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HEALTH

Harnessing vibrational energy can mean heartbeat-powered pacemakers

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by Ethan Bilby



An EU team is working to create a pacemaker that could be powered by the body's own vibrations. Image: Shutterstock/Vadim Ratnikov

The noise of a whirring washing machine or a house-rumbling lorry may seem like little more than a nuisance, but scientists are developing sophisticated devices to turn such everyday vibrations into a new energy source.

Just as solar panels provide a free supply of low-carbon renewable energy from the sun, harvesting vibrations from the environment can be an ecologically and financially friendly way to power sensors in remote areas or charge gadgets wirelessly.

New engineering techniques are helping scientists to gather power from even the smallest tremors, as tiny as the beating of a human heart.

'Vibrations from the body in movement, from muscles or organs such as the heart or the lungs, share a common feature: a higher energy density in the low frequencies, well below 30 Hertz,' said Dr Renzo Dal Molin, Director of Advanced Research for French pacemaker manufacturer Sorin Cardiac Rhythmic Management.

Those are deep tones. Human hearing bottoms out at around 20 Hertz.

Dr Dal Molin is part of an EU team working to create a pacemaker that can store such energy to shock the heart back into action if it stops beating, rather than using conventional batteries. The device would be the first medical implant capable of being powered by the body's own vibrations.

The low frequency makes gathering the energy a challenge. Dr Cian O'Murchú at University College Cork's Tyndall National Institute in Ireland is coordinating the EUR 6 million Manpower project to build the pacemaker. Experts on the team are working with new materials like polymers that can be tailored for individual patients to best capture vibrations.

'We can tune it using different types of parameters, for example using light we can stiffen the polymer,' Dr O'Murchú said. 'Depending on the frequency of your heartbeat, we want to tune it so it matches that.'

The team is experimenting with electrostatic and pressure-sensitive piezoelectric materials to harvest the energy, generating the microwatts of electricity needed by a pacemaker. The electrostatic materials generate power through shifts in capacitance as tiny finger-like structures are moved back and forth by the vibrations. Piezoelectric materials create energy as the device material is flexed, in the same way squeezed quartz powers wristwatches.

The end result could mean better lives for heart patients. Current pacemaker batteries are non-rechargeable and must be swapped out roughly every four to 12 years. The devices are commonly implanted in the shoulder for easy access, with wires leading down to the heart. Every time a battery runs dry or a wire breaks, it means another trip to the operating table for a cardiac patient.

Pacemakers that use vibrational energy harvesters could function for a much longer period, perhaps 40 years. They are also small enough to be implanted directly into the heart wall. That means patients receiving the devices are much less likely to need invasive operations.

Researchers hope the devices will be ready for human trials after the project concludes in late 2016.

Good vibrations

Pacemakers are not the only technology that could benefit from harvesting vibrational energy. As technology enables more electricity to be generated from materials, such techniques could be used to power other devices.

'We can imagine that in the next 10 years with new materials and processes this type of use could be extended to other medical devices with power consumption in the milliwatt range such as cochlear or retinal implants,' Sorin Group's Dr Dal Molin said.

Outside of the body, vibrations have the potential to charge objects like mobile phones or torches. Energy harvesting can also work on a larger scale to provide remote systems with power.

Scientists in the Spanish-led SWAP project created a prototype sensor that could run off vibrations as well as other forms of ambient energy, and successfully tested the device this year.

The EU-funded research could prove lucrative, spurred by the growth of the so-called internet of things – where devices wirelessly communicate with each other.

The global market for semiconductor wireless sensor networks was EUR 2.3 billion last year, and could grow to EUR 10 billion by 2020, according to a report published this year by WinterGreen, a US-based research company focussed on sectors such as the internet, nanotechnology and telecommunications.

Self-powered devices could monitor the status and send back data along remote engineering projects or hard-to-get places where maintenance is difficult. Sensors located along shaking pipelines gushing with oil or rocking ship's hulls could be potential targets. Traffic along streets implanted with vibrational energy harvesters could, for example, power town sensor networks, providing big data that could help city officials monitor weather, the environment, and prevent crime.

Dr O'Murchú is optimistic. 'All these sensors that will be put everywhere all need power, and a lot of the time it might be difficult to change the battery, so energy harvesting is going to be quite huge.'

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*Dr Cian O'Murchú,
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More info

[Manpower](#)

[SWAP](#)