Novel Coercion-Resistant Authentication System Using EEG

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Problem & Approach

The need for a new authentication method such as biometrics becomes apparent as the data breaches on password-based authentication increase. However, current biometric forms of authentication become unusable once compromised. Additional limits are realized when an attacker coerces an authorized user into a forced authentication. To resolve both issues, I propose creating an authentication mechanism that depends on the user's neurophysiological responses to chosen pieces of music (non-lyrical) measured using electroencephalographic (EEG) signals. This poster will describe the procedure for creating a system that incorporates such idea for person classification and authentication. In a group study, the aim is that participant listen to individually selected music and music selected by other participants during an EEG reading. The change in the Alpha and Beta band frequencies across eight electrode EEG sensors serves as the input feature vector for a supervised machine learning algorithm that trains on the user and attacker EEG readings. Ultimately, the goal of the algorithm is to create a user-specific model to uniquely identify the respective user based on the corresponding EEG response to music and grant authentication. This research study lays a solid foundation for creating a promising EEG-based authentication system by solving the drawbacks of current biometric authentication methods.

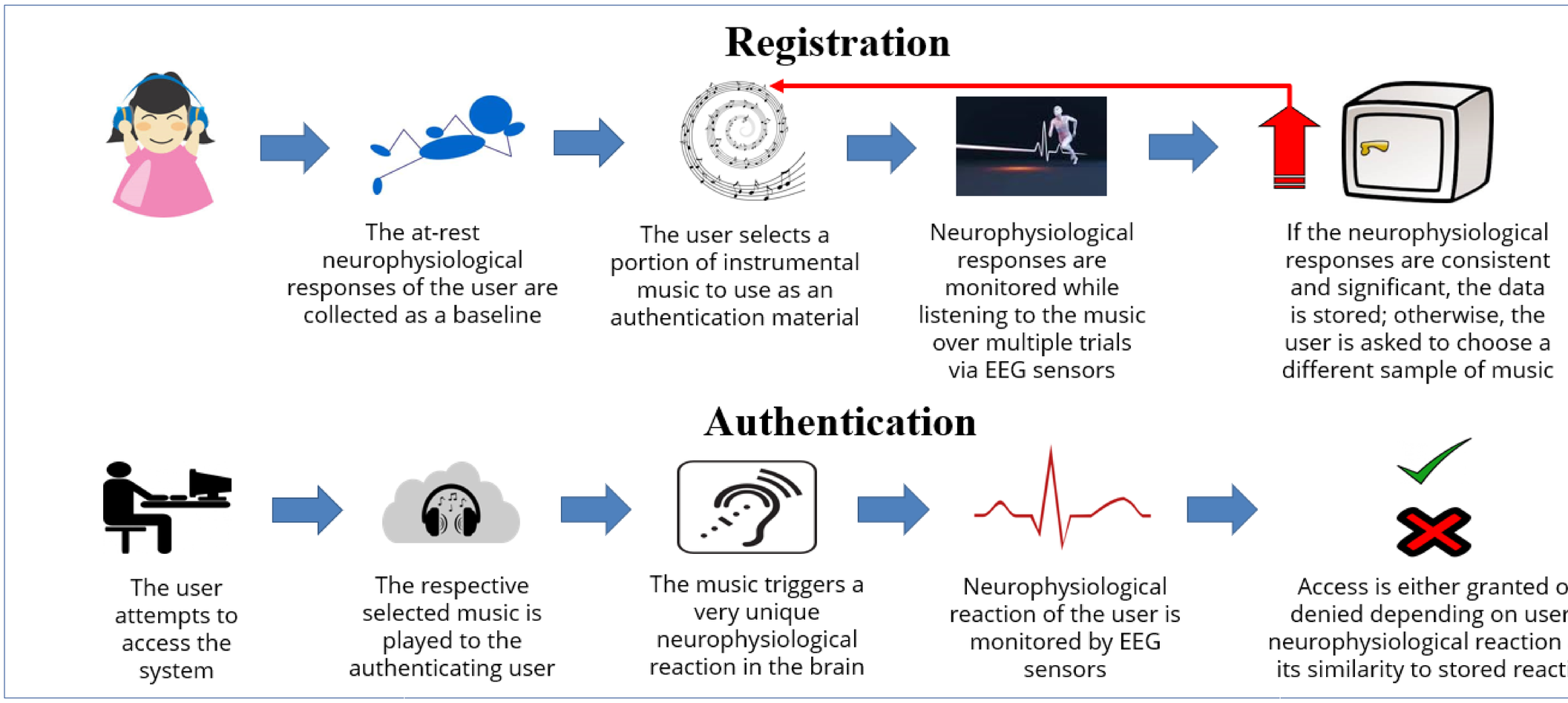

Fig. 1. Diagram representation of the EEG registration and authentication process.

Experiment Details

The goal of the study is to collect EEG data from all participants where every individual respectively listens to a piece of music (non-lyrical) for 30 seconds in entirety. For data collection, a total of twenty-four EEG readings are to be collected from each participant individually. Each participant has four trials. Each trial consists of six readings and every reading lasts for thirty seconds. Reading types include positive, negative, control, and silent. A detailed report is created that describes all necessary elements.

Person Classification for Authentication

A machine learning user-specific model is to be created after choosing a supervised learning algorithm. Applicable examples may include: K-Nearest Neighbors (KNN), Support Vector Machines (SVM), and Artificial Neural Network (ANN). The feature vectors are constructed by subtracting response (musical) readings from baseline (silent) readings for all sensor, with the size corresponding to the number of EEG sensors used. Initial guideline for data splitting is using 60% for training, 20% for validation, and 20% for testing.

Conclusion

I have provided a foundation for creating a new authentication system that resolves the underlying issues of current biometric approaches. The presented authentication system can also be incorporated along with a traditional authentication mechanism as a second factor. Applications and usage capability for the new approach are vast with only the present downside of initial setup and cost. Future work should focus on easing some requirements upon experiment result evaluation and making the process more pragmatic.

References

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