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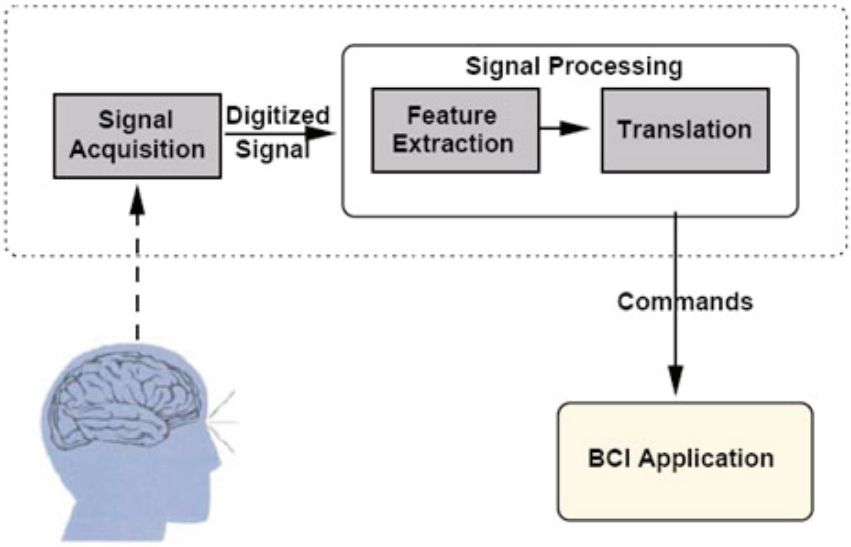
Your Thoughts Are Your Password

Lakshmi Sandhana 04.27.06



Current Brain Computer Interface (BCI) research is focused on the disabled. But Carleton University researchers believe the same interface could form the basis of a mind-controlled password system.

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What if you could one day unlock your door or access your bank account by simply "thinking" your password? Too far out? Perhaps not.

Researchers at Carleton University in Ottawa, Canada, are exploring the possibility of a biometric security device that will use a person's thoughts to authenticate her or his identity.

Their idea of utilizing brain-wave signatures as "pass-thoughts" is based on the premise that brain waves are unique to each individual. Even when thinking of the same thing, the brain's measurable electrical impulses vary slightly from person to person. Some researchers believe the difference might just be enough to create a system that allows you to log in with your thoughts.

A pass-thought could be anything from a snatch of song, the memory of your last birthday or even the image of your favorite painting. A more achievable alternative might present you with predetermined pictures, music or video clips, to which you would think "yes" or "no" while the machine monitors your brain activity.

"It is known there are differences between people's brains and their signals," says Carleton researcher Julie Thorpe, who's working on the project with Anil Somayaji and Adrian Chan. "Can we observe a user-controllable signal encoding hundreds or thousands of bits of information in a repeatable fashion? That's the real question. We think it may be possible."

The system has the potential to become a new kind of biometric security tool that -- in contrast to fingerprint readers, iris scanners or facial recognition -- would allow users to change their pass codes periodically.

But is it really feasible, or is it just another pie-in-the-sky idea?

The research is an outgrowth of efforts to build a brain-computer interface, or BCI, by trying to extract the meaningful parts of brain-wave signals measured by an electroencephalogram, or EEG, and translate them into recognizable computer commands that allow disabled people to control and manipulate prosthetic devices. A chief challenge facing BCI technology is that brain-wave signatures are unique, so a system trained to recognize a particular user can be quite difficult for another to manipulate.

"Brain-wave signatures, represented as the EEG signals of a person ... are different from one individual to another, even when they perform the same thought or task," says professor Touradj Ebrahimi at the Swiss Federal Institute of Technology.

But the very distinctiveness of brain waves that works against researchers in developing universal tools is an asset when building an authentication system. A security device wouldn't need to interpret or understand the thought, but simply extract

the repeatable features of the pattern and recognize a match. "A brain-based biometric can be as strong as DNA-based biometric," says Ebrahimi.

However, some researchers are skeptical that a computer will ever be able to passively recognize a p[illegible]ge in a person's head.

Iead Rezek, of the Pattern Analysis Research Group at the University of Oxford, says the proposal h[illegible] impractical: Too many things are going on in the brain at the cellular level that all look the same from a scalp distance. "Signals from an uncountable number of nerve cells are smeared and lumped together by the time we are recording the brain-wave patterns," says Rezek. "Authentication is akin to recognizing speakers from muffled voices because, for example, the speakers are some distance away."

Even if recognizable readings could be taken, "the link between thought and brain waves is immensely indirect," says Jacques Vidal, a BCI expert and professor with UCLA's computer science department.

Moreover, the way we remember things evolves. It may not be possible to design a system that can passively recognize the changing signature of the same thought by the same individual over time.

Vidal is more optimistic about a simpler form of mind reading, in which the computer provides a stimulus, then measures the brain's response. Such "event-related responses," or ERPs, to color flashes or specific sounds tend to produce brain signals that are different with each individual, but nearly identical when repeated on the same person. "ERPs could be used for biometric identification," says Vidal.

Such a technique could even benefit from the adaptability of our brains. Instead of trying to passively recognize a thought, like in the ideal implementation, a system could rely somewhat on the user deliberately learning how to generate the right brain pattern, using feedback from the machine as a guide.

In experiments with monkeys, researchers found that the animal and computer can effectively train each other. "As the animal learns to control the machine, both the neurons in his brain and the algorithm that uses those signals change," says Reza Shadmehr, professor of biomedical engineering and neuroscience at John Hopkins University. "Together, the coupled system converges to a successful decoding."

For now, the Carleton group is proposing a simple, binary pass-thought system as a first step -- something similar to the brain-guided spelling devices being developed for the extremely disabled. A successful login would only occur when you are able to identify your password by thinking "yes" to the letters or pictures that form it in sequence -- like a mental game of 20 questions.

If they get it working, there remain pragmatic obstacles to rolling out pass-thoughts as a replacement for other biometrics. It's easy enough to slide an index finger into a fingerprint reader, but right now the only way to tap into a person's brain signals is through a highly inconvenient EEG cap that's smeared with conductive gel and worn on the scalp.

Remote brain-activity sensors, though, are coming closer to reality every day. One company, NeuroSky, claims to have developed a noninvasive neural sensor that converts brain waves into useful electronic signals, but it's not clear when the product will be publicly available.

Optical devices seem to hold more promise. "There are commercial devices now that use optics to infer neural activity near the outer layers of the cortex," said Shadmehr. "They shine a focused beam of light and measure the reflectance, and this reflection changes as the blood-oxygenation levels change. The device does not make contact with the head at all.

"The technology to remotely measure brain activity is in its infancy," says Shadmehr. "Yet if we consider that it was only 40 years ago that neuroscientists developed robust single-brain-cell recording techniques in awake, behaving animals, the future for sensing brain activity is very bright indeed."

But don't throw out your passwords yet, warns the more-reserved Somayaji. "I'd be surprised and impressed if a pass-thought system was deployed in 20 years," Somayaji says. "Maybe pass-thoughts will make the transition from science fiction to science fact one day. For now, though, they're still very much science fiction."

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