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# Human stress level detection and monitoring system

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**Abstract –** *According to the world health organization, stress is a significant problem in the age of internet era that affects both physical as well as the mental health of people. The mental response of events in stressed state of mind causes thr imbalance in neural activities. There are various traditional stress detection methods. Research in area of stress detection has developed many techniques for monitoring the human brain that can be used to study the human behavior. This project investigates detection of patterns in brain waves while induced with mental stress. This research uses the cluster based and statistical analysis to classify the EEG signals into sub signals. The sub signals include characterstics like gamma, beta, alpha, theta and delta waves classified based on their frequencies and behavior.The project uses Brainstorm and MATLAB softwares to analyze the EEG signals.*

***Key Words***: EEG( ElectroEncephaloGram), Stress, Brainstorm, MATLAB.

## 1.Intoduction to Stress Detection and EEG signals

The term "Stress" is generally defined in biological system as a condition that seriously disturbs the physiological/ psychological homeostasis of an organism.Stress is so harmful that it can/may leads to long-term diseases. Stress detection is an ongoing research topic among both psychologists and engineers. Various technologies are developed on human stress detection using wearable sensors and bio signal processing. response to stress i.e. how a person's physiological feature changes in response to stressful events. Stress detection is an ongoing research topic among both psychologists and engineers. Various technologies are developed on human stress detection using wearable sensors and bio signal processing. Stress can be detected from human bio-signals such as EEG(Electroencephalography),EMG(Electromyograph),Electrocardiography (ECG), Galvanic Skin Response (GSR), Blood Volume Pulses (BVP), Blood Pressure (BP), Skin Temperature (ST) and Respiration. Also human physiological features are used to measure the stress level using physiological signals. There is difference between individuals when he/she response to stress i.e. how a person's physiological feature changes in response to stressful events.

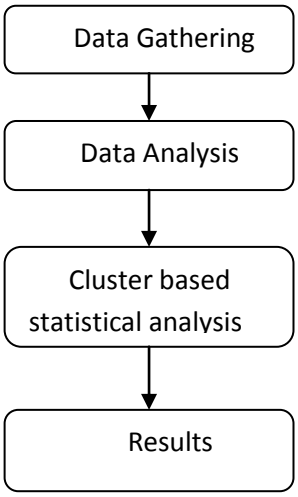
### 1.1 Intoduction to Bio signals

Human brain consists of millions of neurons which are playing an important role for controlling behavior of human body with respect to internal/external motor/sensory stimuli. These neurons will act as information carriers between human body and brain. Human behavior can be visualized in terms of motor and sensory states such as, eye movement, lip movement, remembrance, attention, hand clenching etc. These states are related with specific signal frequency which helps to understand functional behavior of complex brain structure. Electroencephalography (EEG) is an efficient modality which helps to acquire brain signals corresponds to various states from the scalp surface area.
**Electroencephalography(EEG)** is an electrophysiological monitoring method to record electrical activity of the brain. It is typically non-invasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used, as in electrocorticography. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. Clinically, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp.

**Table -1:** Brainwave frequencies with their characterstics

| Type | Frequency(Hz) | Behavioral | location |
|---|---|---|---|
| Delta | 0-4 | Deep rest | Frontal region |
| Theta | 4-8 | Deeply relaxed | Thalamic region |
| Alpha | 8-13 | Day dream, calm | Posterior region |
| Beta | 13-30 | Alert, actice thinking | Frontal and parietal |
| Gamma | 30-100 | Stress | Somatosensory cortex |

## 2. Process flowdiagram




1.Data gathering: The data collected of the patients EEG data is useful for the detection of stress and analysis process. The EEG data will be collected from lab study by involving subjects. Eight channel EEG is used for collecting the brain signals. Once the signals are collected by using EEG electrodes are stored into the data set.
2.Data analysis: is a process for obtaining the raw data and converting it into useful information for decisionmaking.
3.Cluster based analysis: classification of data is the process of sorting and categorizing data into various types or classes or forms like gamma waves,beta waves, alpha waves, theta waves, delta waves.Data classification enables the separation and classification ofdata according to data set requirement for the analysis. Clustering process is used todivide subjects into set ofsubgroups.
4.Statistical analysis: is a term used to summarize a process that an analyst uses to characterize a data set. It involves collecting and scrutinizing every data set sample into a set of items like gamma, beta, alpha, theta and delta.

