JOINT NEWS RELEASE

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New artificial intelligence tool invented by NTU, NP and NHCS scientists could speed up diagnosis of cardiovascular diseases

A team of researchers from **Nanyang Technological University, Singapore (NTU Singapore), Ngee Ann Polytechnic, Singapore (NP),** and the **National Heart Centre Singapore (NHCS)** have invented a tool that could speed up the diagnosis of cardiovascular diseases.

Powered by artificial intelligence (AI), their innovation uses electrocardiograms (ECGs) to diagnose coronary artery disease, myocardial infarction and congestive heart failure to an accuracy of more than 98.5 per cent.

The joint development of the diagnostic tool is timely, as the number of deaths caused by cardiovascular disease in Singapore has increased over the past three years. According to the Singapore Heart Foundation, 29.3 per cent of all deaths in Singapore in 2019, or almost 1 out of 3 deaths in Singapore, was due to heart diseases or stroke.

The scientists hope that their innovation could support the diagnosis of cardiovascular diseases in clinical settings, specifically while physicians carry out preliminary ECGs, ultimately leading to speedier courses of treatment.

The researchers devised the diagnostic tool by using an AI machine learning algorithm called Gabor-Convolutional Neural Network (Gabor-CNN), which mimics the structure and function of the human brain, enabling computers to learn from past experiences like a human. Using the algorithm, they trained their tool to recognise patterns in patients' ECGs by inputting examples of ECG signals that reflect cardiovascular diseases.

Clinical Associate Professor Tan Ru San, Senior Consultant at the Department of Cardiology, NHCS, who co-authored the study, said: "Our study on a preliminary small group of subjects has demonstrated promising results in terms of the accuracy of using routine ECGs to classify some common cardiovascular conditions. Although confirming the specific disease still requires additional testing, our diagnostic tool will

allow physicians to triage patients more efficiently and to streamline the number and type of downstream confirmatory tests."

Associate Professor Eddie Ng Yin Kwee from NTU's School of Mechanical and Aerospace Engineering, who co-led the study, said: "Scientists and physicians have been exploring AI techniques to aid in disease diagnosis. Our diagnostic tool is the first to use GaborCNN to allow for ECG signals to be directly entered into the system for analysis, and could lead to advancements in the pursuit of merging AI with medical solutions. Our proposed system is equipped to be validated with bigger database and has the potential to aid the clinicians to screen for cardiovascular diseases using ECGs."

Dr U Rajendra Acharya, Senior Faculty Member from Ngee Ann Polytechnic's School of Engineering said: "Our AI diagnostic tool, which was developed using a small public database, can detect coronary artery disease, myocardial infarction and congestive heart failure using ECG signals accurately. It has the potential to aid clinicians in the screening of cardiovascular diseases quickly, speed up the delivery of treatment and reduce costs for patients."

The study was published in the peer-reviewed scientific journal *Computers in Biology and Medicine* in May.

Using AI to aid in detecting heart disease

To test their diagnostic tool, the researchers obtained ECG signals from both healthy individuals and patients with prevalent cardiovascular diseases.

In a pilot study, the researchers used the tool to analyse ECG signals from 92 healthy individuals, as well as seven patients with coronary artery disease, 148 patients with myocardial infarction and 15 patients with congestive heart failure.

Clin Assoc Prof Tan added: "Our AI-enhanced tool could automatically identify ECG signals associated with healthy people and patients with the different cardiovascular diseases with an accuracy of more than 98.5 per cent. Heart disease is a leading cause of death worldwide, and affects not only the heart but other major parts of the body. Early detection prevents complications such as heart failure, stroke, kidney disease and artery disease."

Elaborating on the role of AI in disease detection, Assoc Prof Ng added: "AI techniques have the potential to radically improve healthcare solutions, especially in data analysis, offering clinicians novel tools to interpret data and make clinical decisions. AI techniques such as machine learning and deep learning can also improve medical knowledge due to the increase of the volume and complexity of the data, unlocking clinically relevant information."

The team hopes to collaborate with local healthcare institutions to conduct further studies to validate the use of their new diagnostic AI tool with larger datasets. They also hope it can be used to complement current techniques of diagnosing cardiovascular diseases such as magnetic resonance imaging (MRI) and coronary angiography.

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Note to Editors:

Paper titled *'Automated detection of coronary artery disease, myocardial infarction and congestive heart failure using GaborCNN model with ECG signals'* published in *Computers in Biology and Medicine*, 7 May, 2021, 104457.
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Media contact

Mr Joseph Gan
Manager, Media Relations
Corporate Communications Office
Nanyang Technological University, Singapore
Email: joseph.gan@ntu.edu.sg

Ms Lau Qian Yu
Executive, Corporate Communications
Corporate Development Department
National Heart Centre Singapore
Email: lau.qian.yu@nhcs.com.sg

Ms Sarah Lim
Manager, Corporate Communications Office
Ngee Ann Polytechnic
Email: sarah_lim@np.edu.sg

About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Humanities, Arts, & Social Sciences, and Graduate colleges. It also has a medical school, the Lee Kong Chian School of Medicine, established jointly with Imperial College London.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI) and Energy Research Institute @ NTU (ERI@N).

Ranked amongst the world's top universities by QS, NTU has also been named the world's top young university for the last seven years. The University's main campus is frequently listed among the Top 15 most beautiful university campuses in the world and it has 57 Green Mark-certified (equivalent to LEED-certified) building projects, of which 95% are certified Green Mark Platinum. Apart from its main campus, NTU also has a campus in Singapore's healthcare district.

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

For more information, visit www.ntu.edu.sg

About the National Heart Centre Singapore

The National Heart Centre Singapore (NHCS) is a 185-bed national and regional referral centre for cardiovascular diseases. NHCS provides a one-stop comprehensive cardiac care ranging from preventive, diagnostic, therapeutic to rehabilitative services.

Established in 1998, NHCS is the pioneer in cardiovascular care in Singapore. It is also the only heart and lung transplantation centre in Singapore. Its clinical outcomes for heart attack treatment, balloon angioplasty with stenting and coronary bypass surgery have been shown to be equivalent to international benchmarks.

For more information, please visit www.nhcs.com.sg.

About Ngee Ann Polytechnic

Ngee Ann Polytechnic started in 1963 and is today one of Singapore's leading institutions of higher learning with 15,000 enrolled students in over 30 disciplines. It seeks to develop students with a passion for learning, values for life, and competencies to thrive in a global workplace.

http://www.np.edu.sg