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EEG based Stress Analysis Through Feature Extraction

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Abstract—The diagnosis of Stress relies virtually solely on doctor-patient conversation and scale analysis, which includes problems such as patient denial, insensitivity, subjective biases, and inaccuracy. Improving the accuracy of Stress diagnosis and therapy necessitates the development of an objective, computerized system for predicting clinical outcomes. Using the modification of EEG data and machine learning techniques, this study attempts to improve the recognition of Stress. The EEG data of 10 volunteers were acquired using a Narosky device during an experiment, including emotive facial stimuli. Psychiatrists used the EEG signal as the criterion for diagnosis of Stress in patients. The different approaches processed the features: machine learning and deep learning. Significant outcomes are achieved using PCA, ICA & EMD for BCI applications. SVM empowers a developer with several advantages: PCA exhibits excellent generalization properties, with stress & pressure detection using EEG Signals. If the signals are negative, the impact of overtraining is sensitive to the curse-of- dimensionality. These advantages were achieved by using EEG signals to detect Stress. The experimental analysis gives some overview of all different approaches, which depend on frequency domain analysis with 14 fourteen-channel EEG signals with reasonable accuracy.

Keywords-Human Stress, EEG signal, Feature extraction, BCI.

I. INTRODUCTION

Stress is a mental disorder with which human cultures have been grappling in recent times . A person who is depressed finds it very. Difficult, if not impossible, to continue living. Despair, a sense of emptiness, loss, impatience, pessimism, perpetual fatigue, a sense of isolation, etc., cause individuals to withdraw from society and their surroundings progressively. The course of the condition may result in self-injurious behavior; the patient may often consider suicide and obligate suicide towards the termination. Prompt analysis of Stress is crucial to saving an individual's life.

Psychiatrists, psychologists, and clinicians employ a particular context to analyze Stress in patients; based on the responses to a series of queries from patients or other health studies, they determine if a person is well or depressed and determine the severity [1]. However, these methods present their difficulties, such as the innocence of the physicians, the patient's annoyance or unwillingness to answer questions, mental struggles between the patient and the doctor, expensive counseling sittings, etc., which make dealing complex error-prone. Therefore, investigators and clinicians seek low-cost, effective, and dependable approaches to diagnosing Stress.

An electroencephalogram (EEG) is an alternative way of detecting illness. Electric waves are the means through which brain cells interact the EEG analyses the brain's electrical activity, an excellent technique for learning about brain functions [2]. EEG signals have been used in the diagnosis of several disorders.

Since sadness affects brain activity and EEG indications monitor the electrical movement of

the brain owing to their synaptic relationship, we may conclude that EEG indications may be a valued biomarker for diagnosing Stress. Graphic investigation of long-term EEG data to differentiate between a regular and a depressed patient is complicated and disposed to humanoid error since such an analysis depends on the specialist knowledge of the psychiatrist [3]. Also, since EEG is a composite, nonlinear, and non-stationary indication, its visual assessment and explanation are arduous and tiresome, and there is a significant possibility of inaccuracy. Therefore, a computer-aided diagnosis structure is desired to differentiate between standard and depressive EEG indications correctly.

A. PROBLEM STATEMENT

Lack of a cost-effective and straightforward system for stress detection using a single-channel device. Keeping the above issue as motivation, it is decided to design a real-time human stress recognition framework for brain signals using suitable feature extraction and classification techniques to improve accuracy.

1. Inadequate selection of EEG channels and bands for the stress/Stress identification system.
2. Absence of stress/Stress consideration
3. Lack of a cost-effective and system for/Stress detection using a single-channel device.

Hence there is a lot of scope for developing efficient feature extraction techniques involving robust EEG single preparation and significant emotion investigation to give a solid decision about human Stress recognition. The framework focused on finding appropriate feature extraction and classification technique for Stress detection the brain owing to their synaptic relationship, we may conclude that EEG indications may be a valued biomarker for diagnosing Stress. Graphic investigation of long-term EEG data to differentiate between a regular and a depressed patient is complicated and disposed to humanoid error since such an analysis depends on the specialist knowledge of the psychiatrist [3]. Also, since EEG is a composite, nonlinear, and non- stationary indication, its visual assessment and explanation are arduous and tiresome, and there is a significant possibility of inaccuracy. Therefore, a computer-aided diagnosis structure is desired to differentiate between standard and depressive EEG indications correctly.

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II. RELATED WORK

Wherever Times is specified, Times Roman or Times New Roman may be used. If neither is available on your word processor, please use the font closest in appearance to Times. Avoid using bit-mapped fonts if possible. True-Type 1 or Open Type fonts are preferred. Please embed symbol fonts, as well, for math, etc.

