Automated EEG-based major depress disorder detection through transformer-based network

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Introduction

In recent years, deep learning has been extensively used for arbitrary diagnosis of many mental diseases based on EEG or fMRI, including epilepsy[1], seizure prediction[2], Alzheimer's disease[3], etc. Simultaneously, depression is a common illness worldwide, with an estimated 3.8% of the population affected, including 5.0% among adults and 5.7% among adults older than 60 years. Over 700,000 people die due to suicide caused by the depression every year. [4] However, it can be effectively diagnosed and treated in early period. A schematic comparison of synapses from a healthy subject and a depressed subject is presented in Fig. 1.

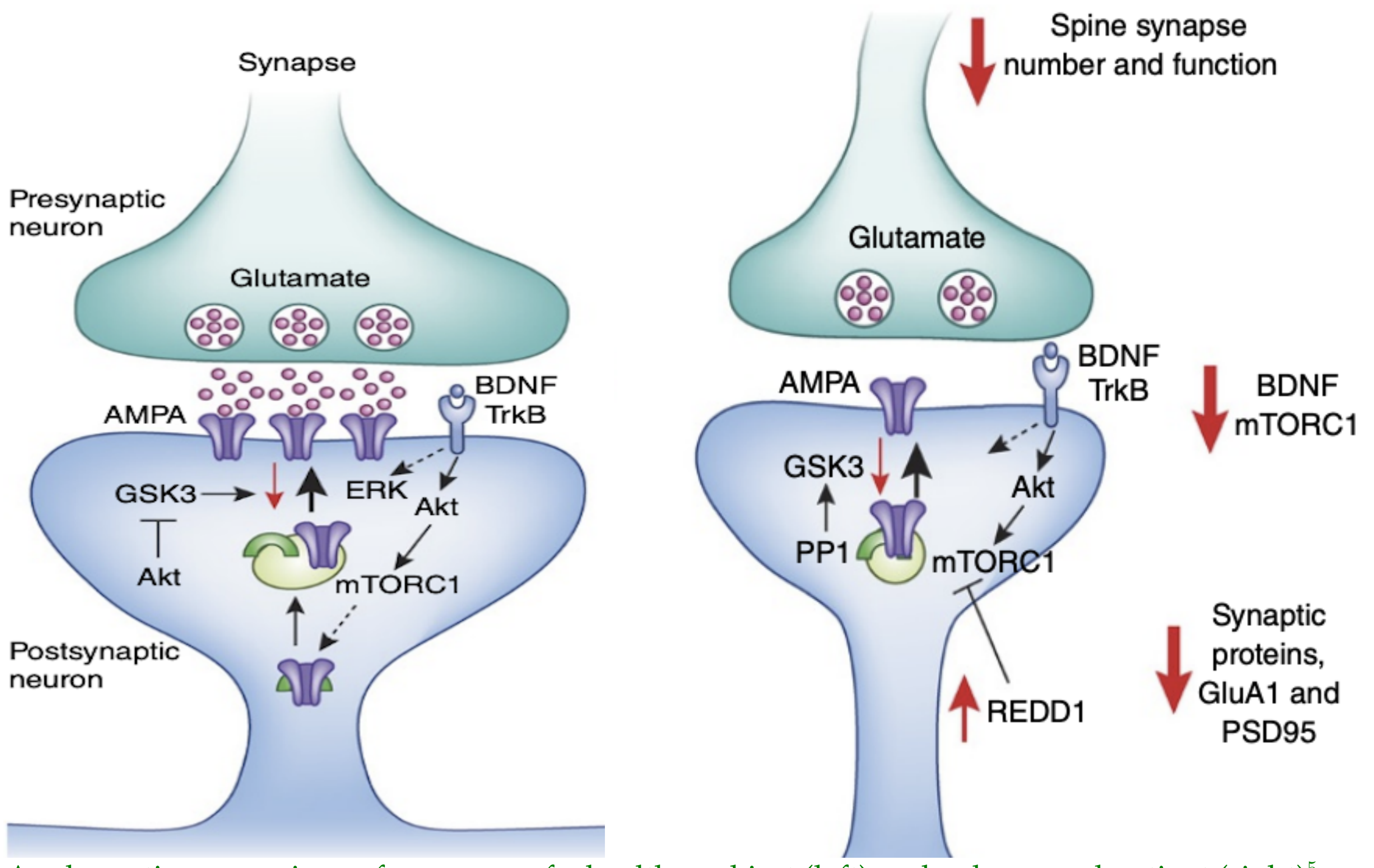

Figure 1: A schematic comparison of synapses of a healthy subject (left) and a depressed patient (right)[5].

