

# AI HELPS COMPUTERS TO SEE AND HEAR MORE EFFICIENTLY

**ARTIFICIAL INTELLIGENCE IN HONG KONG** is being used for everything from identifying neurological disorders, to inspecting manufactured parts for defects.

**When it comes to facial recognition, human eyes are incredibly accurate,** but in 2013, an algorithm reached an accuracy of more than 97%, beating human ability for the first time. The code was devised by researchers at The Chinese University of Hong Kong's (CUHK) Multimedia Lab (MMLab).

In 2021, in collaboration with the Shanghai Artificial Intelligence Laboratory on the Chinese mainland, MMLab became part of the new Interdisciplinary Artificial Intelligence Research Institute (IAIRI) at CUHK.

Dahua Lin is director of IAIRI and leads the MMLab in working on computer vision technology, artificial intelligence that identifies features in images and videos. Computer vision, he explains, is now used to guide anything from driverless vehicles, to

X-ray analysis, and automatic sorting of rubbish and recycling.

One key use for computer vision, for instance, is to help doctors speed up the identification of anomalies in medical scans, says Lin. "Humans can only process one or two images per minute, whereas a computer can handle thousands or even millions," he explains. "AI can help pick out the scans that show a problem, so the doctor can focus their valuable time on those patients."

This technology could also be used to detect faulty products on factory assembly lines, rather than people having to inspect items individually.

## DIGITAL VISIONARY

The MMLab has been working to expand computer vision's capacity, Lin says. Early technology could only analyse up to 10 seconds of video footage at a time, but in 2018 Lin's team

created analytics software with the capacity for analysing 10 minutes of video in one go — identifying people, objects and even what the video is about.

**"CREATING AI TECHNOLOGIES THAT CAN LISTEN, UNDERSTAND AND CONVERSE HAS BECOME A VERY HOT TOPIC."**

But a major challenge for computer vision, says Lin, is that different environments require different AI models. The MMLab is among many groups working on a computer vision 'super model' that can be applied to hundreds of different applications.

Engineering and data analytics specialist, Helen Meng, at CUHK, is developing

AI technologies that can analyse human speech to detect neurocognitive disorders, as well as assess pronunciation proficiency.

Meng says: "Creating AI technologies that can listen, understand, and converse has become a very hot topic." She says the challenge is to teach AI to detect emotions and hidden meanings in speech.

In 2013, Meng helped establish the CUHK Stanley Ho Big Data Decision Analytics Research Center and she still serves as its founding director. Her team has now built a mobile app that uses speech recognition to screen for cognitive disorders such as dementia, providing a non-invasive and affordable alternative to brain scans and blood tests.

"There is a perceptible difference between the speech of a healthy person and someone with mild cognitive impairment,"



▲ Dahua Lin (left) studies computer vision, while Liu Shu (right) is the co-founder of SmartMore which provides machine-vision tech to manufacturers.



she explains. "Consistent pauses, hesitations, and word choice can be markers of early cognitive decline."

Meng also works on speech reconstruction technology for disordered speech. After a stroke, people can lose some ability to move the muscles associated with articulation, she explains. "If we can help transform this 'dysarthric' speech into more normal sounding speech, we can help patients with neuro-motor diseases communicate," she says.

Meng's lab is also developing an AI to help Chinese students improve their pronunciation in English. "Accent is generally a good thing as it adds texture to the language," she says. "But there are times when deviations in pronunciation can lead to miscommunication."

Her team has used thousands of recordings collected from Chinese people learning English to train AI technologies to detect mispronunciations and provide corrective feedback.

## MEDICAL MOVEMENT

Because AI's use in medicine must undergo rigorous safety testing, in 2020 CUHK opened the Multi-Scale Medical Robotics Center, a pre-clinical research base to support surgical robot development.

"There is a limit to what a surgeon can achieve with their hands," explains Philip Chiu, a surgeon and co-director of the centre. "Robots can enhance our skills by providing better precision in the confined spaces of the human body, which will improve the outcomes of surgery," he says.

The centre includes a simulated operating room, a magnetic resonance imaging (MRI) machine and 3D imaging, which provides real-time observations during trials. "Teams can come to test their surgical robots and get instant feedback on performance," says Chiu.

The lab uses data from surgeries collected from nearby teaching hospitals to help create realistic simulation environments.

Another co-director of the centre, engineer Samuel Au, understands the challenges of developing robots. "Each part of the body requires different tools and levels of flexibility," he says. "Surgical robots are already performing more than a million procedures per year, but they are mostly simpler, soft-tissue operations in less confined spaces. We aim to expand upon this."

The lab provides an accessible space for start-ups in the region

to develop robots for more complex procedures, making it easier to get them to market. However, Chiu says they are far from sending surgeons into early retirement.

"Surgical robots are just an extension of our eyes and hands," he says. "There may be some automation in the future if we can get enough data to build AI in robotic surgery, and perhaps one day robotic surgery can be performed on a patient at one site through remote tele-assistance and mentoring by another surgeon."

## STREAMLINING SERVICE

In 2019, another researcher at CUHK, Liu Shu, with some of his colleagues, developed a self-learning, intelligent manufacturing inspection system that is helping factories streamline processes and reduce their reliance on manual labour.

Now, using cutting-edge computer vision and deep learning, Liu and his team at a CUHK spin-off called SmartMore are creating intelligent inspection platforms that can streamline the complete manufacturing cycle.

One of their intelligent inspection platforms monitors the production of semiconductor chips. "There are a lot of processes involved that can

affect the quality of the chip," explains Liu. "Our intelligent inspection platforms can assess what combination of processes results in the fewest defects, making adjustments until we have the highest yield of impeccable products."

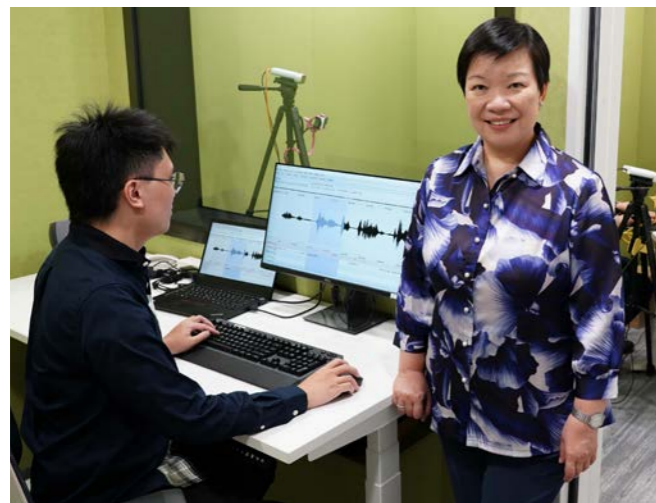
"We are working towards an intelligent all-in-one device that is a bit like the human body, for defect inspection," adds Liu. "It can grab a product, photograph it from all angles, analyse the images and then make a decision on what should be done and act on it."

These kinds of advances will soon become standard, Lin says. But that will mean that the world will need a lot more talent to service industries using AI, and so the university is very keen to promote a focus on AI in early education.

"By introducing AI education at a young age, we will help prepare a pool of talented and informed minds for the future," he explains. Lin's lab has already published a textbook on AI for middle school students. ■



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▲ Helen Meng (left) is developing AIs that analyse speech. Samuel Au (right, at left) and Philip Chiu at CUHK's Multi-Scale Medical Robotics Center.

