Chapter 5
Enhanced BiLSTM Model for EEG Emotional Data Analysis

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ABSTRACT

Emotion recognition based on biological signals from the brain necessitates sophisticated signal processing and feature extraction techniques. The major purpose of this research is to use the enhanced BiLSTM (E-BiLSTM) approach to improve the effectiveness of emotion identification utilizing brain signals. The approach detects brain activity that has distinct characteristics that vary from person to person. This experiment uses an emotional EEG dataset that is publicly available on Kaggle. The data was collected using an EEG headband with four sensors (AF7, AF8, TP9, TP10), and three possible states were identified, including neutral, positive, and negative, based on cognitive behavioral studies. A big dataset is generated using statistical brainwave extraction of alpha, beta, theta, delta, and gamma, which is then scaled down to smaller datasets using the PCA feature selection technique. Overall accuracy was around 98.12%, which is higher than the present state of the art.

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1. INTRODUCTION

Human emotions are vital in daily life and influence daily activities (Bos, 2006). The goal of affective computing is to create an emotional model that can monitor and interface with human emotional states. The subjective nature of a person's inner emotions is based on feelings, and experiences, both internal and external to the individual (Alarcao & Fonseca, 2019). To name a few, voice, facial, and physiological signals can all be used to detect and evaluate emotional states. The subject might disregard or falsify their mood states, which can lead to erroneous choices, according to the defects of the speech and facial approach. These shortcomings have been overcome by analyzing using physiological signals (Liu et al., 2010). The use of electroencephalogram (EEG) to detect emotions is quickly rising due to factors such as no interference with brain signals and the availability of numerous portable data-gathering equipment. This has allowed for the development of medicinal and non-medicinal applications (Molina et al., 2009).

The importance of EEG has been vastly exaggerated over time, and it is far from a panacea for brain activity. It can be detected if someone is awake, asleep, brain dead, suffering a seizure, and a few other things clinically. The EEG is the sum of all electrical stimulation on the surface of the brain. Because this action must pass through layers of soft tissue, bone, and skin, the data is naturally noisy.EEG data is collected using a standard setup of 20 electrodes spread across the scalp. The letter in each lead denotes which section of the brain it is closest to (Temporal, Frontal, Parietal, and so on), with odd numbers and even numbers on the left and right respectively. In the clinic, usually consider the potential difference between pairs of electrodes rather than the electrical potentials at each electrode. This allows deducing what the brain is doing in that location by looking at the electrical field in the brain region between these two places. When any two electrodes are chosen and it generates 20 factorial distinct potential differences, not all of them will be beneficial.

As Montages, the arrangement of selecting pairs of electrodes to compare potential differences. There are several other montage systems, but the 10-20 system is the most prevalent. Looking at the firing rate is where the EEG data gets fascinating. The neuronal activity begins to synchronize in quite amazing ways with specific medical illnesses and mental states. This activity's firing rate is measured in Hz and divided into bands:

- Delta (<4Hz) Continuous attention activities, slow-wave sleep
- Theta (4-7Hz) Repression of evoked responses, drowsiness
- Alpha (8-15Hz) Closed eyelids, relaxed
- Beta (16-31Hz) Active thinking, concentration, and vigilance

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