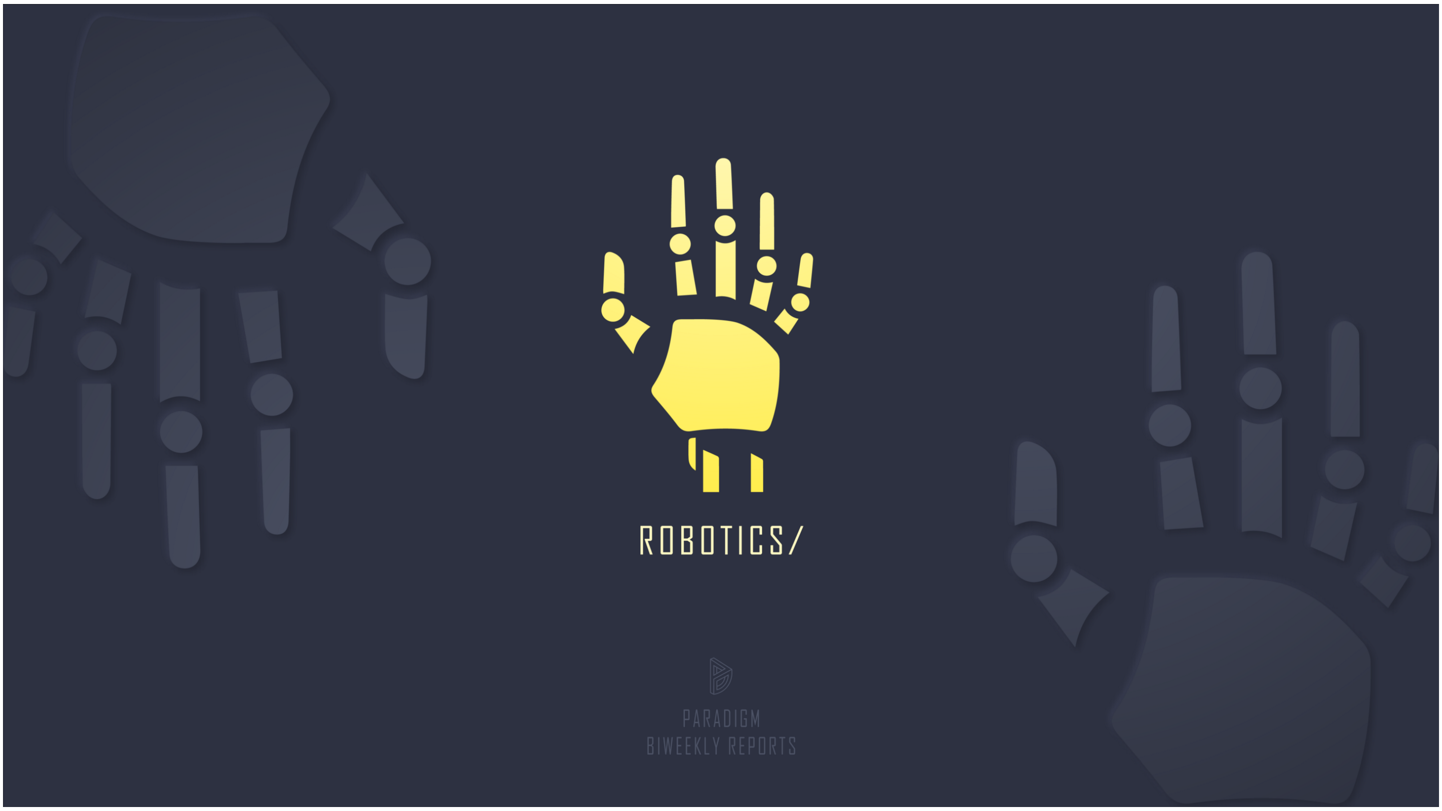
RT/ AI system for high precision recognition of hand gestures

Paradigm
Aug 21 · 26 min read

Robotics biweekly vol.11, 6th August — 20th August



TL;DR

- *Scientists have developed an Artificial Intelligence (AI) system that recognises hand gestures by combining skin-like electronics with computer vision.*
- *Researchers used artificial intelligence and genetic analyses to examine the structure of the inner surface of the heart using 25,000 MRI scans. They found that the complex network of muscle fibers lining the inside of the heart, called trabeculae, allows blood to flow more efficiently and can influence the risk of heart failure. The study answers*

very old questions in basic human physiology and leads to new directions for understanding heart diseases.

