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# IMOGRAPH- Sentiment Analysis to Detect Stress and Behaviour of Students and Employees Using EEG and SVM

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## ABSTRACT

Human emotions are always considered with high priority.Work related stress andpressure faced by students have a toll on their menal behavior. There could be serious long term side-effects to such exposures. A system that can detect and measure the amount of stress and happiness would help in reducing the burden faced during work and work efficiency is increased. Technologies like BCI (Brain Computer Interface) and EEG analysis helps in decoding the brain activity of users and helps the institution to assign work accordingly.

**Key words**: EEG sensors, Emotion Detection, BCI, EEG, Brain wave, Cognitive measurement, Stress Analysis.

## 1. INTRODUCTION

Since the start of the industrial era, humans have been getting the opportunity to work in an enclosed area than doing manual labor. Even though they do not face any physical side-effects, the demand for them to finish deadlines and projects hasan adverse effect on their mind [1]. It is common in schools and universities to put a pressure on the students by means of various assessments and active learning methods to help them gain knowledge faster. Even though for the majority, there might be no noticeable problem.Yet in the long run, it could lead to severe mental side-effects including work related stress and depression. This would also affect their performance at work which in turn reduces the efficiency of the institution they work for.

In this paper, we discuss a method to read the emotions or stress levels that a person face during work.The information could be used by institutes inorder to manage the workloads and hence drastically improve their efficiency. This system can also be introduced in classrooms to assess the student's cognitive capability and their mental behaviours.Thus helps in identifying any mental stress at the early stage. In order to study emotional behavior we have to focuson the electrical activity of the brain. EEG (electroencephalogram) is a prominent way to derive and study brain activity[2]. There are various brain waves like Alpha, Beta, Gamma, etc.. These waves help in identifying emotions and brain activity.

Hence we use these EEG signals to identify the user's emotions. EEG signals can be collected using an EEG machine. For the complex analysis of brain activity, we can use a simpler EEG devices with EEG sensors similar to ECG sensors for analyzing the electrical signals from the brain. These sensors provide raw signals, which needs to be amplified and measured using a software. We make use of an IoT platform to read EEG signals and a software to analyze the signals from the IoT device. The IoT device consists of the sensor and microcontroller which needs to be worn by the user. The wave parameters need to be converted to vectors by using a scaling parameter.

We can then use SVM to classify these signals for a particular user.And using supervised learning algorithms, we classify the emotions depending on previously obtained results. The output obtained will be in numerical quantities which needs to be assigned a emotion variable like Happy, Stressed, Depressed etc.These steps are to be done with the software using the algorithm specified here. The output can either be monitored at a time or continuous analysis with the help of technologies like Big Data and Cloud Computing. The availability of cloud computing helps to compute large amounts of data without having large resources. Hence we can have large data sets of EEG signals of previous users and these data can be used to improve the accuracy of the learning algorithm [3]. The whole system is divided into three parts: The software part by which a user can monitor the EEG signal, the cloud computations where the data sets are stored and large computations can take place there, and finally the wearable device which is IoT enabled. The wearable device is nothing but a head-wear consisting of various sensors which are to be placed in specific points on the head. Accurate readings can only be made if the sensors are placed in precise manner. Computation using brain signals is considered as a special branch in computer science called Brain Computer Interface (BCI). BCI has various open-source APIs and libraries which are useful in the system.

## 2. MODULES

The system includes various modules used inorder to detect various human emotions.Sentimental analysis of human emotions using EEG Sensors can be divided into following modules

### 2.1 Data Set

Data sets for EEG signals can be obtained from the BCI website or from other open source libraries containing EEG signals, medical records of patients suffering depression or mood swings, or we could create our own data sets by creating a library in the cloud[4]. The raw data is obtained using the sensors in the form of graphs which needs to be extracted and cleaned. If the data in the data sets are images of EEG signals, it needs to be converted to parametric form during feature extraction. If the data sets are given in parametric values of peaks in the waves, we can directly use SVM and classify it. The data in the data set should be in csv format for computation. These data sets are stored in cloud andinorder to access and modify the data set, the software needs to be equipped with internet connection and a interface for accessing the cloud.

### 2.2 EEG Sensors

EEG is the method used to detect human brain waves.The human brain consists billions of nerve cells.An EEG test detects various electrical patterns in the brain.EEG sensor is a device used to detect these electrical pulses and produces a graph containing waves like alpha,beta,theta,delta.The billions of nerve cells produce small electrical signals that forms the brain wave which is identified by the sensor.The sensor used is IoT enabled.

