

This robot can work up a sweat doing pushups

15 October 2016, by Nancy Owano



Meet Kengoro, a humanoid robot. A video starts with a rather surprising sight of a robot doing what looks like an expert floor exercise. You see the robot during its workout, using the strength of his hands and flexible, strong arms.

Kengoro has over 100 motors to keep it going. Yes, the motors generate lots of heat, but the researchers worked out a way to accommodate that, and keep the robot going strong.

Kengoro can do its pushups for 11 minutes straight without [overheating](#).

How? Kengoro sweats, in a manner of speaking. Evan Ackerman in *IEEE Spectrum* noted that "By sweating, we pump water out of our bodies, and as that water evaporates, it cools us down." It cools the motors in this manner.

Steve Dent in *Engadget* talked about what the sweat is all about, and how it keeps the robot from suffering deep fried mode. "Unlike a normal water-cooled radiator system, liquid flows into porous aluminum bones and then evaporates on the surface to cool the motors, in the same way that sweat [cools](#) a human."

Ackerman said Kengoro can run for half a day on about a cup of deionized water.

Dent said the robot was built using laser sintered aluminum powder. This, said Ackerman is "an additive manufacturing technique that can print complex structures out of metal."

Ackerman also explained that " A low permeability piece of metal would be something like a solid brick of aluminum, while a high permeability piece of metal would have a structure full of tiny gaps and tunnels, like a [sponge](#)."

Kengoro's porous skeleton does the sweating.

"The process allows fine control of the metal's permeability, so the team added channels that let water flow through the bones. It then seeps to another porous region near the surface, where it evaporates and cools motors positioned next to the aluminum 'glands.'"

The researchers presented their sweating robot concept at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), said *IEEE Spectrum*.

"Skeletal Structure with Artificial Perspiration for Cooling by Latent Heat for Musculoskeletal Humanoid Kengoro," was presented by Toyotaka Kozuki, Hirose Toshinori, Takuma Shirai, Shinsuke Nakashima, Yuki Asano, Yohei Kakiuchi, Kei Okada, and Masayuki Inaba from the University of Tokyo.

The team is from the JSK Lab led by Professor Masayuki Inaba, said the article.

Not that you can impress everyone on YouTube. One viewer complained, "You call that a pushup? The chest has to be mere inches from the ground."

A comment in *IEEE Spectrum*, however, thought

their work was brilliant.

Ben Popper in *The Verge* shared his assessment of their work as a "promising avenue for further research." He noted that the sweat method was not quite as effective as traditional active cooling, involving a system of radiators, tubes, and fans. "But it took up far less space, allowing the [team](#) to pack more sensors, circuits, and gears onto the robot."

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