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Robotic Skeleton Takes Load Off Humans

By REGINA CHEN
Daily Cal Staff Writer
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The next Bionic Man has arrived—and he's in your nearest UC Berkeley laboratory.

A UC Berkeley team of researchers has created Berkeley Lower Extremity Exoskeleton, known as BLEEX, a self-powered exoskeleton that frames the human body. With metal leg braces, a computerized power unit and a backpack-like structure, BLEEX takes most of the weight burden off its user, allowing humans to carry up to 70 pounds with very little effort.

"This is a very serious and important development in the robotics field," said mechanical engineering professor Homayoon Kazerooni, director of the Robotics and Human Engineering Laboratory. "It's probably the hardest robotics problem solved, which involves human and robotic interaction in a natural way."

The design now paves the way for scientists to create similar machines, Kazerooni said.

The exoskeleton is designed for the user to trek long distances while carrying heavy loads. In the near future, its applications could range from medical to military purposes.

Medics could carry injured soldiers off battlefields, firefighters could lug heavy equipment up several flights of stairs, and rescue workers could bring food and emergency supplies to areas inaccessible to vehicles. Hikers could also wear the exoskeleton to make their mountain treks easier.

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Berkeley Lower Extremity Exoskeleton, BLEEX, is designed to interact with the human body to distribute heavy loads up to 70 pounds onto a self-powered, 100-pound exoskeleton.

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In experiments at UC Berkeley, a man wearing the 100-pound frame and a 70-pound backpack reported feeling like he was carrying only a few pounds.

The exoskeleton is user-friendly, and doesn't require special training, knobs or buttons for operation. Humans provide the balance while a computer calculates how to control the frame so it moves in sync with the operator, according to Kazerooni.

The biggest challenge in building robots is understanding human movement, said Matthew Mason, professor of computer science and robotics at Carnegie Mellon University, who was part of a team that developed an origami-folding robot.

“We can build a machine that knows how to play better chess than a human but not one that moves the pieces around better,” Mason said.

He added that the exoskeleton was very successful in combining the best of human and robotics research.

“I see the computer evolution as just barely starting because they’re completely hindered in their abilities to interact with the real world and that’s where robotics come into play,” Mason said.

Before the exoskeleton could be designed, researchers analyzed the mechanics behind the basic human step for about a year. They studied the forces used by ankles and also the shock-absorbing power of knees.

UC Berkeley engineers are working on making the exoskeleton more “robust,” Kazerooni said. The parts could be more compact, the engine more powerful and quiet. The frame could eventually carry up to 120 pounds.

The project was funded in 2000 by the Defense Advanced Research Projects Agency, the central research and development organization for the U.S. Department of Defense.
