Combined Biometrics for e-Learning Security

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Abstract. As the information delivery mechanisms are rapidly changing with the advancement of information technologies, accessibility to e-learning contents is much easier and convenient than a few decades ago. However, with the prevailing e-learning courses in various domains arises new issues.Providing security in e-learning systemsby reliablepersonal authentication mechanismstoon-line systemsarerequired. For this issue, we present the possibility of cognitive biometric applications to secure the personal identification by combining both eye tracking and event relevant potential (ERP) of brain waves.

Keywords: e-learning, security, authentication, eye-tracking, ERP 300

1 Introduction

Applying new informational devices for delivering learning content to learners accelerates the advancement of e-learning technologies. Combined Internet and high performance computing facilities have changed the learning environment in industries into cyber space and e-learning systems. As new technologies appear, the shape of delivering learning contents to users isalso changing.Recently applying smart phones and iPad type devices are actively adopted into classrooms, this practice is sometimesreferred to as smart learning.

Even though e-learning may provide learning opportunities to many individualsin an‘anytime, anywhere learning environment,’ there exist new issues of security. The security problems aredue to the client server system characteristics of acquiring contents from learning content management systems (LCMS/LMS)and applying them to users. Among the issues examinedsecurity policies and mechanisms must be designed to support authentication, authorization, confidentiality and accountability [1, 2].

Authentication involves validating the end users’ identity prior to permitting them server access. Authorization defines what rights and services the end user is allowed once server access is granted.Similarly, the confidentiality of e-learning keeps information from being disclosed to anyone not authorized to access it.Accounting provides the methodology for collecting information about the end user’s resource consumption, which can then be processed for billing, auditing, and capacity-planning purposes.

These issues may be significant as new devices such as smart phones extend accessibility to contents and create 'anywhere and any place' learning environments. For example, the Korean government aims to implement paperless schools where learning contents and exams are carried out using computers and pad type devices [3]. To implement such a plan, it is vital to provide security to ensure that a user is exactly the person he claims to beto avoid cheating.

Typically, authorized person checking is done eitherby entering some password, using some (smart) cards or using finger identification, i.e. biometrics [4]. But, the possibility of circumvention is high in an on-line education environment, and new solutions are required as smart devices are adopted more in educational sectors. It is very important to considersituations where students cheat on exams due to the separation of instructor and students. For example, one can place their finger for identification but a friend can answer the question. That is why some authors claim that physical contact between a student and lecturer (trusted person) must be established and places where this can be done must exist.

One good aspect of the information delivery mechanism is that it adopted more information gathering capability interfaces such as web cameras or finger printing. Using these new features may leadthe way to implementing more reliable person authentication systems, and we propose the combined biometrics of eye tracking and brain wave to establish a reliable e-learning system.

2 Brain wave and eye movement for e-learning security

Various combinations of biometric sensors are possible, but few researches report the possibility of a brain wave person authentication system. One main issue for applying a brain wave identification system is the need foreffortless application and differentiation between users. In our research where ERP (Event Related Potential) was applied to show the gender discrepancy through a more scientific and objective measurement of brain waves, we found that the ERP may be applicable for reliable personal identification due to its robustness and compact brain wave acquiring systems that weredeveloped [5].

2.1 ERP 300

Among the EEG (electroencephalogram)signals,the Event Related Potential (ERP) is acquired by providing information and observing the individuals cognitive response.[6]. The ERP signal is related tothe presentation of stimuli and event, and occurs limited times in the brain. This signal appears 250 ~ 450ms after the presentation of stimulus, and is useful to explain the cognitive information process, showing personal decision making, attention, uncertain solutions, and verification of stimuli.

Various ERP signals may be acquired and one notablecomponent is the P300 (P3). The P300 wave is known to elicit the decision making process related to a person's reaction process to a given stimuli. The P300 is obtainedfrom low-probability target items thatare mixed with high-probability non-target (or "standard") items.

2.2 The characteristics of ERP and the possibility of user authentication

Experiments performed that relate tothe P300 emotional information attention and process shows that the difference in capacityaccording to gender is significance in Fp1, Fp2, F3, Fz and F4 channels ($p<.05$)among ERP components. In other words, the amplitude of differences inP300 according to gender were significant in the prefrontal and frontal lobes. It suggested that curiosity or attention of boys to informational devices were more than thatof girls, since the prefrontal lobe isresponsible for humanity, curiosity, decision-making along withreflection and the frontal lobe isresponsible for concentration of attention and working memory.

Becauseof ERP's characteristics of capturing the cognitive function in the human brain, it is possible to identify personal identity for e-learning authentication. The P300 needs target stimulus and standard stimulus, and shows better results under the oddball game. From the ERP, we can see several positive peaks and negative peaks according to the various brain waves at specific times. The peaks are consisting of latency and polarity, and N and P are used to represent the positive and negative peaks.

The presence, magnitude, topography and timing of this signal are often used as metrics of cognitive functions in decision making processes. While the neural substrates of this ERP component still remain hazy, the reproducibility and ubiquity of this signal makes it a common choice for psychological tests in both clinical and laboratory settings.From these experiments, we concluded that ERP can be useful to show differences between e-learning users, and we have devised different types of biometric combinations; ERP and eye movement technology.

2.3 Proposed combined biometric system for e-learning security

Nowadays, most advanced informational devices areequipped with web cameras as built in components. Therefore, to harness the camera function to interact with users research is being carried outin the field of eye feature tracking for validatingusers. However, once a user gets permission or has been identified as an authorized person to take an e-examination some other person may still be able to take their seat, causingthe reliabilitytobe damaged.

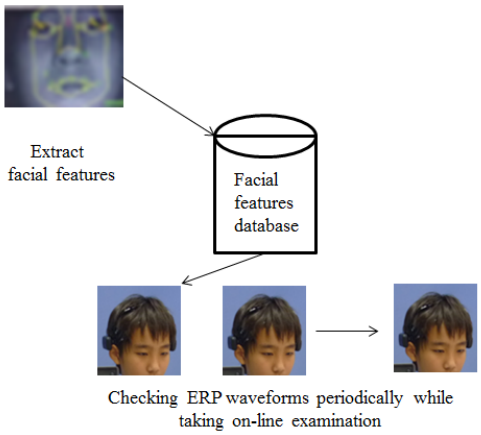

Fig. 1. The combination of EEG and eye tracker for usability test of e-learning.

Therefore, it is necessary to regularly identify a person throughout the session or e-learning. From this rationale, we are proposing a combined sensor based authentication system. The combined sensor based authentication system is using both brain wave and eye movement to authenticate a person in e-learning. In particular the cameras in Pad type PC's and smartphone's can be used as personal information gathering systems. Also, the EEG taps can be designed to capture very basic signals from scalps. The identity authentication system takes the following steps as shown in Fig. 1.

3 Conclusions

Although e-learning provides the learning opportunity of an anytime and anywherelearning environment with easy access to the Internet, many security issues have to be considered. Among these issues, e-examination needs a personalauthentication that guarantees the individualwho takes the examination is the right person.

We are currently trying to implement the combined biometrics of brain wave and eye tracking.TheP300 signal can alsobe used as a reliable observing method for identifying each person under e-learning environments. We need more experiments to verify the reliability of the proposed system, but harnessing advanced information devices along with developingan effortless way to implement a brain wave detection system may provide a better security system for e-learning.

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