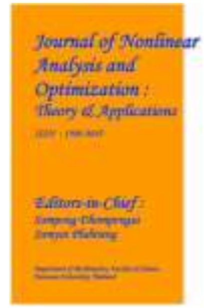
**J**ournal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 16, Issue. 1: 2025
ISSN : **1906-9685**




# EEG SIGNALS -BASED HUMAN EMOTION IDENTIFICATION USING DEEP LEARNING

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**ABSTRACT—** A crucial field of study in psychology, human-computer interaction, and healthcare is emotion recognition. Traditional approaches are unreliable and have intrinsic limitations, even if they primarily rely on textual analysis and facial expressions. Emotion recognition based on facial expressions makes the potentially incorrect assumption that they reflect true internal emotions. Similar to this, textual analysis relies on the information at hand and requires assistance in precisely identifying nuanced emotions in text. But an increasingly popular substitute for objective, real-time emotion identification is electroencephalography (EEG). EEG measures brain activity directly and yields a reliable result, unlike facial and textual approaches. In this work, we suggest a thorough approach to EEG-based emotion identification that overcomes the drawbacks of conventional approaches and fundamental machine learning strategies. Our method includes feature extraction approaches after preprocessing EEG signals with a butter-worth bandpass filter to remove noise. In order to ensure effective data representation, we next use Principal Component Analysis (PCA) for dimensionality reduction.

*Index Terms* – EEG, machine learning, deep learning, FFT, neural network, PSD, spectral entropy.

## I. INTRODUCTION

Affective computing has evolved as a significant subject of study to develop systems that can perceive emotions automatically. Emotion recognition technology is expected to be worth $21.6 billion in 2019 and $56 billion by 2024. Our daily interactions with others, our decisions, and the way we describe the world are all influenced by our emotions. Although, basic human emotion can be recognized through body language and facial expressions, but there are additional specific types of emotions. In recent decades, research on emotion recognition has been robust. It enables machines to learn about human emotions, and it can be achieved primarily in two ways:

**A. NON-PHYSIOLOGICAL SIGNALS** These signals represent how our body physically operates. It contains information that we gather from our surroundings, including visual and aural data. Examples include body language, voice tone, and facial emotion.

**B. PHYSIOLOGICAL SIGNALS**

These signals are also related to the physical functioning of the body. It includes the changes in a human's mental state, heart rate, breathing, body temperature, and muscle tension. It can also provide us with some of the physical states, such as whether we are relaxed or stressed, and can also be used to measure the effects of different stimuli on our body. But in actual situations, it can be very challenging to tell someone's feelings only by glancing at their face and behavioral patterns. Because, emotions are strong feelings acquired from human's happenings, moods, or relationships with others. Emotions are basically mental states that come from changes in our body and brain. They can be related to our thoughts, behaviors, or how good or bad we feel. It is difficult to recognize the real or correct emotions of every human and also the expressions of disabled people based on their appearance. Also, there is an issue in modern times, especially with teenagers and adults that they often pretend to be happy and show off (fakeness) in social settings like- parties, clubs, and gatherings with friends. During the period of the COVID-19 epidemic, this pattern has become more noticeable. Social media has a big role in this trend, as people try to present themselves as a perfect and happy life to their friends and followers, even if it is not true.

## II. LITERATURE SURVEY

### *A. EEG-based brain wave recognition using GRU and LSTM*

The human brain is made up of millions of neurons, each of which plays a crucial part in directing the behaviour of the human body in response to internal/external motor-impulses. These neurons will act as data conduits between the brain and the body. Studying brain signals or images may help us better understand the cognitive behaviour of the brain. Motor and sensory states including eye movement, lip movement, memory, concentration, hand clutching, and others may be used to depict human behaviour. These states are associated with certain signal frequencies, which aids in understanding the functional behaviour of complex brain structures. In this study, the characterization of EEG signals in connection to various bodily states is the main topic of study. It also talks about the experimental design used for the EEG analysis. On a dataset of physiological signals, in this case the AMIGOS dataset, including electrocardiogram and galvanic skin reaction, this study uses a deep convolutional neural network. In order to characterize a person's emotional state, these physiological signals are combined with the dataset's arousal and valence data. In addition, a tool for detecting emotions based on traditional machine learning techniques is provided in order to extract the properties of physiological data in the time, frequency, and nonlinearity domains. For autonomous feature extraction of physiological inputs in this application, a convolutional neural network is used. Fully connected network layers are then used to predict emotions. Compared to the original authors of this dataset, the experimental results on the AMIGOS dataset show that the approach suggested in this study provides more accurate emotional state categorization.

### *B. Emotions recognition using EEG signals: A survey*

Emotions recognition using EEG signals: A survey Emotions have an important role in daily life, not only in human interaction, but also in decision-making processes, and in the perception of the world around us. Due to the recent interest shown by the research community in establishing emotional interactions between humans and computers, the identification of the emotional state of the former became a need.

