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

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1 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.

2 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.

3 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, and additional metrics are provided.

Table 1: Model Performance Metrics

Metric	Class 0	Class 1	Macro Avg	Weighted Avg
Precision	0.50	0.50	0.50	0.50
Recall	0.45	0.55	0.50	0.50
F1-Score	0.48	0.52	0.50	0.50
Support	11	11	22	22

Table 2: Confusion Matrix

	Predicted 0	Predicted 1
Actual 0	5	6
Actual 1	5	6

Table 3: Additional Metrics

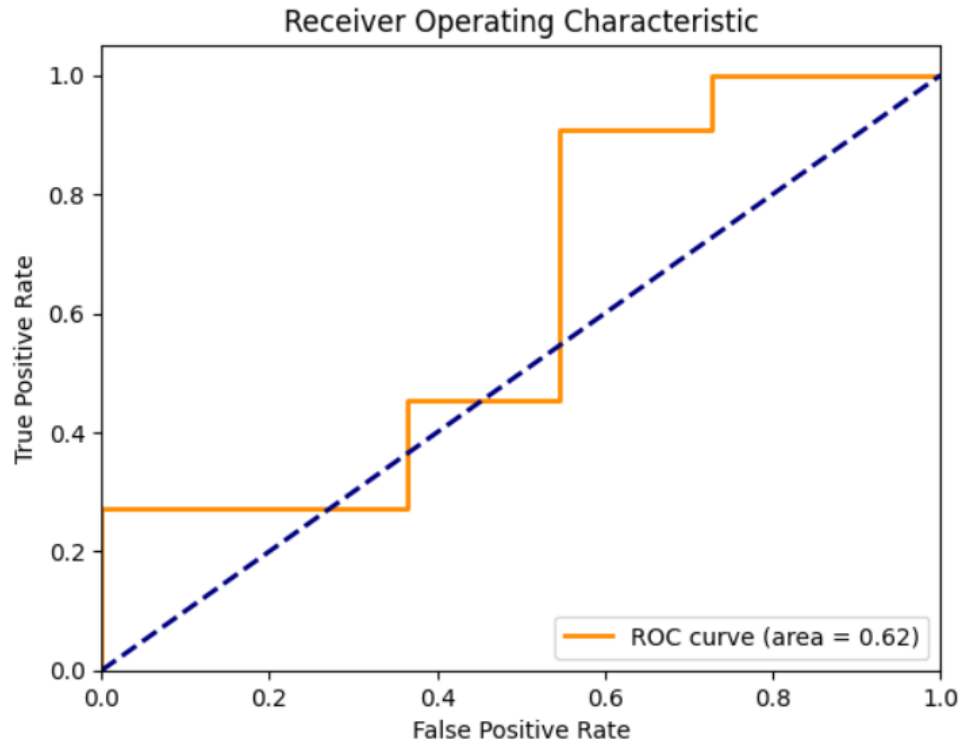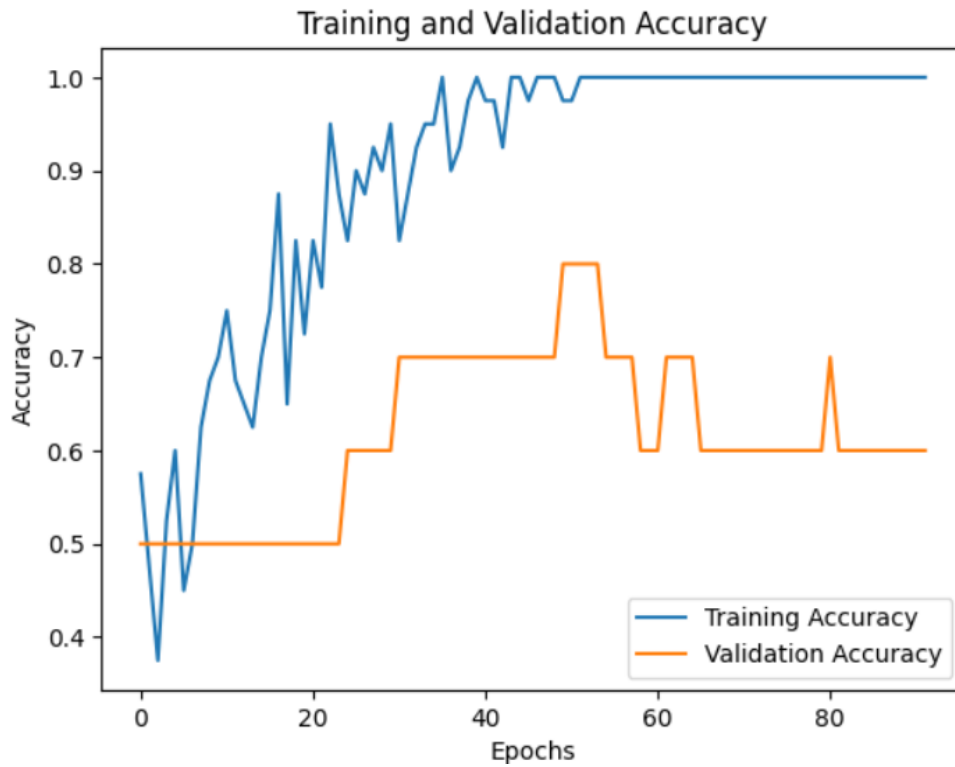| Metric	Value
Accuracy	0.50
Sensitivity (Recall for Class 1)	0.5455
Specificity	0.4545
Precision	0.5000
Negative Predictive Value (NPV)	0.5000
F1 Score	0.5217
Positive Likelihood Ratio (+LR)	1.0000
Negative Likelihood Ratio (-LR)	1.0000

Figure 1: ROC Curve of CNN-BLSTM Model

Figure 2: Training and Validation Accuracy

4 Conclusion

The CNN-BLSTM model achieved an accuracy of 50%, with balanced precision and recall. Improvements in feature extraction or model tuning may enhance performance on this dataset. Future experiments will explore additional tuning and alternative features.