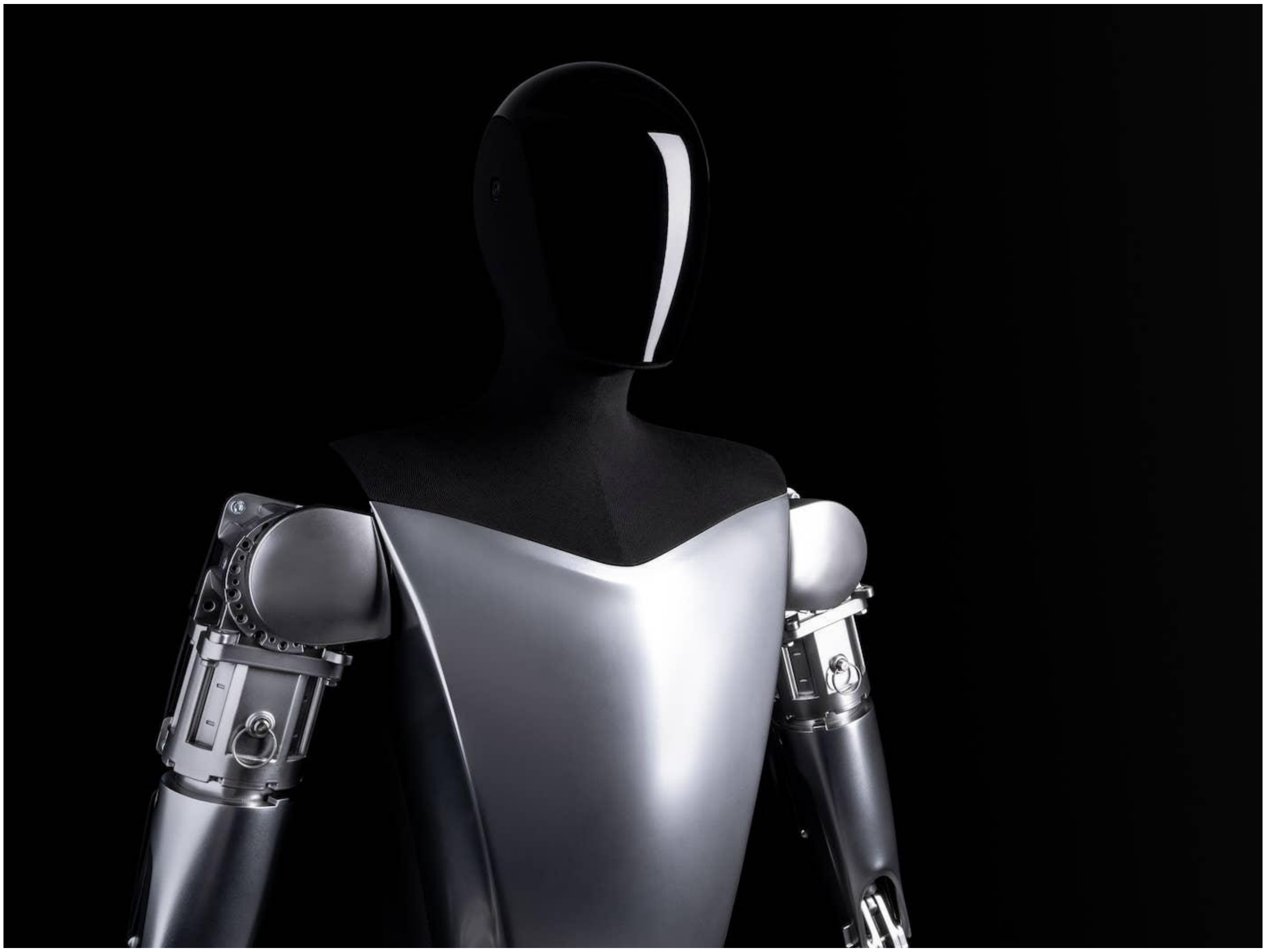
Description:
Swiss-Mile, a spin-off of ETH Zurich's Robotic Systems Lab, is commercializing robots that have both legs and wheels to perform a variety of tasks, including mapping, inspection, disaster relief, and logistics in urban environments. The robot is based on ETH's ANYmal quadruped and can travel at speeds up to 13.87 MPH (22.32 kilometers per hour) with a payload capacity up to 110 lb (50 kg).

The hybrid robot uses a combination of GPS, LiDAR, and cameras to autonomously navigate city streets and avoid obstacles. According to Swiss-Mile, the robots have a two-hour runtime per battery charge.

Analysis:
Swiss-Mile is extending the capabilities of mobile robots by deploying a hybrid mobility platform that can overcome challenging obstacles like stairs and enable seamless navigation in indoor and outdoor environments. Being able to use both wheels and legs helps robots efficiently adapt to different situations, trading the ability to traverse rough terrain for speed, and likely outperforming wheeled mobile delivery robots or quadrupeds.

Today's Humanoid Robots Look Remarkable—but There's a Design Flaw Holding Them Back

Beyond brains, robots desperately need smarter bodies.



