

# EEG-Based Stress Detection Using CNN-BLSTM Hybrid Model

## 1. Introduction

A hybrid deep learning model that combines Convolutional Neural Networks (CNN) and Bidirectional Long Short-Term Memory (BLSTM) layers is used to detect stress from EEG readings. With particular patterns corresponding to mental states, EEG, a non-invasive measure of brain activity, offers important insights regarding stress levels.

## 2. Dataset Description

**Source:** Physionet EEG database Database link.

The dataset includes EEG recordings in EDF format for each subject in two conditions:

- **Background (\_1):** EEG recorded before a mental arithmetic task.
- **Task (\_2):** EEG captured while performing the task with the goal of creating cognitive load.

Subjects are divided into two groups based on task performance:

- **Group G (Good Performance):** 24 subjects, averaging 21 operations per 4 minutes.
- **Group B (Poor Performance):** 12 subjects, averaging 7 operations per 4 minutes.

**Data Preprocessing:**

- **Discrete Wavelet Transform (DWT)** was applied to decompose EEG signals into Delta, Theta, Alpha, Beta, and Gamma frequency bands.

## 3. Model Architecture and Implementation Details

The CNN-BLSTM model combines CNN layers for spatial feature extraction and BLSTM layers for capturing temporal dependencies.

**Model Layers:**

- **Conv1D Layers:** Two Conv1D layers (64 and 32 filters) extract features from the EEG frequency bands.
- **MaxPooling and Dropout:** Applied to reduce dimensionality and prevent overfitting.
- **BLSTM Layers:** Two BLSTM layers (64 and 32 units) capture sequential dependencies.
- **Dense Layer:** A final Dense layer with a sigmoid activation for binary classification.

# 4. Results

## 4.1 Performance Metrics

Metric	Class 0 (Non-Stressed)	Class 1 (Stressed)	Macro Avg	Weighted Avg
Precision	1.00	0.60	0.80	0.80
Recall	0.33	1.00	0.67	0.67
F1-Score	0.50	0.75	0.62	0.62
Accuracy	0.67			

Table 1: Model Performance Metrics

## 4.2 ROC Curve

With an Area Under the Curve (AUC) of 0.81, the model demonstrated a moderate level of efficiency in differentiating between stressed and non-stressed states.

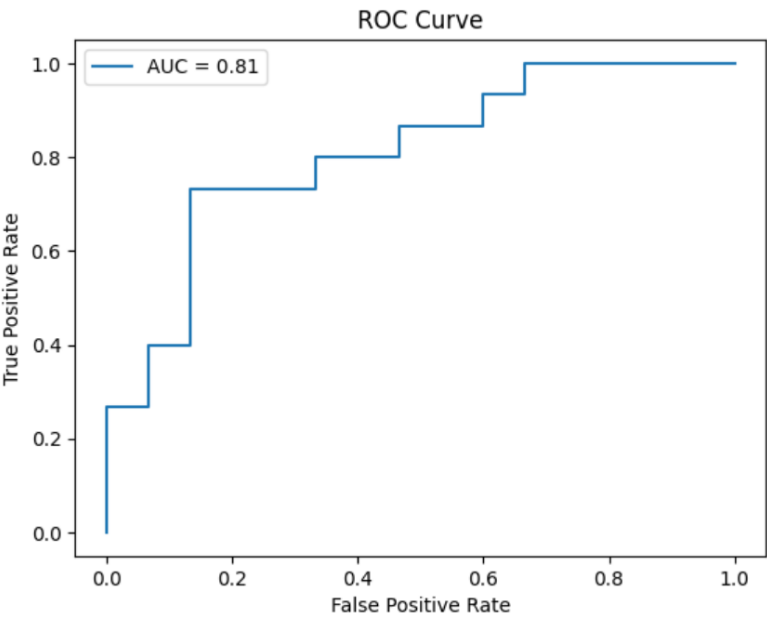


Figure 1: ROC Curve for Stress Detection Model