UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

Usability and Security of Brainwave-Based Authentication in Real-World Applications

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Data Protection Notice and User Study Consent Form

Information

Thank you for your interest in participating in this study. My name is Markus Röse, and I am a computer science student at Paderborn University. This study is part of my master thesis, supervised by Prof. Dr. Patricia Arias Cabarcos.

Our goal is to evaluate the usability and security of a brainwave-based authentication system under real-world conditions. Current research in this area is mainly limited to theoretical approaches under optimal conditions. To move on from theoretical research, we developed a novel application that replaces classic online authentication methods, such as passwords, with a brainwave-based mechanism. Your participation will help us improve the application and identify challenges and limitations for the future use of this technology. Participation in this study will take approximately 20 to 25 minutes. If you have any questions, please do not hesitate to contact us using the provided contact information below.

Procedure and Participation

If you decide to participate, you will first be given a short introduction to the shown application and the used brainwave sensing headset. Following the introduction, the study progresses in two distinct phases: an experiment phase followed by a survey phase.

In the experiment phase, you will be asked to interact with a password manager which uses brainwave-based authentication as part of a web browser plugin. After performing an enrollment procedure, in which your brainwaves are recorded and temporarily stored, you are asked to perform several authentication tasks to evaluate the mechanism's usability and security. Both the enrollment and authentication consist of you looking at images while your brainwaves are recorded. We enable you to authenticate at different web services using the browser plugin. We will further provide you with the credentials for these web services. This process will take around 10 minutes, depending on the number of web services visited.

Following this, the survey phase starts. Here, you will be asked to fill in a brief survey of questions aimed at your perception of the usability and general opinions about the presented application. This will take an additional 10-15 minutes.

Your participation in this study is voluntary, and you are free to stop it at any time. If you decide to drop out of the study, we will delete all data collected immediately.

Possible Risks of Participation

While minimal, there are still potential risks associated with participating in this study. These risks include those associated with computer tasks in general, such as discomfort, mental distress, boredom, or mild fatigue. Additionally, you may be exposed to flashing images and colors during the study, potentially triggering seizures in people with photosensitive epilepsy. During the study, you will be asked to wear a brainwave-sensing headset. This headset utilizes the electroencephalography (EEG) method to read brainwaves, where small electrodes are fitted tightly against parts of your head. Wearing such a headset for prolonged periods can lead to discomfort and temporary skin irritations. You can withdraw from the study anytime if you feel uncomfortable or experience adverse effects.

Possible Benefits of Participation

By participating in this study, you can gain first-hand experience with novel brain-computer interface technology in the form of a brainwave-sensing headset. Further, you will contribute to the advancement of brainwave-based authentication and help us shape the future of user authentication in general. Your participation will help us in our efforts to make this futuristic idea a reality.

Data Collection and Processing

During your participation, different types of data will be collected and either temporarily or permanently stored. Regardless of the duration of storage, we will handle all collected data with the utmost care to ensure your privacy.

In the experiment phase, we temporarily store some of your recorded brainwaves. This is necessary to allow for a comparison with brainwaves recorded later in the process allowing for authentication. After finishing the experiment phase, these temporarily stored brainwaves are immediately removed if not explicitly indicated otherwise by you in this consent form.

In the latter case, your recorded brainwaves are stored for up to one year without any other personal identifiers. This is done to use them for further testing and development of the system. If you decide to end the study early, all recorded brainwave data will be removed immediately, regardless of any other indication given prior. All processing of brainwave data happens locally. During the study itself, your brainwaves never leave the designated study computer. No brainwave data is shared with any other third party. All brainwave data is stored on encrypted devices to avoid accidental leakage at any point.

After interacting with the system, you will be asked to complete a survey in the survey phase. All data collected as part of the survey will be used exclusively for research purposes. In the event of the presentation or publication of the research results, the collected data will be anonymized to protect the privacy of each participant. Personal data that might allow for conclusions to be drawn about the participant's identity will be removed. No attempt will be made to draw conclusions about single individuals. The data will be collected through the GDPR-compliant LimeSurvey instance of Paderborn University. The personal data collected in the survey are age group, gender, and level of education. This is done to ensure a heterogeneous pool of participants. If you do not feel comfortable sharing this information, you can skip these questions. Please do not enter any personal data, even from other persons, in the free text fields.

Compliance with the GDPR

All handling of collected personal data happens in compliance with the General Data Protection Regulation (GDPR). Following Art. 4 para. 1 of the GDPR, personal data describes all kinds of information related to an identified or identifiable natural person. A natural person is considered as being identifiable, directly or indirectly, as soon as this natural person can be identified using an identifier such as a name, an identification number, location data, an online identifier, or one or more special characteristics expressing the physical, physiological, genetic, mental, economic, cultural or social identity.

The GDPR grants you several rights concerning your personal data. These rights are aimed at providing you with greater control. You can exercise any of these rights by contacting us. For this study, the most important are:

- The right to withdraw your consent for any future processing (Art. 7 para. 3 GDPR)
- The right to be informed about the collection, usage, and sharing of your personal data (Art. 15 GDPR)
- The right to rectify any collected data (Art. 16 GDPR)
- The right to erase any collected data (Art. 17 GDPR)
- The right to restrict processing of the collected personal data (Art. 18 GDPR)
- The right to object to the processing of the collected personal data (Art. 21 GDPR)

Further, if any of your rights were violated as part of this study, you might contact the responsible supervisory authorities for data protection listed below (Art. 77 GDPR). Data is collected based on participants' consent according to Art. 6 para. 1 lit. a. of the GDPR.

Consent

Name: _____

- ☐ I am over the age of 18 and have read and understood this consent form, and freely agree to participate in this study voluntarily.
- ☐ I agree to the processing and storing of my data, including personal data, as described in this document.
- ☐ [Optional] I consent to the prolonged (up to one year) storage of my brainwave data for further development and research of brainwave-based authentication.

Place, Date	Signature

Responsible Persons

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Right to Lodge a Complaint with a Supervisory Authority

If you feel like your rights concerning our handling of your personal data were violated, you may contact a government data protection authority of your choice to complain (Art. 77 GDPR).

Government Data Protection Authority NRW:
North Rhine-Westphalia DPA
E-mail: poststelle@ldi.nrw.de