There has been a significant amount of study done on the categorization of emotions based on human brain activity, mostly as a result of investigations carried out by a number of researchers located all over the world [4]. Their exhaustive research led them to discover methods of EEG signal processing that make use of a variety of methodologies for the extraction and classification of features. The majority of studies that have been published contain a significant number of machine learning algorithms geared toward the analysis of facial images, speech signals, and EEG data. Despite the fact that these earlier research provide useful insight into identifying the major elements that regulate human stress, the framework for human stress in the modern era is only partially addressed by these solutions. This chapter focuses on the significant contributions made by researchers in the modern age from the point of view of the electroencephalography signal processing tool, and it sheds light on the approaches that are linked with those contributions.

The number of responses received from each country is presented in Figure 1. These findings indicate that controlling for socioeconomic factors, perceived employment conditions, and employment disappointment does not explain the majority of the variation that exists between countries in perceived risk of word-related stress. This holds true for each of the national stress indices that were compiled by the individuals. Figure 1 illustrates the assessed quantity of stress-related side effects for each relapse model across nations, as well as the position of each nation on these evaluations [5]. When viewed from the perspective of the mainland of India, a significant portion of the working population is affected by a wide variety of forms of stress.

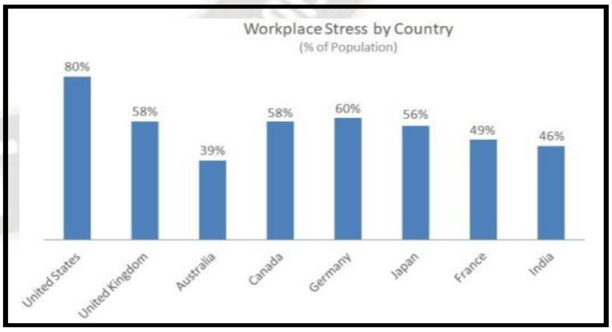

Figure 1: MOTIVATIONAL GRAPH FOR APPROACH SELECTION

This study reveals that about eighty percent of people are affected by stress brought on by their jobs, and the findings point to a number of variables that are both intriguing and concerning. Because of the stresses associated with their jobs, about sixty percent of the workforce has quit. More than ninety percent of workers take advantage of the opportunity to enrol in stress management programs [6].

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The utilization of an EEG methodology has as its overarching purpose the employment of a single-channel stress detection mechanism that will, if successful, lead to the effective development of an efficient strategy. Traditional methods of stress detection yield inconsistent results that can only be attained by investing a significant amount of money in the component equipment [7]. The EEG approach utilizes a computerized analysis to determine a person's emotional rhythm. The following sections provide an overview of some of the key research that has been conducted over the past two decades towards the identification of stress and the methodologies that have been used.

C. Lin et al. (2018) [10] investigated the relationship between the number of keystrokes on the keyboard and the levels of work-related stress experienced by individual respondents. They examined the participants over both a short and a lengthy period of time and determined that they suffered from a variety of unique and genuine illnesses. For the purpose of identifying pressure, a few strategies featuring a variety of techniques have been recorded in writing. N. Suleiman et al. (2011) and C. Viegas et al. (2018) observed facial expressions to detect stress, and J. Zhang et al. (2017) investigated the presence of stress levels using the temperature of the finger, human gestures, and eye blink as the primary modalities. All of these studies focused on the facial expressions of the participants.

Review of the Research on Brain Activity Measurement Methods

III. PROPOSED METHOD

This paper presents a multimodal Stress identification model based on synthesizing EEG information recorded while listening to neutral, adverse, and helpful auditory stimuli. As seen in Fig., the synthesis is predicated on the subsequent factors: Using EEG data, the subjective perception of positive emotional stimuli is diminished in depressed individuals (lowered positive feelings).

(I) Depressed people are further susceptible to adverse expressive stimuli, as shown by a greater focus on unpleasant feelings and an elevated emotional reaction (negative emotions are improved).

(II) In the event of discrete differences, the retrieved structures in separate modalities utilizing distinct feature extraction approaches (constructive audio stimulus or adverse audio stimulus) are erroneous. In light of the difficulties, combining numerous modalities' characteristics may reimburse for the absence of discrete modality characteristics. This research does EEG data fusion at the feature level.

The choice of synthesis characteristics and the weighing of synthesis characteristics.

(I) The EEG attainment equipment simultaneously gathers the theme's EEG information. At the same time, they are exposed to neutral, adverse, and helpful auditory impetuses, and then the EEG information is preprocessed.

(II) The characteristics derived under unbiased audio stimulus are designated neuEF, those removed under adverse audio stimulus as negEF, and those released under helpful audio stimulus as posed.

(III) The three straightly mixed attributes in the third stage are signified as neg neuEF, pos neuEF, and pos negEF, separately.

