# Electrooculography-based User Authentication Technique for AR/VR Systems

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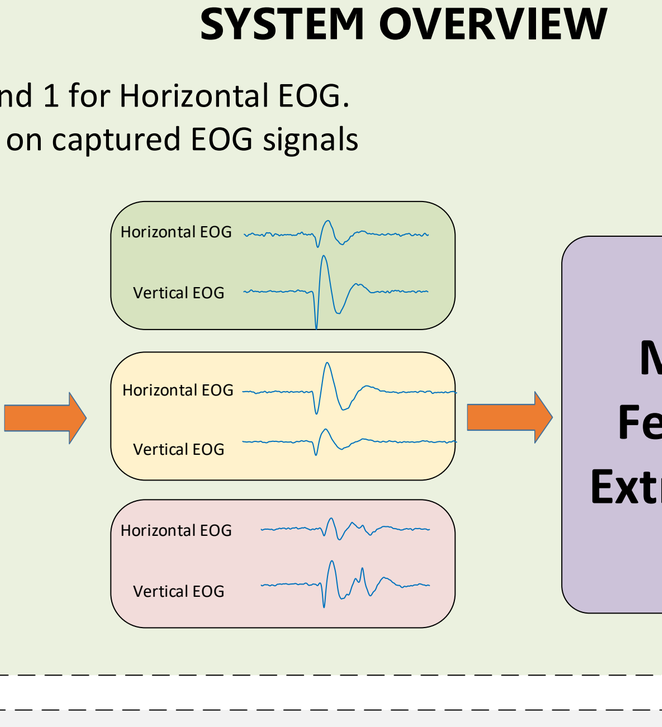
## MOTIVATION

- Many VR/AR apps handle user authentication with weak security
- Limited length and complexity of passwords.
- Tedious to type and requiring several times to input password.
- Traditional method to point at each key with a laser pointer and pull trigger.

https://www.securitymagazine.com/articles/91016-ar-and-vr-how-immersive-technology-is-bringing-cybersecurity-scenarios-to-life

## KEY IDEAS

- Use eye movement as an input for authentication
- Capture 5 eye movements as an directional input




## CHALLENGES

- Creating tools in Unity app and programming base on user requirements.
- Noise transferring while capturing the signals, due to the nature of data, it was rigorous to classify.
- The unstable OpenBCI captures the signals several times.

## TECHNICAL KNOWLEDGE

- Physiological Signal Analysis
- Data Engineering, Feature Engineering
- Machine Learning: Support Vector Machine, K-Nearest Neighbor, Random Forest Regression
- Virtual Reality and Augmented Reality

## SYSTEM OVERVIEW

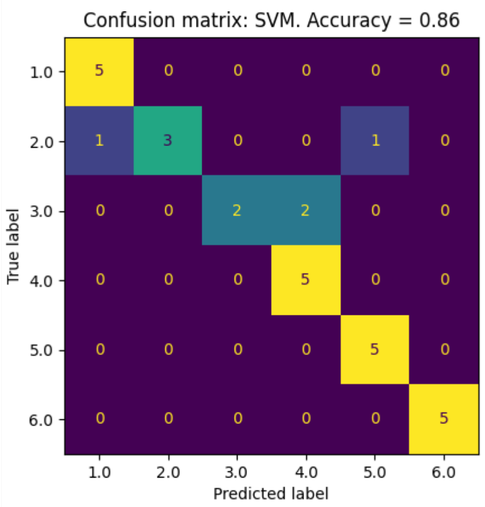
- Use 2 channels from OpenBCI board: 1 for Vertical EOG and 1 for Horizontal EOG.
- Apply Machine Learning to classify the eye activities base on captured EOG signals




## RESULT

### Support Vector Machine

**Confusion Matrix**




**Cross validation**

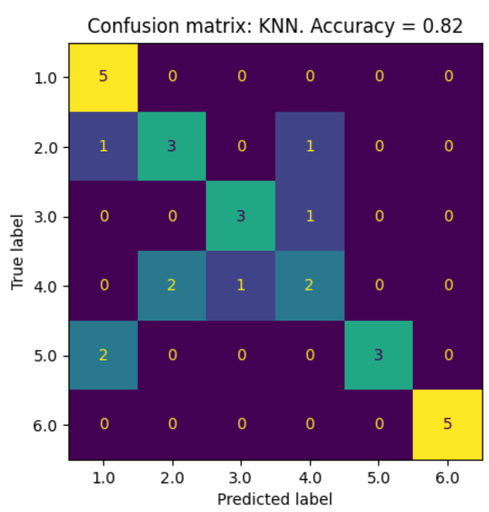
Fold 1. Accuracy : 0.72
Fold 2. Accuracy : 0.72
Fold 3. Accuracy : 0.72
Fold 4. Accuracy : 0.83
Fold 5. Accuracy : 1.00

**Average**

79.8 %

### K-Nearest Neighbor (K = 3)

**Confusion Matrix**




**Cross validation**

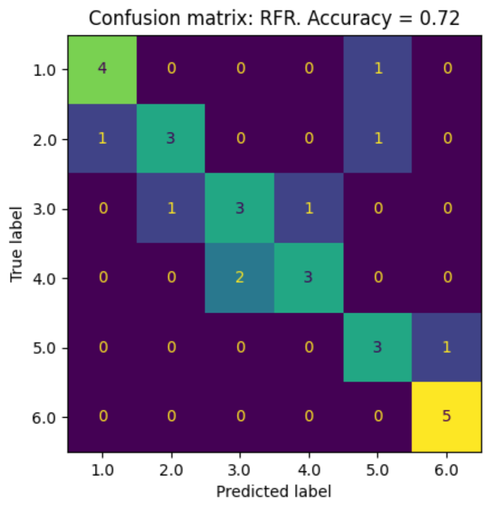
Fold 1. Accuracy : 0.62
Fold 2. Accuracy : 0.90
Fold 3. Accuracy : 0.79
Fold 4. Accuracy : 0.86
Fold 5. Accuracy : 0.82

**Average**

79.8 %

### Random Forest

**Confusion Matrix**




**Cross validation**

Fold 1. Accuracy : 0.62
Fold 2. Accuracy : 0.79
Fold 3. Accuracy : 0.69
Fold 4. Accuracy : 0.72
Fold 5. Accuracy : 0.75

**Average**

71.4 %

## CONCLUSION

- This research study is targeting to contribute the security of users' authentication.
- Future experiments such as performing more complex eyes movements.
- Combining other bio signal such as EMG and MEG for higher level encryption.

## ACKNOWLEDGEMENT

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