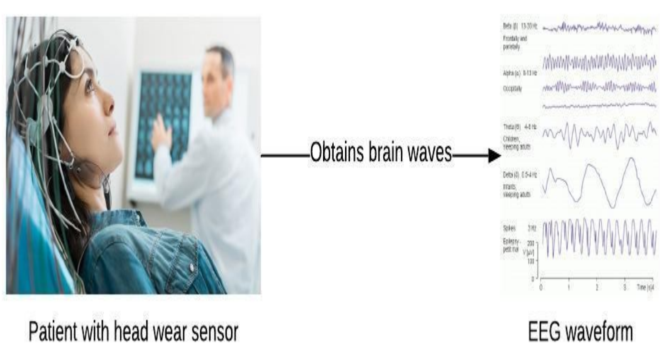


**Figure 1:**EEG sensor working

## 3. PROPOSED METHODOLOGY

The training data is obtained from BCI libraries or previously obtained EEG signals from other users. Test data is data obtained from the current user. Both these data are initially in the form of waves [5].These raw data of brain waves must be extracted and cleaned to get the appropriate parametric values of amplitude, wavelength etc. This is done in the process of feature extraction.

The extracted features are sent to a supervised machine learning algorithm and the various parameters are converted to a metric form to apply SVM. To use SVM, python library of Scikit learn is used to vectorize the values. The values are then compared and classified.

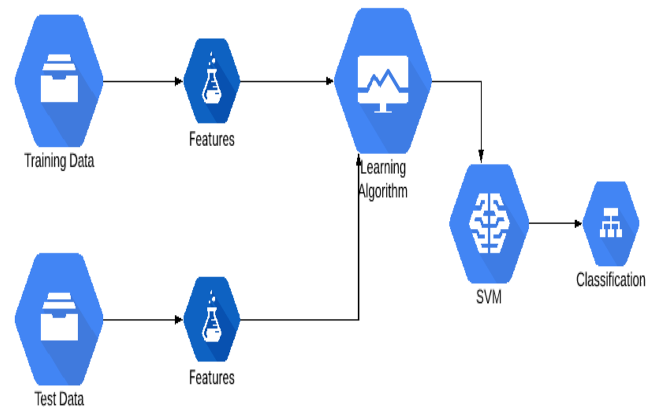


**Figure 2:**Working of the proposed system(including classification)

The classified data is also sent back to the cloud dataset to be used as training data after the validation is found to be accurate. The process of extracting the EEG signals are taken when the person is doing his normal work. In order to get an overall mental analysis, the user must undergo feature extraction process a couple of times while doing different types of work and even when sitting idle.

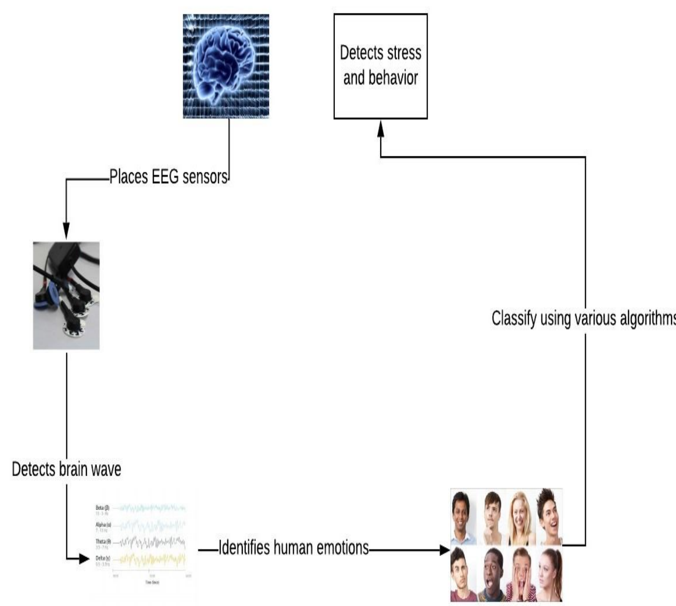


**Figure 3:** Architecture of the sentiment analysis system

As figure 3,the process begins placing the EEG sensors on the scalp of the user.The EEG waves are obtained from the user.This wave is the testing data.Now we compare this data with the trained data that is already available with us.Trained data could be obtained from BCI libraries.Further the input wave should be converted into a vector form.Then the features are extracted and classification could be done inorder to understand different emotions.We use machine learning algorithm.The classification could be done using Support Vector Machine(SVM).Different threshold values are present to identify various emotions.By the classification we could identify whether the individual is stressed or not. Based on which later we could reduce the stress of the user.