- *Scientists have developed a 1cm by 1cm wireless artificial aquatic polyp, which can remove contaminants from water. Apart from cleaning, this soft robot could be also used in medical diagnostic devices by aiding in picking up and transporting specific cells for analysis.*
- *Although true 'cyborgs' are science fiction, researchers are moving toward integrating electronics with the body. Such devices could monitor tumors or replace damaged tissues. But connecting electronics directly to human tissues in the body is a huge challenge. Today, a team is reporting new coatings for components that could help them more easily fit into this environment.*
- *People rarely use just one sense to understand the world, but robots usually only rely on vision and, increasingly, touch. Researchers find that robot perception could improve markedly by adding another sense: hearing.*
- *Researchers have designed an algorithm that allows an autonomous ground vehicle to improve its existing navigation systems by watching a human drive.*
- *Graphene buckles when cooled while attached to a flat surface, resulting in pucker patterns that could benefit the search for novel quantum materials and superconductors, according to new research.*
- *Engineers have developed a flexible, portable measurement system to support design and repeatable laboratory testing of fifth-generation (5G) wireless communications devices with unprecedented accuracy across a wide range of signal frequencies and scenarios.*
- *NASA JPL are developing autonomous capabilities that could allow future Mars rovers to go farther, faster and do more science. Training machine learning models on the Maverick2, their team developed and optimized models for Drive-By Science and Energy-Optimal Autonomous Navigation.*
- *The Multi-robot Systems Group at FEE-CTU in Prague is working on an autonomous drone that detects fires and the shoots an extinguisher capsule at them.*
- *The experiment with HEAP (Hydraulic Excavator for Autonomous Purposes) demonstrates the latest research in on-site and mobile digital fabrication with found materials. The embankment prototype in natural granular material was achieved*

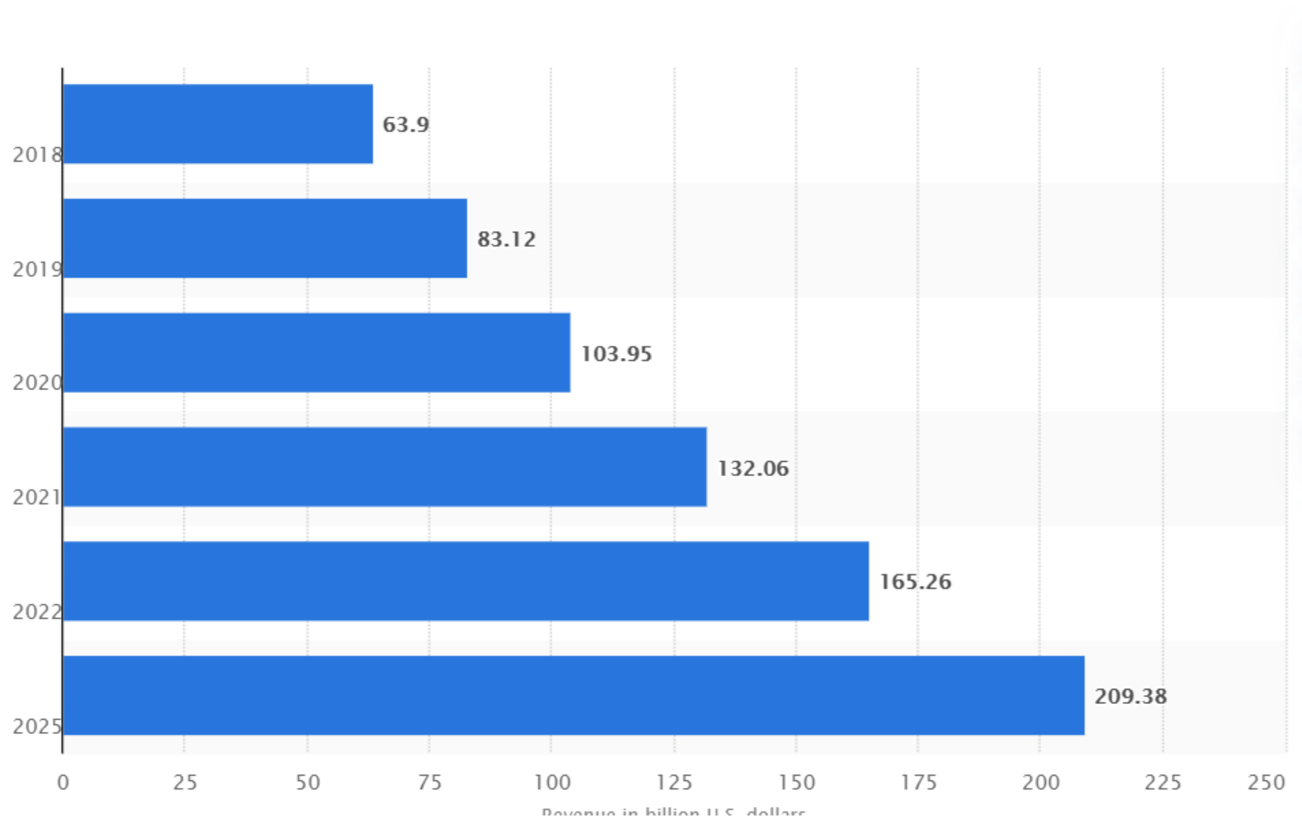
using state of the art design and construction processes in mapping, modelling, planning and control. The entire process of building the embankment was fully autonomous. An operator was only present in the cabin for safety purposes.

