Cracking the Emotional Code: Identifying Emotions through Electroencephalograms.

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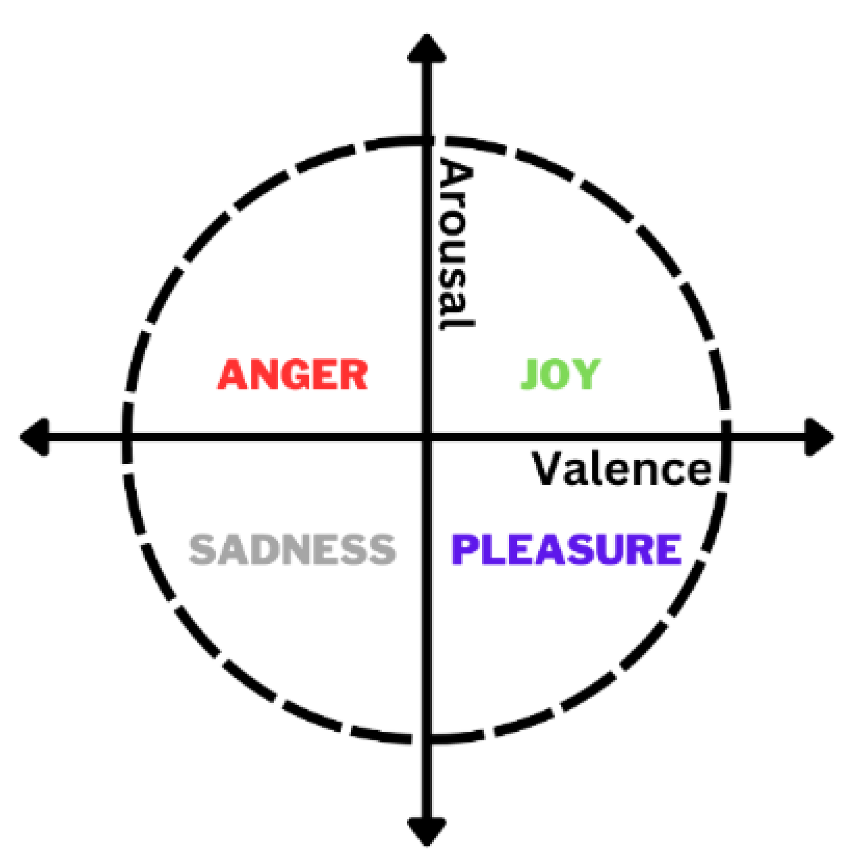
Abstract

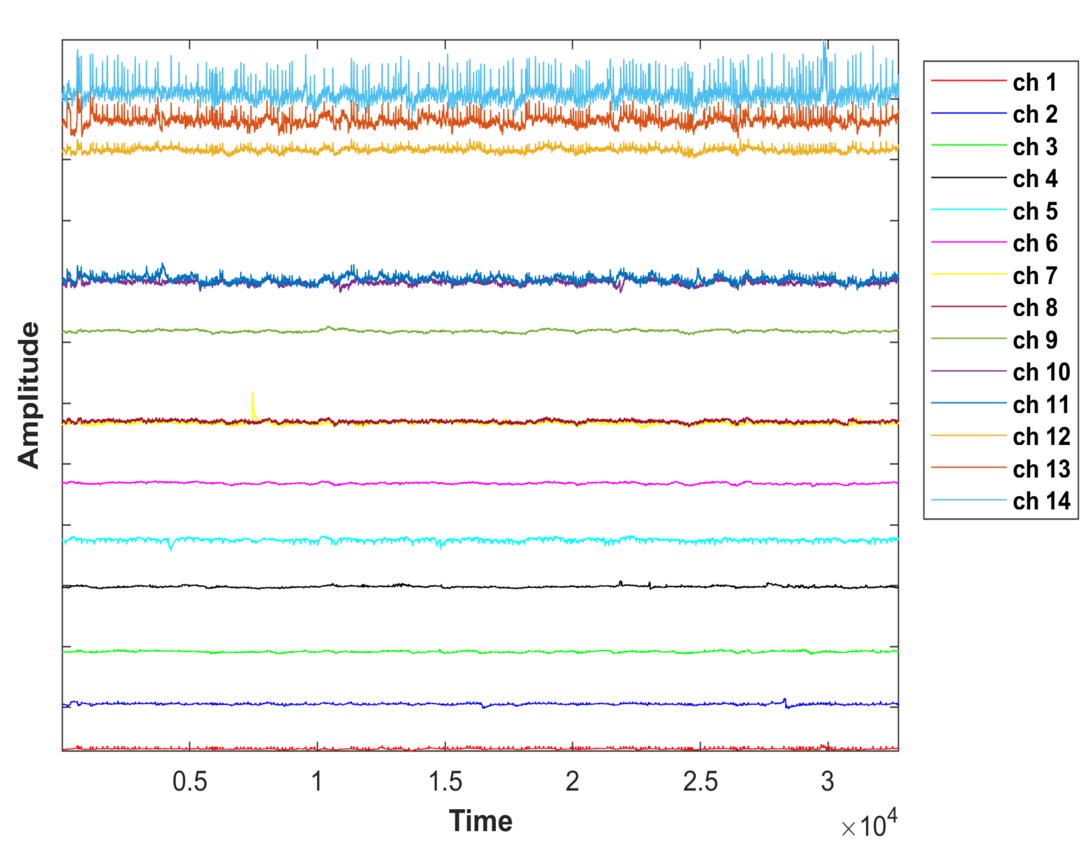
This research investigates the relationship between EEG signals and human emotions using the DREAMERs dataset. The study employs the k-nearest neighbors (KNN) algorithm to classify sadness, joy, anger, and pleasure. A 30-second segment of EEG signals is analyzed, noise is removed using a band stop IIR filter, and five frequency bands are extracted. Six time and frequency-based features are obtained. Imbalanced classes are handled using ADASYN, and feature selection is performed using CHI2. The proposed method outperforms other classifiers, achieving 91.1% accuracy and improved time efficiency in emotion detection using EEG signals.

