Researchers assess uniqueness, collectability, permanence of method for ERP biometrics

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Credit: GUK

Security researchers continue to explore what can be measured as successful alternatives to passwords, and the effort requires alternatives to make authentication easy but safe and reliable. We are already

witnessing advances in iris recognition and fingerprints; might security systems experts use brainwaves as a means for personal identification? A research team has been working on a special approach that involves brainwaves and words—as words mean different things to different people, and the brain waves which words provoke could serve as identifiers to replace traditional passwords. Bas den Hond in *New Scientist* on Tuesday told the story about that research.

Blair Armstrong of the Basque Center on Cognition, Brain, and Language in Spain and his team conducted a study which involved 45 volunteers. Their brain signals were recorded as they read off a list of 75 acronyms –such as FBI and DVD. Computer programs were then utilized to spot differences between individuals.

New Scientist said that "the programs could identify the volunteers with about 94 per cent accuracy when the experiment was repeated."Armstrong said it was a promising start. According to *New Scientist*, "Armstrong thinks that this technique based on semantic memory could be developed into a more personal, harder to compromise alternative to fingerprint recognition or iris scanning."

The researchers' use of words for identification sets them apart in this research area; this after all is not the first instance where techniques for identifying people based on electrical signals in the brain have been developed. "But so far," said Bas den Hond, "the noise associated with measurements of all the brain's signals has made such data hard to analyze. Armstrong's approach solves this by focusing on brainwaves from just one region, associated with the task of reading and recognizing words."

Signals are generated when a person accesses "semantic" memories.

The authors' study, which became available online on May 6 in

Neurocomputing, is titled, "Brainprint: Assessing the uniqueness, collectability, and permanence of a novel method for ERP biometrics," by Armstrong, Maria Ruiz-Blondet, Negin Khalifian, Kenneth Kurtz, Zhanpeng Jin and Sarah Laszlo. The authors are from the Basque Center on Brain, Cognition, and Language; and Binghamton University.

What do they mean by "ERP" biometrics? Our brains generate electrical potentials representing neural communication. The potentials can be measured at the scalp, said the authors, and constitute the electroencephalogram (EEG). "When the EEG is time-locked to stimulation— such as the presentation of a word—and averaged over many such presentations, the Event-Related Potential (ERP) is obtained."

Their results indicated "robustly identifiable features of the ERP that enable labeling of ERPs as belonging to individuals with accuracy reliably above chance (in the range of 82–97%). Further, these features are stable over time," they wrote.

Meantime, the NeuroCognitive Imaging Lab, which researches neuroplasticity and language, describes what EEG and ERP mean for researchers. "EEG stands for 'electroencephalography.' Break the word down and you get 'electrical-brain-writing.' This is a technique for recording 'brain waves' or more technically the electrical activity produced by the brain."

The Lab goes on to explain that ERP is a specific use of EEG; we look at brain waves generated in response to particular events, such as seeing a word or picture on a computer screen. "Within the first second of seeing a stimulus, like a word or a picture, the brain generates a series of 'blips' in the ERP brain wave that indicate the activity of different brain systems that are involved in perceiving and making sense of that stimulus. By looking at the timing of these blips (technically called

'components') we can gain a better understanding of how different types of information are processed, and when."

More information: Brainprint: Assessing the uniqueness, collectability, and permanence of a novel method for ERP biometrics, *Neurocomputing*, DOI: 10.1016/j.neucom.2015.04.025

Abstract

The human brain continually generates electrical potentials representing neural communication. These potentials can be measured at the scalp, and constitute the electroencephalogram (EEG). When the EEG is time-locked to stimulation— such as the presentation of a word—, and averaged over many such presentations, the Event-Related Potential (ERP) is obtained. The functional characteristics of components of the ERP are well understood, and some components represent processing that may differ uniquely from individual to individual— such as the N400 component, which represents access to the semantic network. We applied several pattern classifiers to ERPs representing the response of individuals to a stream of text designed to be idiosyncratically familiar to different individuals. Results indicate that there are robustly identifiable features of the ERP that enable labeling of ERPs as belonging to individuals with accuracy reliably above chance (in the range of 82–97%). Further, these features are stable over time, as indicated by continued accurate identification of individuals from ERPs after a lag of up to six months. Even better, the high degree of labeling accuracy achieved in all cases was achieved with the use of only 3 electrodes on the scalp— the minimal possible number that can acquire clean data.

https://techxplore.com/news/2015-05-uniqueness-permanence-method-erp-biometrics.html