- *The Simulation, Systems Optimization and Robotics Group (SIM) of Technische Universität Darmstadt's Department of Computer Science conducts research on cooperating autonomous mobile robots, biologically inspired robots and numerical optimization and control methods.*
- *Check out robotics upcoming events (mostly virtual) below. And more!*

Robotics market

The global market for robots is expected to grow at a compound annual growth rate (CAGR) of around 26 percent to reach just under **210 billion U.S. dollars by 2025**. It is predicted that this market will hit the **100 billion U.S. dollar mark in 2020**.

Size of the global market for industrial and non-industrial robots between 2018 and 2025(in billion U.S. dollars):



Size of the global market for industrial and non-industrial robots between 2018 and 2025(in billion U.S. dollars). Source: Statista

Latest Researches

Gesture recognition using a bioinspired learning architecture that integrates visual data with somatosensory data from stretchable sensors

by Ming Wang, Zheng Yan, Ting Wang, Pingqiang Cai, Siyu Gao, Yi Zeng, Changjin Wan, Hong Wang, Liang Pan, Jiancan Yu, Shaowu Pan, Ke He, Jie Lu, Xiaodong Chen in Nature Electronics

> ***Scientists have developed an Artificial Intelligence (AI) system that recognises hand gestures by combining skin-like electronics with computer vision.***

The recognition of human hand gestures by AI systems has been a valuable development over the last decade and has been adopted in high-precision surgical robots, health monitoring equipment and in gaming systems.

AI gesture recognition systems that were initially visual-only have been improved upon by integrating inputs from wearable sensors, an approach known as ‘data fusion’. The wearable sensors recreate the skin’s sensing ability, one of which is known as ‘somatosensory’.

However, gesture recognition precision is still hampered by the low quality of data arriving from wearable sensors, typically due to their bulkiness and poor contact with the user, and the effects of visually blocked objects and poor lighting. Further challenges arise from the integration of visual and sensory data as they represent mismatched datasets that must be processed separately and then merged at the end, which is inefficient and leads to slower response times.

To tackle these challenges, the NTU team created a ‘bioinspired’ data fusion system that uses skin-like stretchable strain sensors made from single-walled carbon nanotubes, and an AI approach that resembles the way that the skin senses and vision are handled together in the brain.

The NTU scientists developed their bio-inspired AI system by combining three neural network approaches in one system: they used a ‘convolutional neural network’, which is a machine learning method for early visual processing, a multilayer neural network for early somatosensory information processing, and a ‘sparse neural network’ to ‘fuse’ the visual and somatosensory information together.

The result is a system that can recognise human gestures more accurately and efficiently than existing methods.

Lead author of the study, Professor Chen Xiaodong, from the School of Materials Science and Engineering at NTU, said, *"Our data fusion architecture has its own unique bioinspired features which include a human-made system resembling the somatosensory-visual fusion hierarchy in the brain. We believe such features make our architecture unique to existing approaches."*

"Compared to rigid wearable sensors that do not form an intimate enough contact with the user for accurate data collection, our innovation uses stretchable strain sensors that comfortably attaches onto the human skin. This allows for high-quality signal acquisition, which is vital to high-precision recognition tasks," added Prof Chen, who is also Director of the Innovative Centre for Flexible Devices (iFLEX) at NTU.

The team comprising scientists from NTU Singapore and the University of Technology Sydney (UTS) published their findings in the scientific journal Nature Electronics in June.

High recognition accuracy even in poor environmental conditions

To capture reliable sensory data from hand gestures, the research team fabricated a transparent, stretchable strain sensor that adheres to the skin but cannot be seen in camera images.

As a proof of concept, the team tested their bio-inspired AI system using a robot controlled through hand gestures and guided it through a maze.

Results showed that hand gesture recognition powered by the bio-inspired AI system was able to guide the robot through the maze with zero errors, compared to six recognition errors made by a visual-based recognition system.

High accuracy was also maintained when the new AI system was tested under poor conditions including noise and unfavourable lighting. The AI system worked effectively in the dark, achieving a recognition accuracy of over 96.7 per cent.

> *First author of the study, Dr Wang Ming from the School of Materials Science & Engineering at NTU Singapore, said, "The secret behind the high accuracy in our architecture lies in the fact that the visual and somatosensory information can interact*

> *and complement each other at an early stage before carrying out complex interpretation. As a result, the system can rationally collect coherent information with less redundant data and less perceptual ambiguity, resulting in better accuracy.”*

Providing an independent view, Professor Markus Antonietti, Director of Max Planck Institute of Colloids and Interfaces in Germany said, *“The findings from this paper bring us another step forward to a smarter and more machine-supported world. Much like the invention of the smartphone which has revolutionised society, this work gives us hope that we could one day physically control all of our surrounding world with great reliability and precision through a gesture.”*

“There are simply endless applications for such technology in the marketplace to support this future. For example, from a remote robot control over smart workplaces to exoskeletons for the elderly.”