

Singapore engineers devise a single source to re-charge multiple wearable devices

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Researchers successfully demonstrated the use of the human body as a medium for transmitting and harvesting energy to power wearables



Caption: A team from the National University of Singapore led by Associate Professor Jerald Yoo (left) has developed a novel wireless powering solution for wearables. With him are two team members: Ms Li Jiamin (centre), who has a transmitter on her right wrist and a receiver connected to a smart watch on her left wrist, and Mr Dong Yilong (right) who is holding a panel displaying the technology

Advancements in wearable technology in the healthcare setting include devices such as wearable injectors, electrocardiogram (ECG) monitoring patches, listening aids, and more. Wearables devices demand repetitive charging or multiple batteries.

A research team, led by Associate Professor Jerald Yoo from the Department of Electrical and Computer Engineering and the N.1 Institute for Health at the National University of Singapore (NUS), has developed technology that enables a single device, such as a mobile phone placed in the pocket, to wirelessly power other wearable devices on a user's body, using the human body as a medium for power transmission. The team's novel system has an added advantage – it can harvest unused energy from electronics in a typical home or office environment to power the wearables.

Their achievement was first published in the journal [Nature Electronics](#) on 10 June 2021. It is the first of its kind to be established among existing literature on electronic wearables.

Using the human body as a medium for energy transmission

To extend battery life and sustain fully autonomous – yet wireless – operations of wearable devices, power transmission and energy harvesting approaches are required. The NUS team has designed a receiver and transmitter system that uses the very obstacle in wireless powering – the human body – as a medium for power transmission and energy harvesting. Each receiver and transmitter contains a chip that is used as a springboard to extend coverage over the entire body.

A user just needs to place the transmitter on a single power source, such as the smart watch on a user's wrist, while multiple receivers can be placed anywhere on the person's body. The system then harnesses energy from the source to power

multiple wearables on the user's body via a process termed as body-coupled power transmission. In this way, the user will only need to charge one device, and the rest of the gadgets that are worn can simultaneously be powered up from that single source. The team's experiments showed that their system allows a single power source that is fully charged to power up to 10 wearable devices on the body, for a duration of over 10 hours.

As a complementary source of power, the NUS team also looked into harvesting energy from the environment. Their research found that typical office and home environments have parasitic electromagnetic (EM) waves that people are exposed to all the time, for instance, from a running laptop. The team's novel receiver scavenges the EM waves from the ambient environment, and through a process referred to as body-coupled powering, the human body is able to harvest this energy to power the wearable devices, regardless of their locations around the body.

Paving the way for smaller, battery-less wearables

On the benefits of his team's method, Assoc Prof Yoo said, "Batteries are among the most expensive components in wearable devices, and they add bulk to the design. Our unique system has the potential to omit the need for batteries, thereby enabling manufacturers to miniaturise the gadgets while reducing production cost significantly. More excitingly, without the constraints of batteries, our development can enable the next generation wearable applications, such as ECG patches, gaming accessories, and remote diagnostics."

The NUS team will continue to enhance the powering efficiency of their transmitter/receiver system, with hopes that in future, any given power-transmitting device, be it a user's mobile phone or smart watch, can satisfy the network power demands of all other wearables on the body, thus enabling a longer battery lifetime.