In the case of students, this procedure can be done during their study hours. This system can be accompanied with other technologies like facial recognition and detecting changes in voice to identify emotions more accurately.

## 4. FEATURE EXTRACTION

The data is obtained in the forms of EEG brain waves. There are mainly four types of waves: Alpha, Beta, Gamma and Theta. Each of these waves corresponds to a particular behaviour in human. Decoding these signals will let us know more about the mental integrity of a person.

### 4.1 Conversion of EEG inputs into vector form

Delta: 1-3Hz; theta: 4Hz, alpha I: 89Hz, alpha II: 1,012 Hz, beta I: 1,317Hz, beta II: 1,830Hz, gamma I: 3,140Hz, gamma II: 4,150Hz.
Initially these waves are normalized. After normalization, the raw EEG signal is transformed into a 210*6 dimension vector. The 6 features include wavelength, time, signal quality, etc. X is 6 columns, 210 rows vector, X210*6 can be represented by 6 columns, i.e., X210*6 = [X1, X2 ,…., X6], each vector is Xi where i=1, 2,…, 6. However, in the analysis, and they are Delta, Theta, Low Alpha, High Alpha, Low Beta, High Beta, Low Gamma, High Gamma.

| Wave type | Frequency | When wave is dominant |
|---|---|---|
| δ Delta | 0–4 Hz | Deep sleep |
| θ Theta | 4–8 Hz | Creativity, dream sleep drifting thoughts |
| α Alpha | 8–13 Hz | Relaxation, calmness, abstract thinking |
| Lowβ Beta | 15–20 Hz | Relaxed focus. high alertness, mental activity. agitation, |
| Highβ Beta | 20–40 Hz | Anxiety |

**Figure 4:** EEG wave types

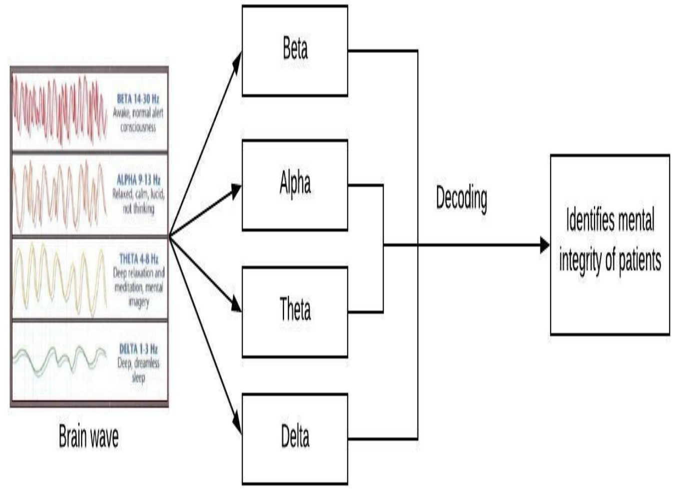


**Figure 5:** Identifying mental state of patients

We use a machine learning algorithm to compute the difference in waves. In order to generate the test and training data first we must extract the features from the brain waves. This can be done by vectorization and we use parameters to represent the depth and amplitude of these waves and unwanted parts of the waves are avoided. In image processing, input is an image and the output may be an image or the characteristics of the input image [8].

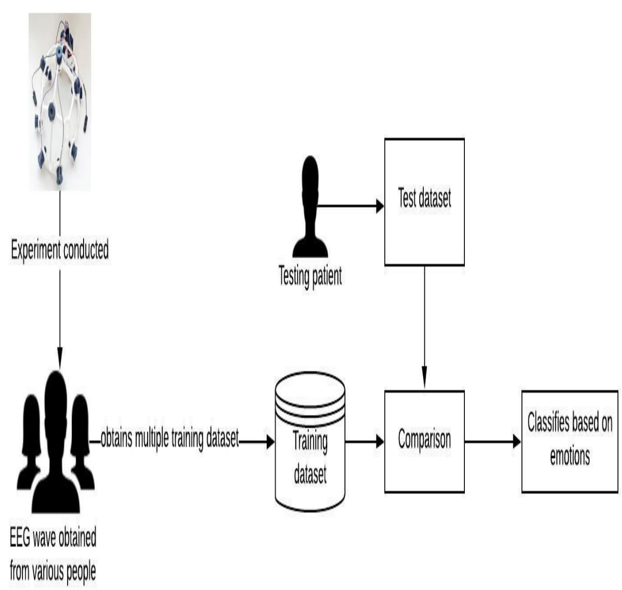


**Figure 6:** Classification based on training and testing data

### 4.2 SVM Classification

The 210 signals are used for both training as well as testing. 105 signals among 210 can be used in training phase of SVM classification and the other 105 is used for testing and each of these signals will have 6 characteristics.
SVM classification is done using a linear decision function of the form:
F(X) = W^a+b
Incase if the data is not linearly separable, we use non-decision function:
F(X) = W^ a g(x) + b
The purpose of classification is to decrease the error between actual output and the targeted output.