This can be achieved through multiple measures, such as subjective self-reports, autonomic and neurophysiological measurements. In the last years, Electroencephalography (EEG) received considerable attention from researchers, since it can provide a simple, cheap, portable, and ease-to-use solution for identifying emotions. In this paper, we present a survey of the neurophysiological research performed from 2009 to 2016, providing a comprehensive overview of the existing works in emotion recognition using EEG signals. We focus our analysis in the main aspects involved in the recognition process (e.g., subjects, features extracted, classifiers), and compare the works per them. From this analysis, we propose a set of good practice recommendations that researchers must follow to achieve reproducible, replicable, well-validated and high-quality results. We intend this survey to be useful for the research community working on emotion recognition through EEG signals, and in particular for those entering this field of research, since it offers a structured starting point.

### *C.* ***EEG-based emotion recognition: A state-of-the-art review of current trends and opportunities***

Emotions are fundamental for human beings and play an important role in human cognition. Emotion is commonly associated with logical decision making, perception, human interaction, and to a certain extent, human intelligence itself. With the growing interest of the research community towards establishing some meaningful “emotional” interactions between humans and computers, the need for reliable and deployable solutions for the identification of human emotional states is required. Recent developments in using electroencephalography (EEG) for emotion recognition have garnered strong interest from the research community as the latest developments in consumer-grade wearable EEG solutions can provide a cheap, portable, and simple solution for identifying emotions. Since the last comprehensive review was conducted back from the years 2009 to 2016, this paper will update on the current progress of emotion recognition using EEG signals from 2016 to 2019. The focus on this state-of-the-art review focuses on the elements of emotion stimuli type and presentation approach, study size, EEG hardware, machine learning classifiers, and classification approach.

## III. PROPOSED SYSTEM

The overview of our proposed system is shown in the below figure.

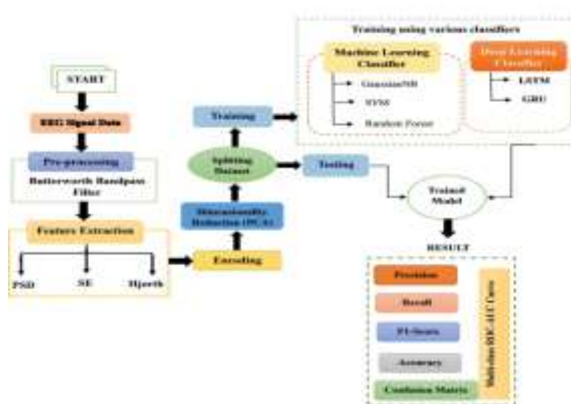


Fig. 1: System Overview

### *Implementation Modules*

**Service Provider Module**

- In this module, service provider login to the system using valid username and password. After login successful, he can perform the following operations like train and test dataset, view trained and tested accuracy and view remote users.

**Train and Test Model**

- In this module, the service provider split the Used dataset into train and test data of ratio 70 % and 30 % respectively. The 70% of the data is consider as train data which is used to train the model and 30% of the data is consider as test which is used to test the model

**Remote User**

- In this module, the remote user register to the system, and login to the system valid username, and password. After login successful, he can perform view profile, Identifying the emotion.

**Graphical Analysis**

- In this module, display the graphs like accuracy and predicted ratio of the system.

## IV. RESULTS

Fig.2: Home Page


Fig.3: Service Provider Login


Fig.4: Model Accuracy

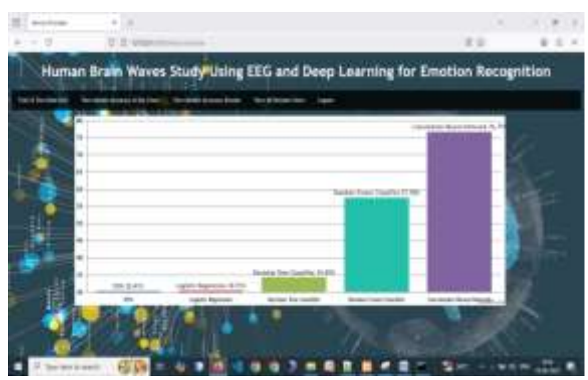


Fig.5: Model Accuracy Results


Fig.6: Model Accuracy Results

## V. CONCLUSION

The model presented in this work has shown good results in classifying EEG brain signals into different emotions. By this work, the ability to classify emotions with EEG signals could enable more personalized and adaptive human-computer interaction and improve our understanding of the neural mechanisms underlying emotional processing. However, there are some limitations. The dataset was small and only included EEG data from people watching emotional videos. Additionally, the features extracted in this study are relatively simple and may only partially capture the complex patterns in EEG signals relevant to emotion classification.

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