Introduction

Emotions impact human consciousness and behavior, and automatic emotion identification is in demand for human-computer interfaces. Physiological signals like EEG offer a reliable and accessible method for emotion recognition. EEG measures brain activity through scalp electrodes and provides insights into neural processes related to emotions. Emotions can be quantified using valence and arousal dimensions. Watching movies affects emotions, including engagement, presence, empathy, attention, and memory encoding. This study focuses on classifying emotions during movie watching based on arousal-valence regions: HALV, HAHV, LALV, and LAHV, corresponding to anger, joy, sadness, and pleasure.

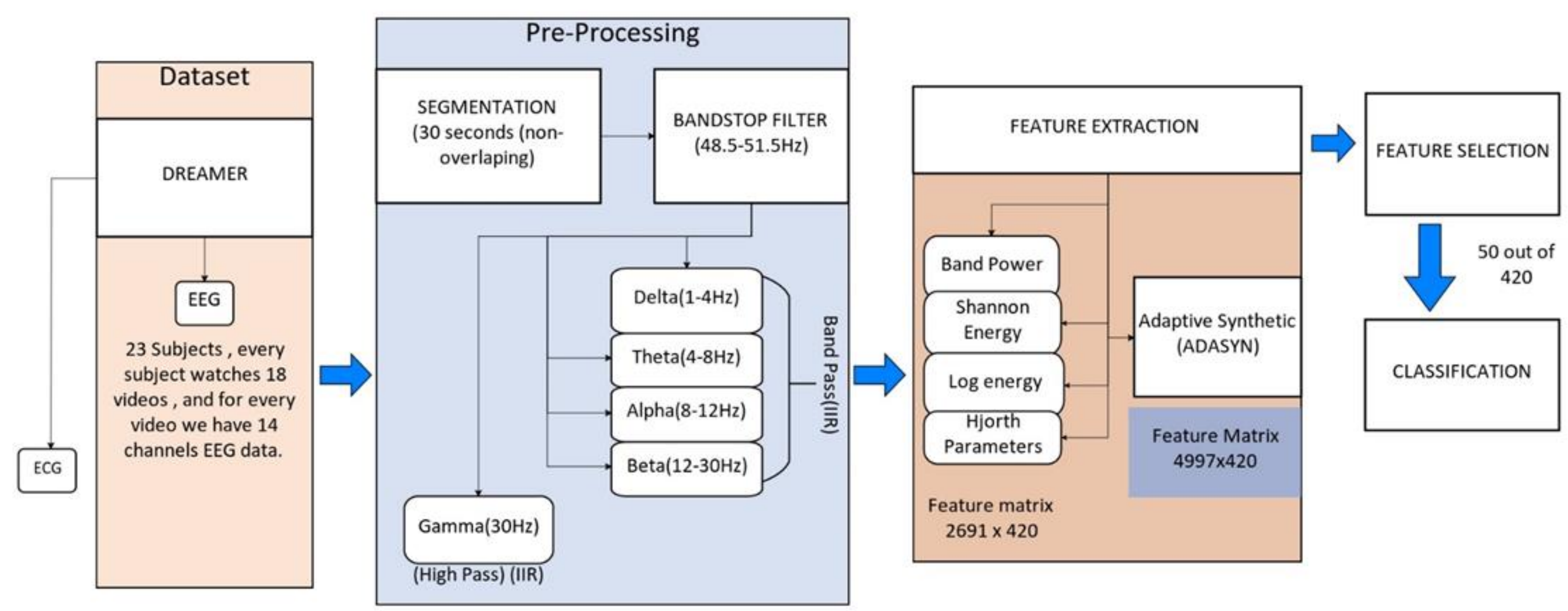


