Opinion **Outlook**

Cyborg cockroaches are coming to a pipeline near you

The remote-controlled insects are equipped with cameras to search disaster zones and check for infrastructure damage

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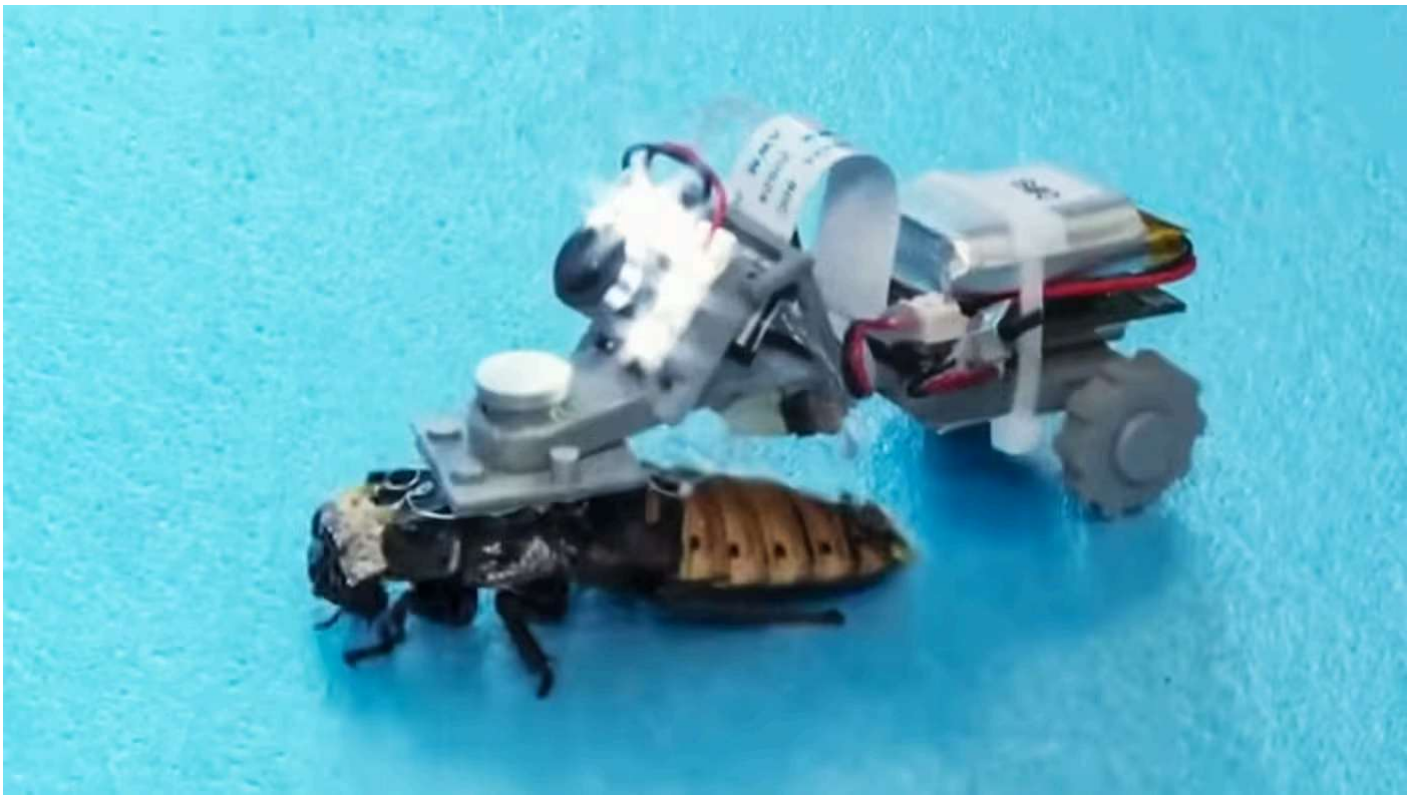

A cyborg cockroach developed by Singapore's Nanyang Technological University. A device attached to its back sends small electric signals into its nervous system to get it to change direction © NTU/YouTube

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In a university laboratory in Singapore's western industrial zone, a wall of plastic boxes contains the island nation's newest emergency service recruits: cyborg cockroaches.

Scores of Madagascan hissing cockroaches — wingless brown insects roughly the size of an adult human thumb — have been fitted with robotic backpacks and trained to help search and rescue teams locate people trapped in disaster zones.

Academics at Singapore's Nanyang Technological University have been developing the insect-hybrid robots for more than a decade. But they were first put to use a year ago following Myanmar's 7.7 magnitude earthquake, which killed more than 3,300 people.

Now the professor behind the programme is working on a more prosaic task for his army of altered insects, one inspired by his childhood growing up in Japan.

"In Japan, we have very old infrastructure," says Hirotaka Sato, a professor at NTU's School of Mechanical and Aerospace Engineering. "We are testing more day-to-day uses, like checking old pipelines."

Sato is a pioneer in the field of cyborg insects. His earlier efforts focused on fitting devices to the backs of flower beetles to control their flight. His work is recognised in the Guinness Book of Records for the first untethered controlled flight by a cyborg beetle in 2015.

The backpacks fitted to his cyborg cockroaches also allow them to be controlled remotely. The devices send small electric signals into the cockroach's nervous system via a circuit board fitted to their back to get them to change direction.

At the lab, one of Sato's assistants provides a demonstration, using a handheld device that looks as if it should be attached to a 1990s games console. He steers the cockroach through a mini assault course using electric pulses that he assures me do not cause the cockroach any pain. The latest model, he says, uses 25 per cent less voltage than previous versions. The upgrade is not solely about animal welfare — more efficient energy usage makes the batteries last longer.

The advantage of using engineered insects over robots is that the cockroaches have over millions of years of evolution gained the agility and flexibility to crawl through tight spaces. And while the 10 cyborgs deployed in Myanmar were unable to locate survivors (via the infrared cameras they carried), Sato believes they will work better in larger numbers.

Swarms of cyborg cockroaches are more possible now that Sato and his team have developed an automated process of fusing the devices to the cockroach's back in just over 60 seconds (the previous manual method took around an hour).

The newer devices designed to help with infrastructure inspections look more like mini chariots than backpacks. They have a bigger battery, a torch and a camera attached to a wheeled platform that the cockroach pulls along.

This design is less focused on manoeuvrability because the assignments the cockroaches take on will have more space than search and rescue operations. Typically they will be used to trudge along miles of underground pipes, capturing images of damage and leaks.

And when the cockroaches have served their purpose, they can retire, living out the rest of their lives in containers filled with a fresh supply of lettuce leaves each day.

Singapore is not the only country developing engineered insects. A German start-up last month announced that it was also making backpacks for cockroaches that could be used in warfare.

Swarm Biotactics said it was building miniature devices equipped with sensors and communication devices. These could then be deployed en masse to provide reconnaissance.

In Singapore, the cockroach chariots are set to be tried first in the transport system to monitor underground pipelines there. After that, Sato says he imagines more places will catch on to the idea. “Infrastructure in many countries is getting old,” he says. “I can see these being used everywhere.”

But, he adds, Singapore is not interested in evolving to military use. The cockroaches, he says, are “only for peaceful purposes”.

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