In this work, we presented an EEG-based major depress disorder detection neural network based on GPT-3. It takes EEG signal as input and outputs its predication graded with None, Mild, Moderate and Severe based on the severity of symptoms. We trained this network with 128 channels resting signal obtained 24 major depressive disorder subjects and 29 healthy control subjects, ranging from 16 - 52 years old[6]. This model was tested by various public datasets, the accuracy and f1 score can reach about 0.9. Additionally, we compared our network with naive CNN and RNN, we can induct that our model performs better.

Data and Methods

The data being used in this work is an open-source EEG dataset from UAIS Lab, Lanzhou University, China[6]. The dataset contains traditional 128-electrodes EEG signals as well as audio data from clinically depressed patients and matching normal controls. The EEG signals of 53 subjects were recorded in resting state & under stimulation.

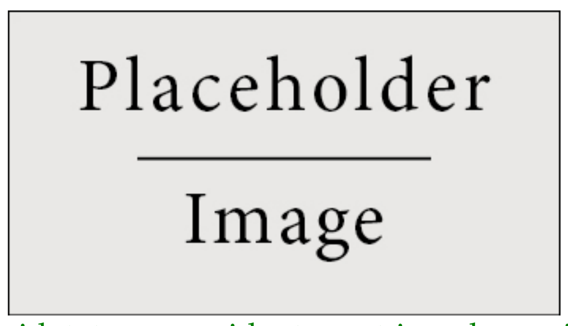

Figure 2: Loreteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

The pre-processing of the raw EEG signal contains 3 parts,
1. Segmenting
2. Band-pass filtering
3. Standarlization

The data is segmented into trials as $C_{eeg} * T$, where C_{eeg} is the number of EEG channels and T is the sample points. Then we add band-pass filter data to $[4, 40]Hz$ to remove high and low-frequency noise. After that we apply standard normalization to relive the fluctuation and non-stationarity as

$$X = x - \mu/\sqrt{\sigma}^2$$

Additionally, we give a feasible way based on CSP usage to improve the difference of the original signal and maintain the temporal information.

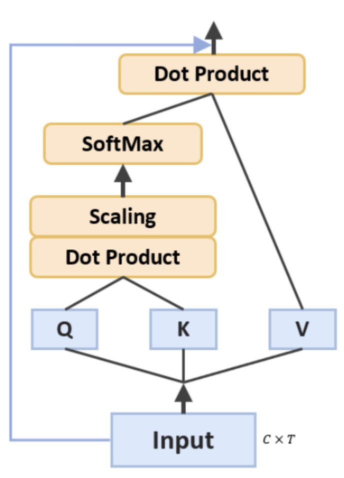

Figure 3: The calculation process of spatial feature-channel attention

We proposed a method of feature channel weighting inspired by the scaled dot-product. As illustrated in Fig.3.
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Results

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Figure 4: Cdfhfghgf R (gfhfgh) and GDDDE.

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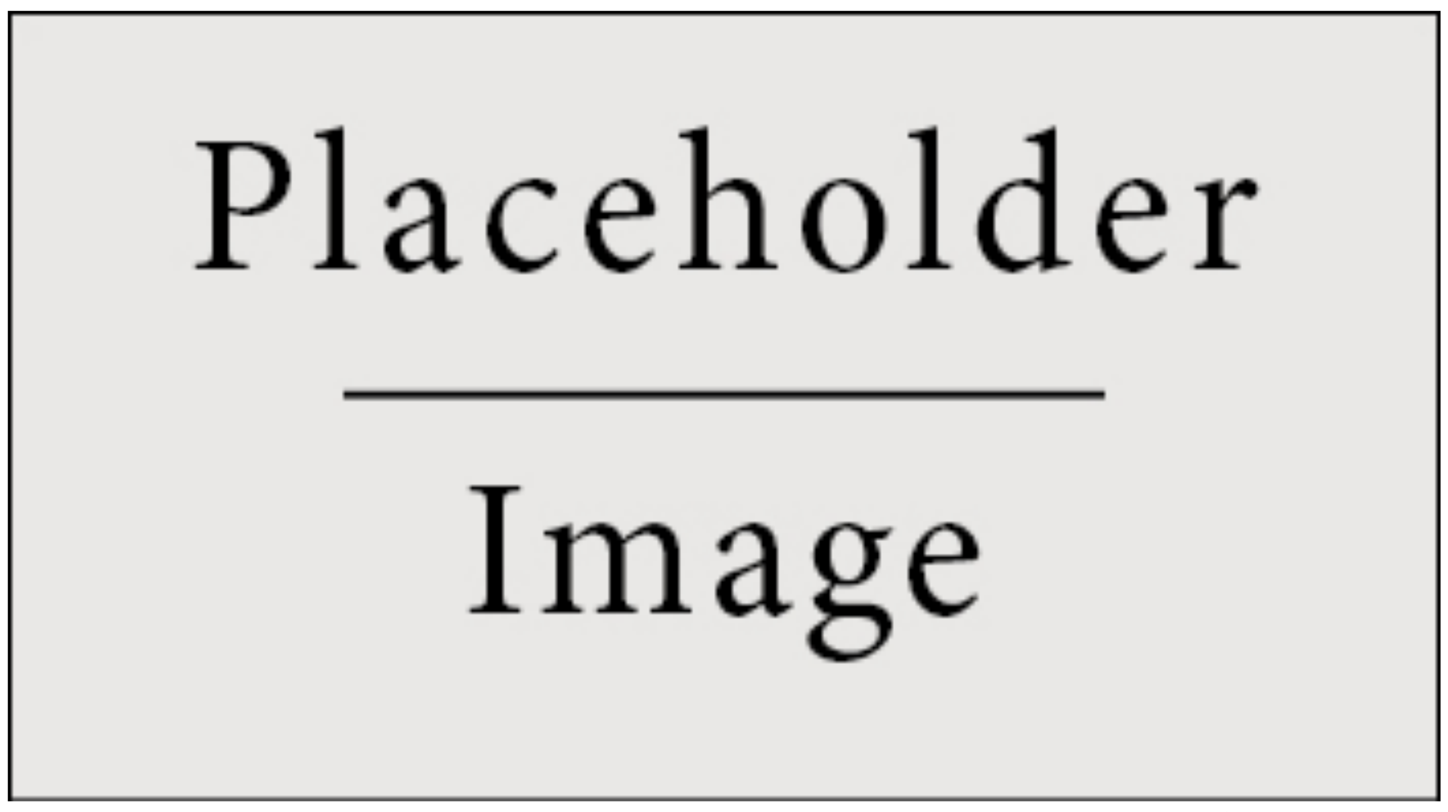

