Robotic Awareness Turns Humans into Superheroes

Non-biological evolution is possible with human augmentics

By John Edwards

April 07, 2013

At Chicago's University of Illinois Electronic Visualization Laboratory (EVL), researchers are pioneering human augmentics (HA), a field that aims to give people the ability to sense the world around them in the same way that machines equipped with electronic sensors can. Long-term HA applications include personal security bodysuits, wearable systems that help employees perform their jobs more efficiently and improved navigation for the visually impaired.

Jason Leigh, professor of computer science at the University and the EVL's director, says that HA's goal is to provide technologies for expanding human capabilities and characteristics. "Eventually, technology and biology will merge," Leigh says, "and any human that does not merge with technology could be left behind."

According to Leigh, HA will be the force that drives the non-biological evolution of humans. He notes that HA devices will supply the technology necessary to compensate for human biological limitations, either natural or acquired through disease or accident.

HA's strength lies in its applicability to all humans, Leigh states. "Its interoperability allows the creation of ecosystems in which augmented humans can draw information from other realms, such as the cloud and other augmented humans, for strength," he says.

Gaining Spider-Sense

EVL's most ambitious project to date is Spider-Sense, a system that its researchers describe as "a wearable extrasensory prediction device," which uses real-time data gathered from multiple sources to forecast upcoming events and alert its user of a potential problem before it occurs. Spider-Sense is designed to convey warnings

about physical and environmental threats to users via an array of technologies delivering tactile, visual and auditory cues.

Spider-Sense was created by a research team that included Leigh, Robert Kenyon, Victor Mateevitsi, Brad Haggadone and Brian Kunzer, all of whom also authored a research paper on the system's development. Mateevitsi presented the paper earlier this year at the Augmented Human International Conference in Stuttgart, Germany.

The Spider-Sense system uses 13 sensor modules that are placed on various parts of the user's body, including the chest, back, arms, legs and forehead. All of the modules are linked to a controller box via 10-pin ribbon cables. Each module contains an ultrasonic distance sensor that can detect the presence of virtually any object within an approximately 17-foot range.

The system, which rapidly analyzes reflected pulses of sound or energy, mimics the way bats navigate their way across a terrain, Whenever a Spider-Sense module detects an approaching object, a servomotor worn by the user activates a pressure arm that pushes down on the wearer's body, functioning as a kind of electronic warning tap. The arm's pressure increases as the object gets closer.

While Spider-Sense has worked well in several different tests, according to the researchers, developing a version that will allow users to accurately interpret several different types of warnings will require additional work.

"It's not like someone could put on a vest and immediately understand what's going on," says Robert V. Kenyon, professor of computer science and director of graduate studies at the University of Chicago. "There's a possibility of getting sensory overload, where you're getting too much information and you have to somehow

sort it through," he says.

The researchers hope to eventually develop a system that generates cue patterns users' brains will be able to easily remember.

"This kind of pattern recognition is something that people all do, all the time," Kenyon says. "It's just that when you have a different kind of sensory input profile coming in, it takes time for you to learn it."

Leigh acknowledges that modfying Spider-Sense for everyday use will require more effort.

"The first time I put on Spider-Sense, it was a really weird feeling," he recalls. "Suddenly, my body was completely inundated with sensation, so much so that I didn't know how to interpret it." Yet the experience was far from unpleasant, he says. "The weird thing is, I felt incredibly empowered," Leigh explains. "I don't know what it was, but I felt somehow stronger."

Tapping into the cloud

Leigh says that Spider-Sense was inspired, not surprisingly, by the famous comic book and movie character. "Some of us are big science fiction fans and you're inspired by things like comic books, like Peter Parker and Spider-Man," he notes. "In Spider-Man, Peter Parker has the ability to sense danger before it happens and get out of the way just in time—that's the ability we wanted to include in Spider-Sense."

The researchers tested Spider-Sense by blindfolding volunteers and asking them to perform several simple tasks, such as throwing cardboard ninja stars at specific targets while strolling down a hallway. As it turned out, the test subjects had no difficulty walking down hallways and sensing obstacles, yet they did experience some trouble navigating their way through rows of narrow library bookshelves.

When used in the real world, Spider-Sense will require the support of local ad hoc sensor networks, created by nearby cell phones, to feed it relevant and timely information about the local environment. "Cell phones and people are going to probably blanket the environment better than we have the ability to blanket the environment with sensors, but it will be a combination of both," Leigh says.

Cells phone can serve as gateways leading to detailed local information. "The intelligence isn't just in the cell phone, it's also in the cloud," Kenyon explains. "The cloud will be able to locate where you are and to locate the sensors [cell phones] it needs to tap in order to give you the information that you requested," he says. "That's pretty far advanced from where we are right now, but it's something that will be possible to do."

Kenyon describes a hypothetical situation: "For example, if you're walking down the street and there's a crowd of people around you, your HA system could contact the cloud and inquire, 'I need to know what's ahead of me,'" Kenyon says. "The cloud can then figure out the GPS locations of the cell phones it needs to tap to get a map of the local area, including things like walls, curbs, trucks moving and everything else that's going on."

Scientific collaboration holds promise

The next step for the Spider-Sense researchers will be enhancing the system's reaction time to allow faster and more accurate recognition of objects approaching the user. A more responsive system would also let users move faster without incurring the risk of bumping into a wall or closed door. Leigh says the team also plans to test the system as a tool designed to help visually impaired people navigate their way through busy and potentially dangerous city streets.

The researchers haven't yet determined exactly how much a fully operational Spider-Sense system would cost. "We can't imagine it being very expensive," Leigh says. "I can imagine, with economies of scale, it could be as cheap as $100 or $150."

Kenyon notes that while EVL has gotten the HA ball rolling, several other schools are now also exploring the field, including the Massachusetts Institute of Technology (MIT), the University of California at Berkeley and several European universities. "It's great to have other people that you can talk and exchange ideas with," he says.

Leigh says that Spider-Sense was the result of a highly collaborative and organic process at EVL. "We each cover bases that otherwise would have left huge gaps in the research," he says, noting that additional close collaboration between researchers is inevitable. "To think about problems like climate change, and how you solve that, it's not just one hero researcher coming up with a single answer—it requires a collaboration between atmospheric scientists, geo scientists, economists and others to understand and solve the problem," he says. "Human augmentics is in exactly the same boat."

About the author

John Edwards

John Edwards is one of the technology revolution's most prolific and widely published writers. A tech journalism pioneer, John launched his career in the 1970s As the budding microcomputer industry gained momentum, John became a regular contributor to the first generation of home and business computer magazines, including onComputing, Popular Computing, Kilobaud and Interface Age. He was also an early contributing editor to both PC Week and MacWeek.

Today, John continues writing in multiple technology areas, including telecommunications, virtualization, cloud computing, mobility, radiolocation, robotics, semiconductors and cutting-edge laboratory research. His work appears in Computerworld, RFID Journal, Electronic Design, IEEE Signal Processing, Robotics Trends, Robotics Business Review and a variety of other publications.

He also contributes content to publications and websites sponsored by AT&T, Oracle, Cisco, Dell, IBM and others. John maintains top-level contacts with technology leaders at corporate, government and academic enterprises. Over the years, John has interviewed scores of technology pioneers, including Gordon Bell, Steve Wozniak, Michael Dell and several Nobel Prize winners.

For better or worse (mostly worse) John has been a New York Mets fan since the team's inception in 1962.

Article topics

Consumer & Household · Education & Research · RBR · Innovation & Technology · Research · Future Trends · Technology · Research · Technology · View all topics

Comments

No comments yet. Be the first to post a comment.