Watch Boston Dynamics' Atlas robot doing training routines, or the latest humanoids from Figure loading a washing machine, and it's easy to believe the robot revolution is here. From the outside, it seems the only remaining challenge is perfecting the AI (artificial intelligence) software to enable these machines to handle real-life environments.

But the industry's biggest players know there is a deeper problem. In a recent call for research partnerships, Sony's robotics division highlighted a core issue holding back its own machines.

It noted that today's humanoid and animal-mimicking robots have a "limited number of joints," which creates a "disparity between their movements and those of the subjects they imitate, significantly diminishing their … value." Sony is calling for new "flexible structural mechanisms"—in essence, smarter physical bodies—to create the dynamic motion that is currently missing.
The core issue is that humanoid robots tend to be designed around software that controls everything centrally. This "brain-first" approach results in physically unnatural machines. An athlete moves with grace and efficiency because their body is a symphony of compliant joints, flexible spines, and spring-like tendons. A humanoid robot, by contrast, is a rigid assembly of metal and motors, connected by joints with limited degrees of freedom.
To fight their bodies' weight and inertia, robots have to make millions of tiny, power-hungry corrections every second just to avoid toppling over. As a result, even the most advanced humanoids can only work for a few hours before their batteries are exhausted.
To put this in perspective, Tesla's Optimus robot consumes around 500 watts of power per second for a simple walk. A human accomplishes a more demanding brisk walk using only around 310 watts per second. The robot is therefore burning nearly 45 percent more energy to accomplish a simpler task, which is a considerable inefficiency.

Diminishing Returns

So, does this mean the entire industry is on the wrong path? When it comes to their core approach, yes. Unnatural bodies demand a supercomputer brain and an army of powerful actuators, which in turn make robots heavier and thirstier for energy, deepening the very problem they aim to solve. The progress in AI might be breathtaking, but it leads to diminishing returns.
Tesla's Optimus, for instance, is smart enough to fold a t-shirt. Yet the demonstration actually reveals its physical weakness. A human can fold a t-shirt without really looking, using their sense of touch to feel the fabric and guide their movements.
Optimus, with its relatively rigid, sensor-poor hands, relies on its powerful vision and AI brain to meticulously plan every tiny motion. It would likely be defeated by a crumpled shirt on a messy bed because its body lacks the physical intelligence to adapt to the unpredictable state of the real world.
Boston Dynamics' new, all-electric Atlas is even more impressive, with a range of motion that seems almost alien. But what the viral acrobatics videos don't show is what it can't do. It could not walk confidently across a mossy rock, for instance, because its feet cannot feel the surface to conform to it. It could not push its way through a dense thicket of branches, because its body cannot yield and then spring back.
This is why, despite years of development, these robots mostly remain research platforms, not commercial products.
Why aren't the industry's leaders already pursuing this different philosophy? One likely reason is that today's top robotics firms are fundamentally software and AI companies, whose expertise lies in solving problems with computation. Their global supply chain is optimized to support this with high-precision motors, sensors, and processors.
Building physically intelligent robot bodies requires a different manufacturing ecosystem, rooted in advanced materials and biomechanics, which is not yet mature enough to operate at scale.
When a robot's hardware already looks so impressive, it's tempting to believe the next software

update will solve any remaining issues, rather than undertaking the costly and difficult task of redesigning the body and the supply chain required to build it.

Autonomous Bodies

This challenge is the focus of mechanical intelligence (MI), which is being researched by numerous teams of academics around the world, including mine at London South Bank University. It derives from the observation that nature perfected intelligent bodies millions of years ago. These were based on a principle known as morphological computation, meaning bodies can perform complex calculations automatically.

A pine cone's scales open in dry conditions to release seeds, then close when it's damp to protect them. This is a purely mechanical response to humidity with no brain or motor involved.

The tendons in the leg of a running hare act like intelligent springs. They passively absorb shock when the foot hits the ground, only to release the energy to make its gait stable and efficient, without requiring so much effort from the muscles.

Think about the human hand. Its soft flesh has the passive intelligence to automatically conform to any object it holds. Our fingertips act like a smart lubricator, adjusting moisture to achieve the perfect level of friction for any given surface.

If these two features were incorporated into an Optimus hand, it would be able to hold objects with a fraction of the force and energy currently required. The skin itself would become the computer.

MI is all about designing a machine's physical structure to achieve passive automatic adaptation—the ability to respond to the environment without needing active sensors or processors or extra energy.

The solution to the humanoid trap is not to abandon today's ambitious forms, but to build them according to this different philosophy. When a robot's body is physically intelligent, its AI brain can focus on what it does best: high-level strategy, learning and interacting with the world in a more meaningful way.

Researchers are already proving the value of this approach. For instance, robots designed with spring-like legs that mimic the energy-storing tendons of a cheetah can run with remarkable efficiency.

My own research group is developing hybrid hinges, among other things. These combine the pinpoint precision and strength of a rigid joint with the adaptive, shock-absorbing properties of a compliant one. For a humanoid robot, this could mean creating a shoulder or knee that moves more like a human's, unlocking multiple degrees of freedom to achieve complex, life-like motion.

The future of robotics lies not in a battle between hardware and software, but in their synthesis. By embracing MI, we can create a new generation of machines that can finally step confidently out of the lab and into our world.