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Wireless ultrasound and AI to auto-detect heart disease

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MoU signed for the development of wearable ultrasound device incorporating an AI assisted Automatic Heart Diagnosis System (AHDS) for screening various heart conditions in the early stages as well as treatment monitoring in the later stages



Heart disease may soon be detected remotely, thanks to a wearable ultrasound device incorporating an Artificial Intelligence (AI)-assisted Automatic Heart Diagnosis System (AHDS) to be developed by a team of researchers from Ngee Ann Polytechnic (NP), National Heart Centre Singapore (NHCS) and Kumamoto University (KU), Japan.

Through the novel combination of wireless ultrasound and AI technologies, the device may be applied for the screening of various heart conditions in the early stages as well as treatment monitoring in the later stages. NP's research team led by Dr Rajendra Archarya has extensive experience in signal and imaging processing techniques for diagnostic applications in cardiology. For instance, they have developed a machine learning system that has the potential to automatically diagnose coronary artery disease, myocardial infarction and congestive heart failure accurately on electrocardiogram. The collaboration will also leverage KU's expertise in the research and development of non-invasive remote ultrasound technology as well as clinical inputs from Associate Professor Tan Ru San, Senior Consultant, and his team from the Department of Cardiology at NHCS.

Current Practices of Heart Disease Detection

Typically, a series of tests and evaluations have to be performed by doctors to diagnose heart conditions. In cardiology, ultrasound is a ubiquitous and versatile technique that allows real-time imaging of the heart and blood vessels for assessment of cardiovascular health. The ultrasound probe is placed on the skin overlying the heart or blood vessel of interest during the test, and the signal obtained is transmitted via a wire that attaches the ultrasound probe to the scanner, which processes the signal to produce images. While the technique is portable, diagnostic information can only be garnered at the time of the scan, which typically lasts 30 to 60 minutes.

How the Wearable Ultrasound Device Works and its Benefits

The team will be developing a wearable ultrasound device prototype that applies wireless patches on the patient to continuously capture ultrasound signals of the patient's heart and blood vessels, for extended periods of time. These signals will be transmitted to an external reader. The output will then be processed by the AHDS to provide results to clinicians for timely assessment and treatment of their patients. This innovative device may be helpful during surgery when close monitoring of the patient's heart condition is critical.

The new computer-aided method of remote wearable image-based cardiovascular monitoring, coupled with AHDS for real-time analysis, will remove the need for routine manual interpretation, which may cut down costs significantly.

The team plans to deploy the prototype for clinical trials at a community hospital in Singapore.

"At Ngee Ann Polytechnic, we see much potential in tapping AI in different arenas and seek to work with industry partners to co-create innovative solutions that will deliver value to the community. At the same time, we hope that these use cases can be harnessed for our learning and educational purposes. We are thus happy to partner Kumamoto University and National Heart Centre Singapore. Our collaboration is an example of how forming strategic alliances can propel the advancement of digital solutions in healthcare, and strengthen the nexus between academia and industry," said Mr Clarence Ti, Principal of Ngee Ann Polytechnic.

"Cardiovascular disease is one of the leading causes of death worldwide. With an ageing population, there is an even greater need to find better ways to prevent and manage heart diseases. We are honoured to work with outstanding researchers to break new ground in cardiovascular care. We hope that this innovation will pave the way for improvements in how heart conditions will be detected and treated in Singapore, and on a global scale," said Dr Rajendra Archarya.

"The use of remote monitoring technology like the AHDS-enabled wearable ultrasound device, which enables instantaneous collection and sending of cardiovascular signals, can potentially complement existing cardiac diagnostic tests and may translate to better patient care," said Associate Professor Tan.

"We have developed flexible ultrasonic sensor technology for 20 years. It is a great pleasure that our sensors will commit to explore a new horizon of clinical ultrasound imaging in collaboration with Ngee Ann Polytechnic and National Heart Centre Singapore," said Associate Professor Makiko Kobayashi, from KU's Faculty of Advanced Science & Technology.