## 5. ALGORITHM

The extracted features are sent to asupervised machine learning algorithmand the various parameters are converted to a metric form to apply SVM. SVMs are the basis of a machine learning technique that has been used for segmentation and classification of medical images [6]. SVM has two stages; training and testing stage. SVM trains itself by features given as an output to the learning algorithm. During training SVM selects the suitable margins between two classes[7].

### 5.1 Algorithm for Support Vector Machine

```
fromsklearn.svm import SVC
fromsklearn.metrics import accuracy_score

clf = SVC(kernel='linear')
clf.fit(x_train,y_train)
y_pred = clf.predict(x_test)
print(accuracy_score(y_test,y_pred))
```

## 6. EXPERIMENTAL RESULTS

Experiments were conducted on a number of people to derive the training data initially and each time more data is added to the training data to make the system more accurate. After a number of training process, the test data could be given as input and it will be classified accurately.
The outcome of this system would be classified into if the person is stressed out or happy. A measure of their work induced stressed is calculated. The user can manage their work accordingly and hence function more efficiently.
The result helps in identifying the human emotions.We have used machine learning algorithm and SVM for classification.The classified data represents the emotions that a human possess.The emotions like happy,sad etc were identified using different threshold values.
Finally,the mental stress of users who belong to schools and industries were identified.

## 7. CONCLUSION

EEG signal can be used in analyzing various human emotions. In this paper, the various emotions can be effectively detectedby using above mentioned methodology.We have done a sentiment analysis of various human emotions using EEG.The idea helped in attaining a better and stress free life. Here, we efficiently recognized emotional statesby analyzing the features of electroencephalography (EEG) signals, which were generated fromEEG sensors that noninvasively measures the electrical activity of neurons inside the human brain.The scalp EEG data of healthy subjects were recorded using a 14-channel EEG machinewhile the subjectviewed images with four types of emotional stimuli (happy, calm, sad, or scared).The optimal features were further processed for emotion classificationusing support vector machine.

## REFERENCES


1. B. Cheng and G. Liu, ‘‘Emotion recognition from surface EMG signal using wavelet transform and neural network,’’ in Proc. 2nd Int. Conf. Bioinf. Biomed. Eng. (ICBBE), 2008, pp. 1363–1366.
2. A Etkin, C. Büchel, and J. J. Gross, ‘‘The neural bases of emotion regulation,’’ Nature Rev. Neurosci., vol. 16, no. 11, pp. 693–700, 2015.
3. Y. Zhang, X. Ji, B. Liu, D. Huang, F. Xie, and Y. Zhang, ‘‘Combined feature extraction method for classification of EEG signals,’’ Neural Comput. Appl., vol. 28, no. 11, pp. 3153–3161, Nov. 2017.
4. B. Hu, X. Li, S. Sun, and M. Ratcliffe, ‘‘Attention recognition in EEG-based affective learning research using CFS+KNN algorithm,’’ IEEE/ACM Trans. Comput. Biol. Bioinf., vol. 15, no. 1, pp. 38–45, Jan./Feb. 2016.
5. R. Jenke, A. Peer, and M. Buss, ‘‘Feature extraction and selection for emotion recognition from EEG,’’ IEEE Trans. Affect. Comput., vol. 5, no. 3, pp. 327–339, Jul. 2014.
6. Cogent Engineering,“ An Improved Segmentation Algorithm From T2 And FLAIR Multimodality MRI Brain Images By Support Vector Machine and Genetic Algorithm “ , 2018 ( Scopus Indexed , ESCI ) .
7. IOSR Journal of Electronics and Communication Engineering,“MRI Brain Tumor Segmentation Using Genetic Algorithm With SVM Classifier”, 2016.
8. International Journal of Innovative Science and ResearchTechnology ” Survey on Brain Tumor Detection and Segmentation Techniques on MRI Images”: 2016.