Machine Learning for Authentication Using Brain Waves

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MindLock

Abstract:

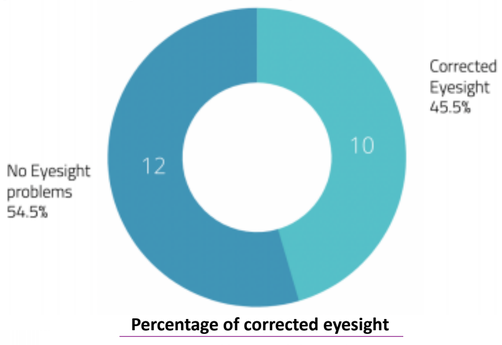
Security risks and hacks have increased over the years. With **authentication** being an important part of security, Brain signals has emerged as a new biometric for authentication. Many studies have been done in this field. However, a **comparison** between different classification methods for authentication of brain waves has not yet been proposed. After comparing the performance of these algorithms using raw EEG data. The results show that the algorithms with the best performance are KNN and ANN with an accuracy of 98.23% and 69.34% respectively.

Introduction:

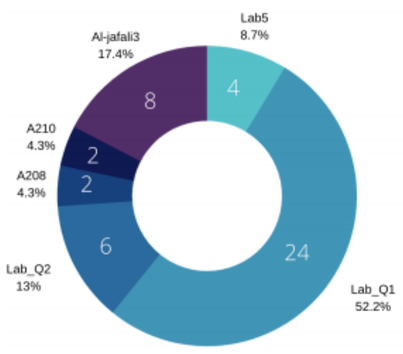
What? Authentication is one of the most important parts of security. It is the process of verifying that the user is who they claim to be.
How? Electroencephalography (EEG) measures the electrical potentials produced by the brain.
Why? EEG is used in most studies because of its portability as well as affordability. EEG is sensitive to changes in the neural functioning of the brain.

Data collection:

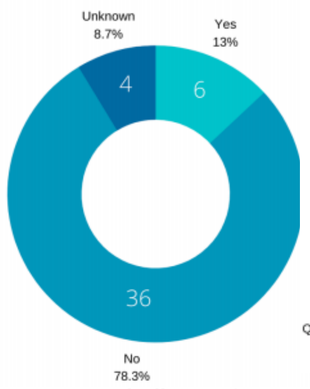
Subjects: 22 right-handed females (21-25 years old) with no neurological problems.
Device: Emotiv Epoc+
Outcome: 22,760 seconds of raw EEG with 13 channels



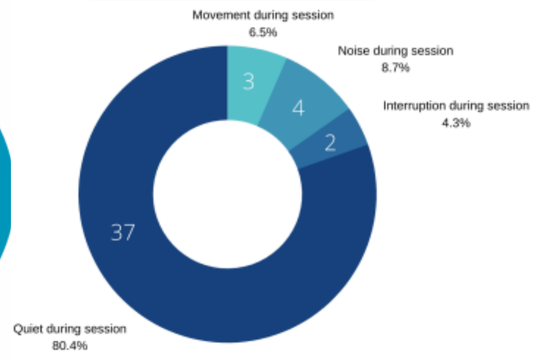
Percentage of corrected eyesight



Percentage of labs picked to experiment



Percentage of caffeine intake



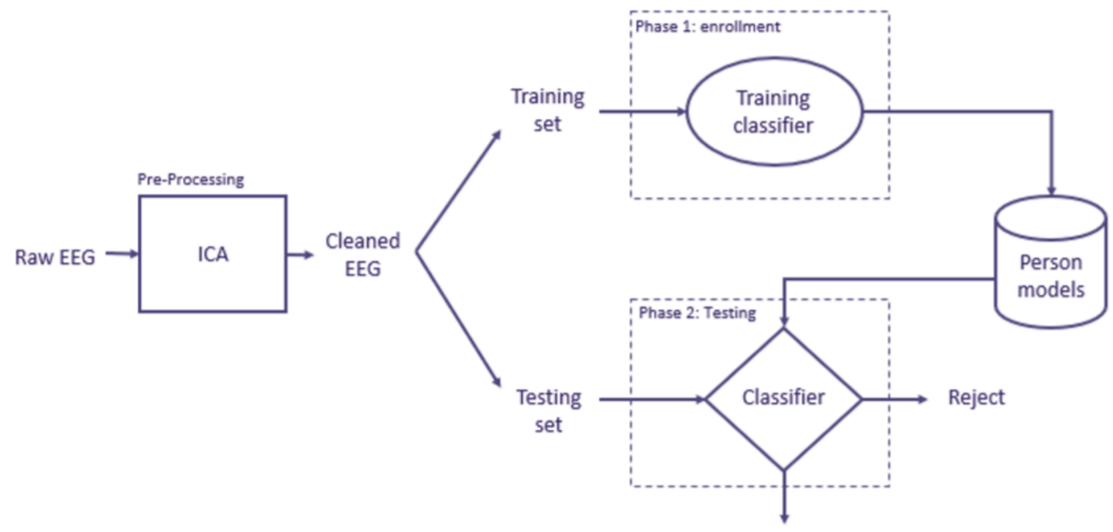
Percentage of interruption during session

Research Aim:

Find the best model to be used with EEG for authentication.