(IV) neg neuEF, pos neuEF, and pos negEF are picked and weighted to create the new designs neg neuSF, pos neuSF, and pos negSF, individually.

(V) The classifier is prepared utilizing neg neuSF, pos neuSF, and pos negSF to construct a downturn acknowledgment model.

A. Methodology

The schematic views designed an automated framework to recognize human stress and avoid the side effects of stress using EEG signals with sentiment analysis. The various electrical frequencies in EEG with conclusion investigation can be related to multiple actual activities and mental states.

So, EEG shows wide varieties in plentifulness relying upon outer incitement and diverse inner mental states. The fig shows the method of identifying a stressed and unstressed state of a person, and this method consists of pre-processing, EEG band separation, EEG band selection, EEG feature extraction, and emotion detection with sentiment analysis. As well the following figure gives the flow of detail work.

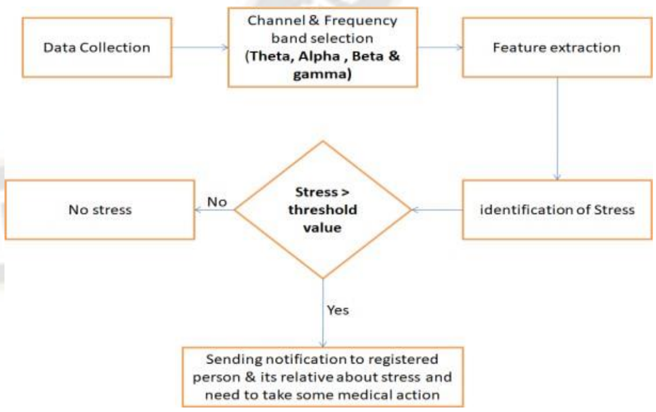

Figure 2: human Stress detection Approach

The goal of this study is to create a human Stress detection framework that can be used with EEG readings without requiring any user input. Human emotion recognition and stress detection sentiment analysis: uncovering the most effective and efficient features to use.

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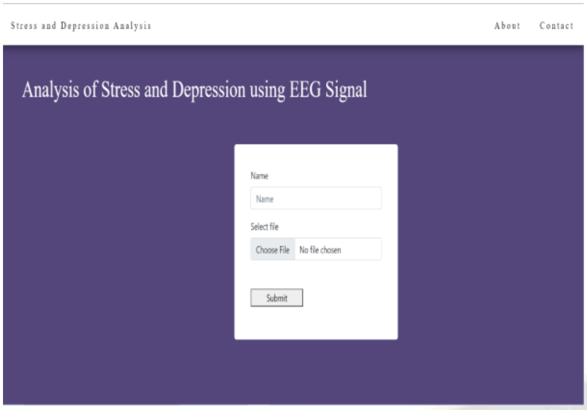

Figure 3: home screen for CSV file selection

The following section gives a details overview of the existing feature extraction algorithm. The Significant outcomes are achieved using PCA, ICA & EMD for BCI applications. SVM empowers a developer with several advantages: PCA exhibits excellent generalization properties, with stress & pressure detection using EEG Signals; if the signals are negative, then its impact of overtraining

sensitive to the curse-of-dimensionality. These advantages were achieved by using EEG signals to detect stress & pressure. The following figure gives an overview of all the different approaches, which are depend on frequency domain analysis with 14 fourteen channel EEG signals,

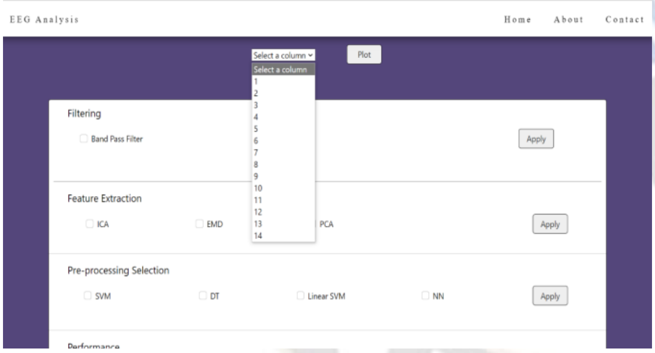

Figure 4: brain signal analysis

Figure 5: SVM pre-processing analysis using different parameter

IV. CONCLUSIONS

This is the initial research to utilize the EEG signal data and its geometrical elements to differentiate between regular and depressed participants . This is the initial research to examine and compare the presentation of optimization techniques designed to reduce feature vector ranges to categorize normal and depressed EEG data. We discovered that the SVM classifiers are superior to other feature choice techniques and classifiers when reducing feature vector displays and detecting sadness accurately. We have examined the presence of the suggested outline with 9 healthy and 9 depressed patients. The suggested technique yielded a classification ACC of 98 percent in categorizing regular and depressed EEG signals. We presented a precise and healthy computer-assisted screening approach for Stress

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