Depiction of 14-Channel's Data



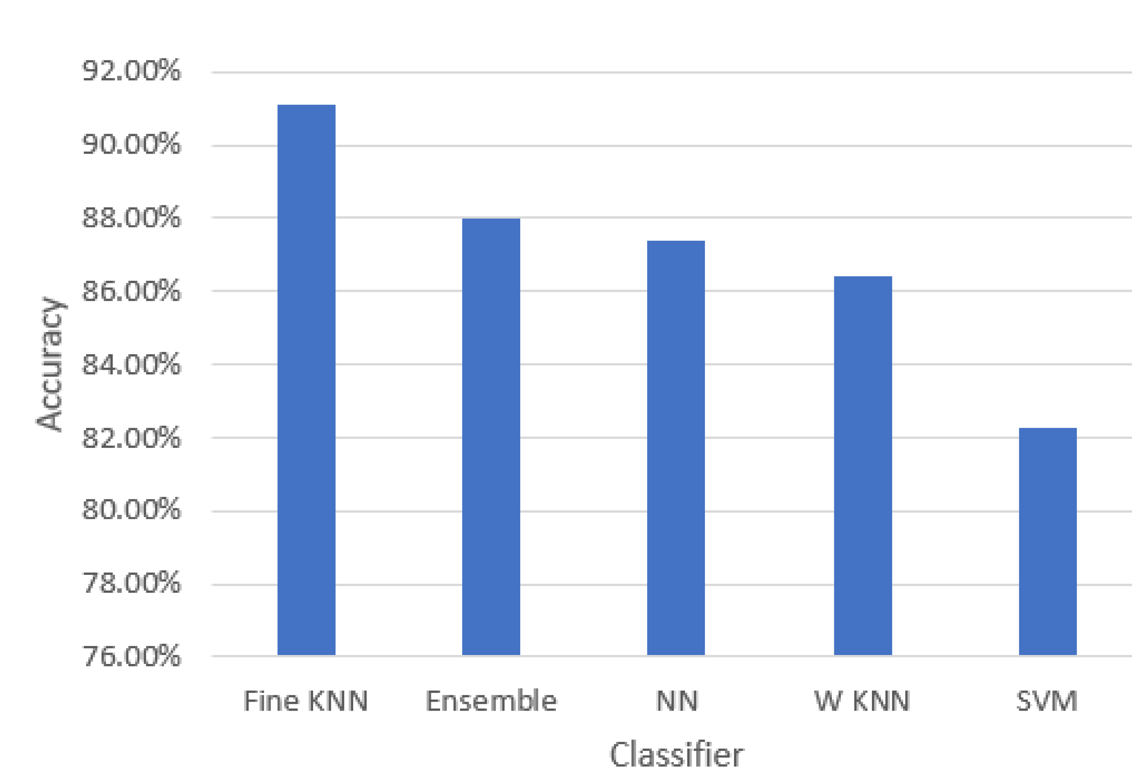
Methodology

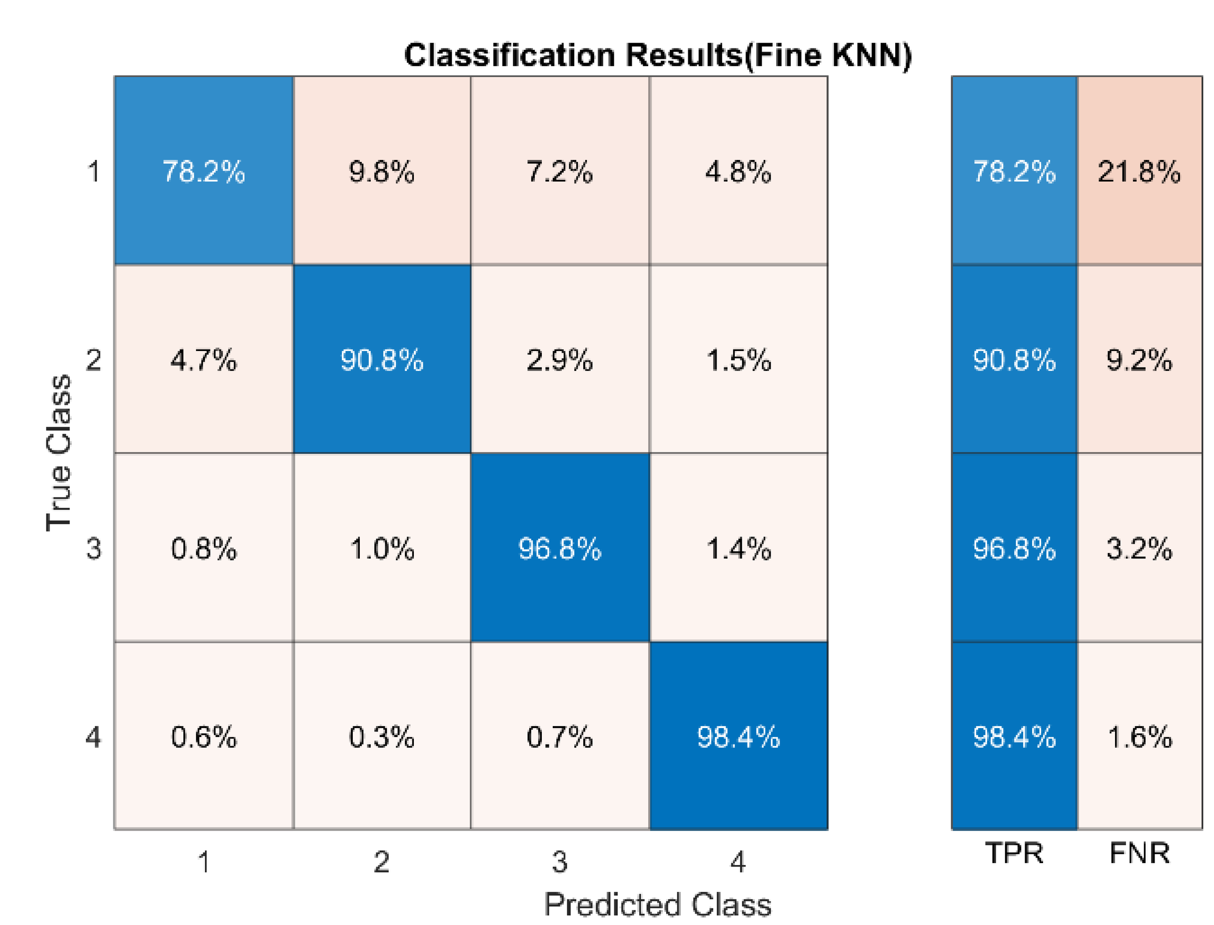
The block diagram of our proposed method is depicted in figure



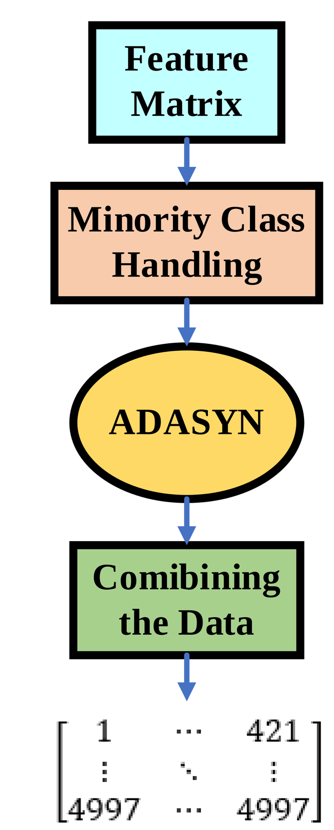
Results and Discussion

Here, we presented a non-invasive technique to detect four various emotions such as sadness, joy, pleasure, and anger using EEG signals. We extracted six best time-frequency-based features from 5 brain signals (frequency bands) with ADASYN for handling imbalance class problems, CHI2 is used to select 50 best features (Columns) as shown in TABLE-II. From the table, it is shown that the channel F8 is rejected and it is not involved in emotion recognition. Comparisons with other classifiers and class-wise accuracy are shown in the figures below.





Adaptive Synthetic (ADASYN)



Conclusion

The study focuses on accurately classifying four emotions (pleasure, sadness, joy, and anger) from EEG signals. Features like Shannon energy, log energy, band power, and Hjorth parameters are extracted. To handle imbalanced classes, the adaptive synthetic method is used. The Fine KNN classifier is employed for classification, offering high accuracy and fast training time compared to other classifiers. Feature selection using the CHI2 algorithm further improves accuracy to 91.1% by selecting the top 50 features out of 420. This approach effectively classifies emotions from EEG signals with efficient computational time.

References

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