Methodology:

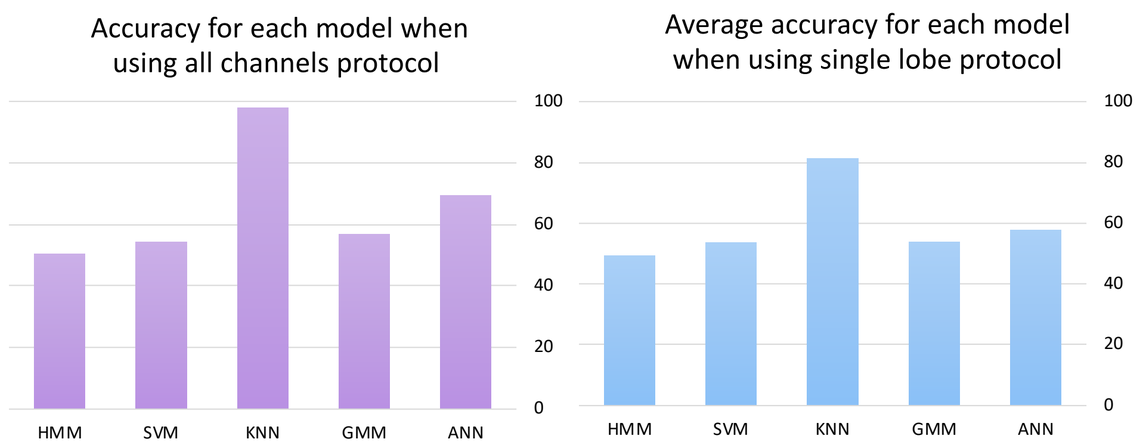
Classifiers: five different models. These are **Gaussian mixture models** (GMM), **artificial neural network** (ANN), **k nearest neighbor** (KNN), **support vector machines** (SVM), and **hidden Markov models** (HMM).

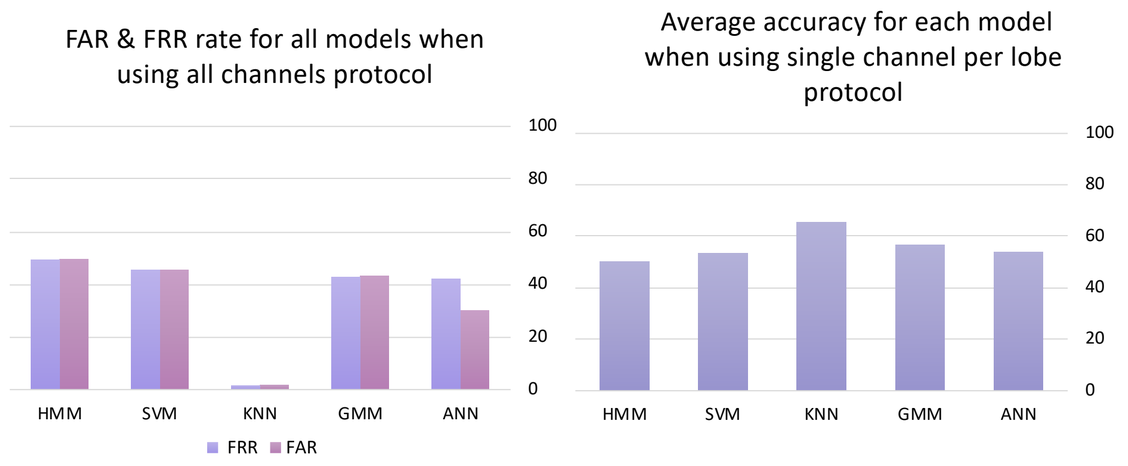


Tools used:

Python Jupyter Matlab Emotiv Pro

Results:





Conclusion:

KNN has the best performance in accuracy, FAR and FRR. For the other protocols, followed by **ANN, GMM, SVM** and lastly HMM. All the algorithms show better results when using all 14 channels. and the performance decreases as the number of channels decrease except SVM where the performance is higher in the one channel per lobe protocol than in all channel per lobe protocol. The occipital lobe and parietal lobe give the highest performance followed by the temporal lobe. Overall results show that using **raw EEG** is not discriminative enough to be used for authentication systems.

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