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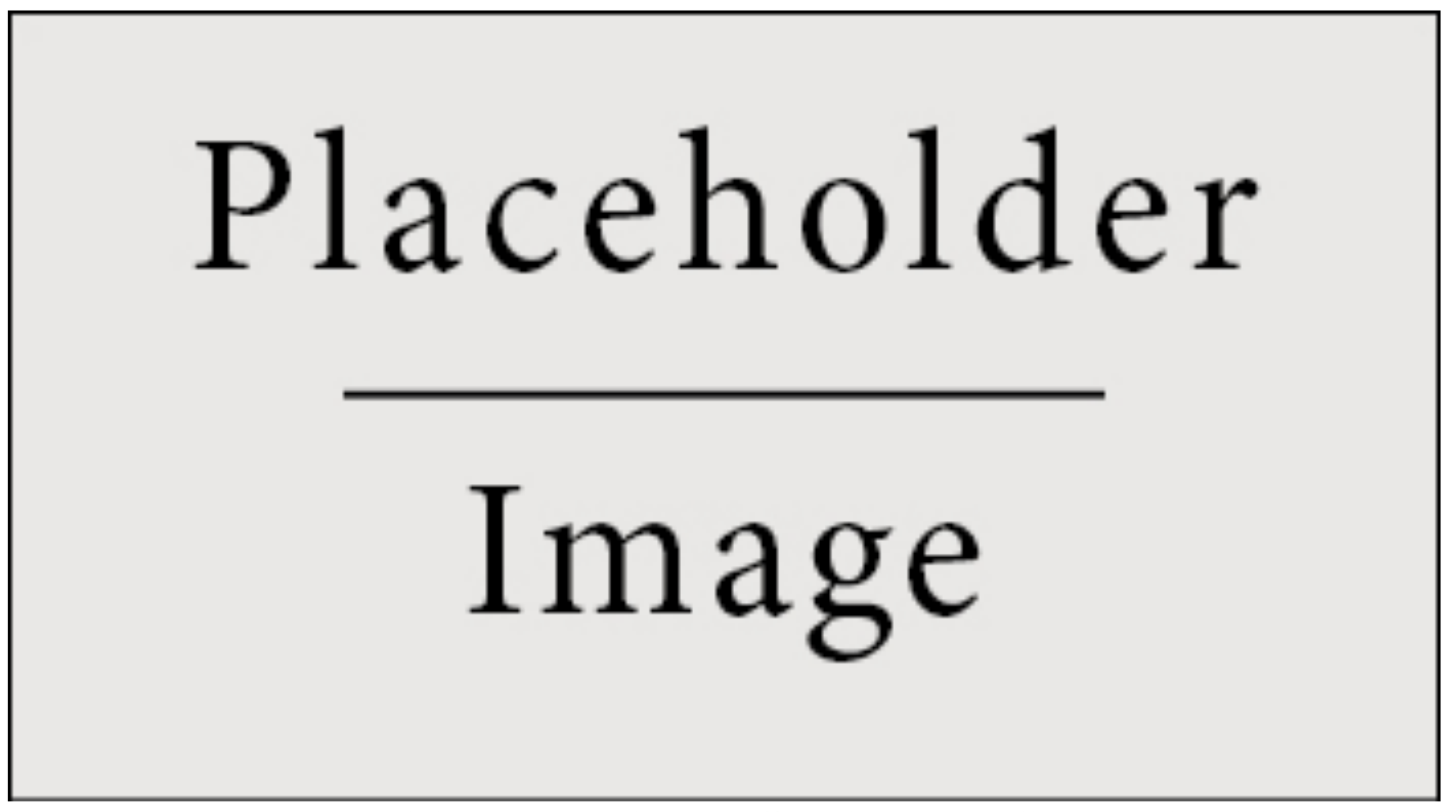
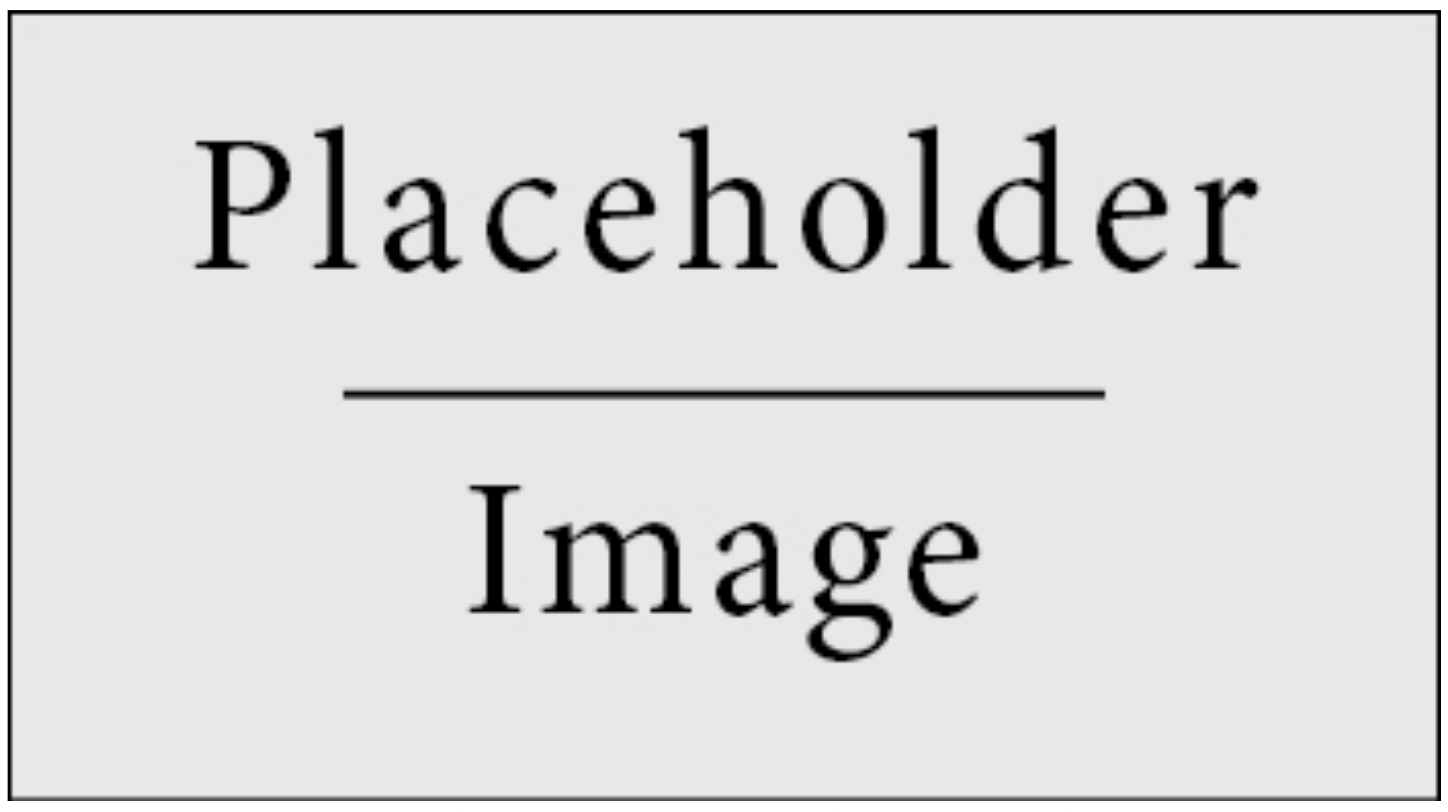


Figure 6: VLorem ipsum dolor sit amet, ulpa qui officia deserunt mollit anim id est laborumime.



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Summary

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