Implementation and Results of Hybrid CNN-BLSTM Model for EEG Stress Detection

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1 Introduction

Due to its importance in mental health applications, stress detection via EEG signals has been extensively studied in recent years. The dataset, methodology, and outcomes of a hybrid CNN-BLSTM model application using EEG data are described in this article.

2 Dataset Description

The PhysioNet EEG data gathered from 36 participants as they performed mental arithmetic exercises served as the basis for the EEG dataset. Signals from 19 channels were captured at 500 Hz for 62 seconds to create the dataset. For categorisation, the data were divided into two states: stressed and relaxed.

3 Methodology

Discrete Wavelet Transform (DWT) is used to preprocess EEG data by breaking them down into frequency bands. CNN is then used to extract features. Lastly, the stress levels are categorised using a Bidirectional Long Short-Term Memory (BLSTM) network.The following steps were applied:

- **Preprocessing:** EEG signals were filtered using DWT for noise removal and divided into frequency bands: Delta, Theta, Alpha, Beta, and Gamma.
- **Feature Extraction:** CNN layers were used to extract key features from DWT-filtered signals.
- **Classification:** BLSTM was employed to classify the data into stress and relaxed states based on extracted features.

4 Results

The performance metrics for the model, including precision, recall, and f1-score, are shown in Table 1. The confusion matrix is presented in matrix form for clarity.

Table 1: Model Performance Metrics

Metric	Class 0	Class 1	Macro Avg	Weighted Avg
Precision	0.39	0.75	0.57	0.62
Recall	0.88	0.21	0.54	0.45
F1-Score	0.54	0.33	0.44	0.41
Support	8	14	22	22

Table 2: Confusion Matrix

	Predicted 0	Predicted 1
Actual 0	7	1
Actual 1	11	3

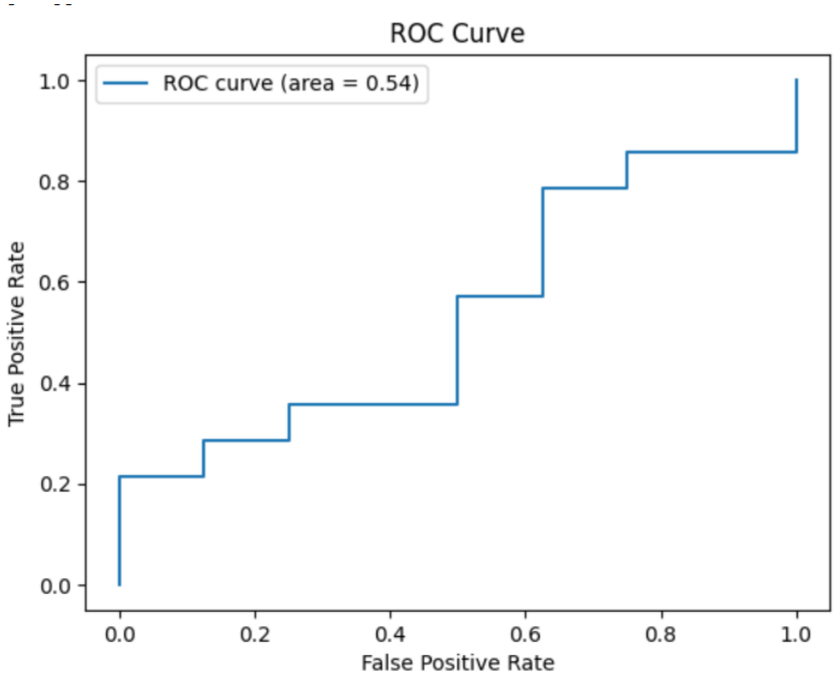

Figure 1: ROC Curve of CNN-BLSTM Model

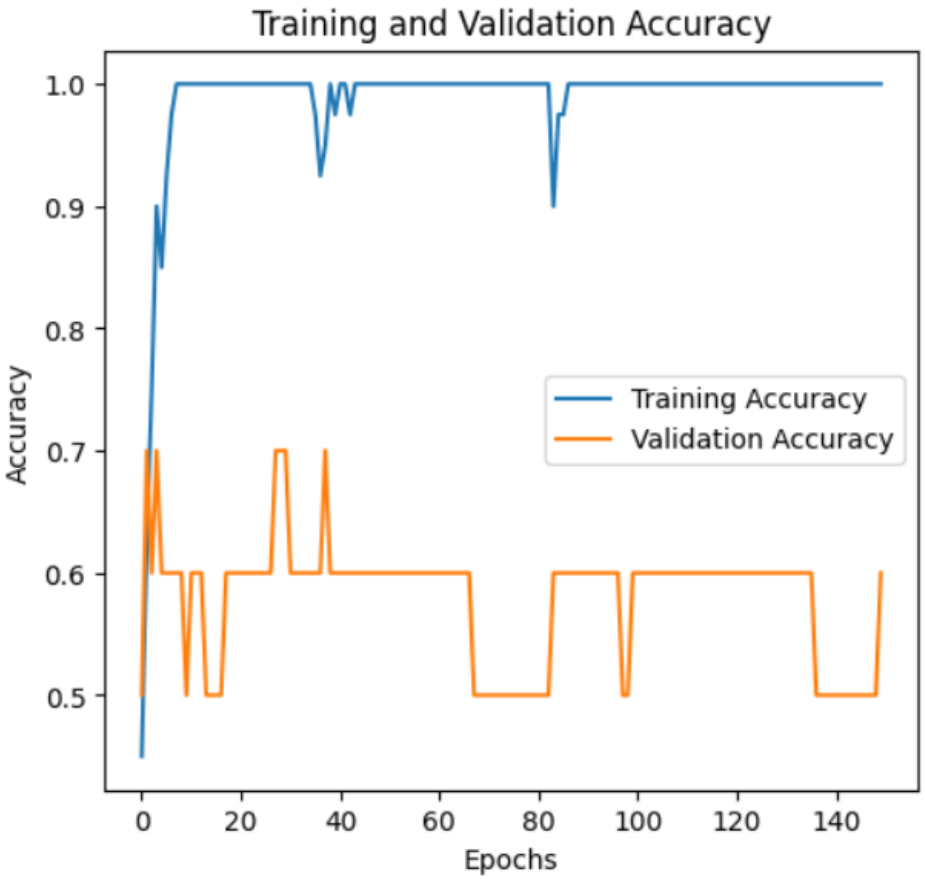

Figure 2: Training and Validation Accuracy

5 Conclusion

The CNN-BLSTM model provides moderate classification accuracy but shows significant room for improvement. Further model tuning or alternative feature engineering may improve class 1 recall in future experiments.