## 3. Results

### 3.1 Brainstorm outputs

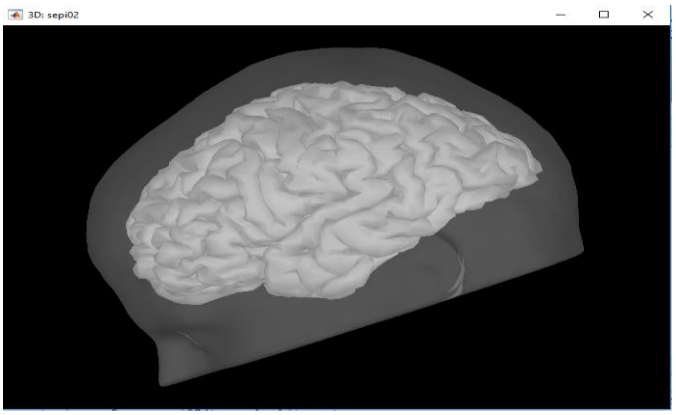



Fig 1: **Cortex and scalp**

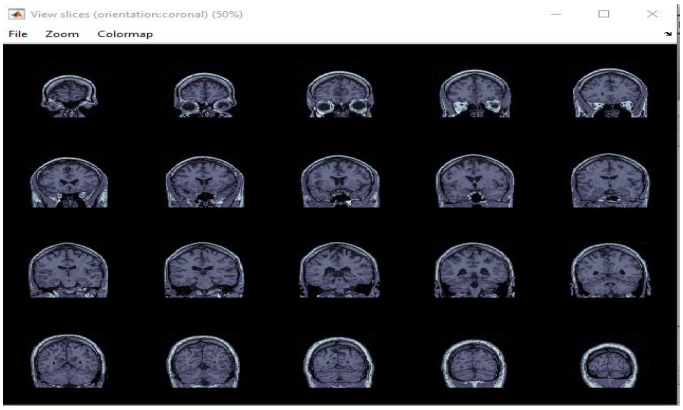



Fig 2: **Coronal view after MRI**

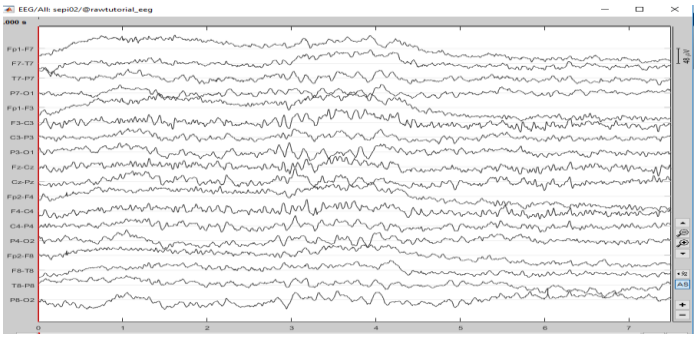



**Fig 3: EEG signal.**

Computing sample data to obtain EEG output signal for the data set provided from the electrode placement is shown in above fig 3. After placing the electrodes at main reference points like Nasion,left ear, right ear, posterior and anterior commissure the EEG signal is been computed with other set of electrodes with reference electrodes.

### 3.2 MATLAB outputs

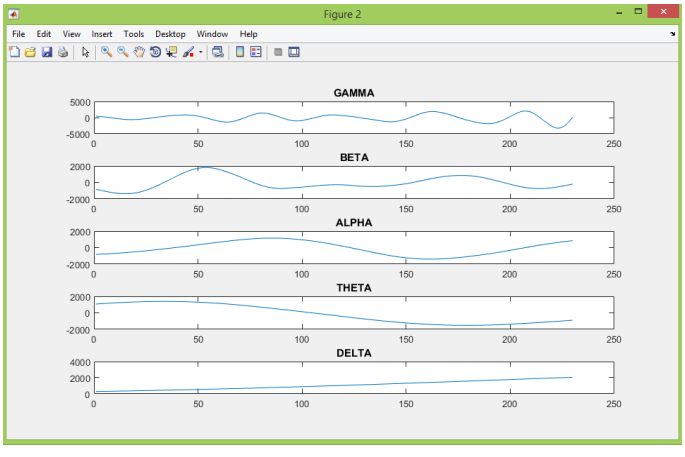



**Fig 4:Cluster based analysis of EEG signal.**

The electrodes output will be in the form of volts. The dataset is downloaded from the brainstorm software's website. The dataset is then plotted into waveform using DWT(Discrete Wave Transform) of Wavelet Toolbox available in the matlab.The classification of different brainwaves of signal is made using clustering analysis. There

are 5 different brainwaves they are, Alpha, Beta, Gamma, Delta and Theta. The classification is shown in below fig 4. Based on the calculations the stress level of the subject (patient) is detected. A threshold for the brainwaves is set and compared if the frequency calculated is greater than the threshold a dialogue box appears stating that stress is detected as shown below in fig 5(a) otherwise it displays stress is not detected as shown in fig 5(b).

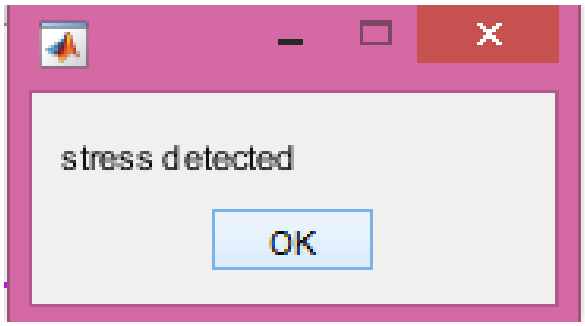



Fig 5(a)

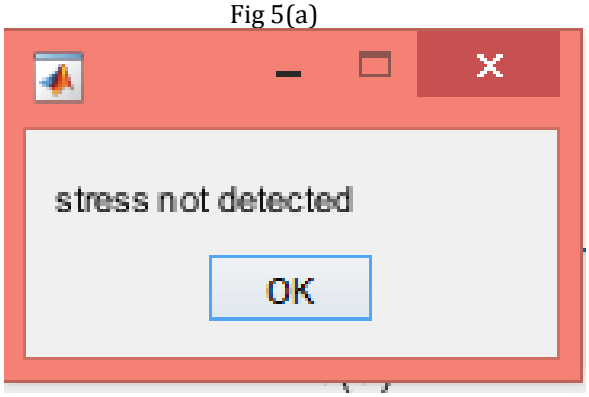



Fig 5(b)

## 4. CONCLUSIONS

This project aimed at detecting the stress level of human based on cluster and statistical method of analysis.Stress increases the risk of heart diseases by 40%, heart attack by 25%, and stroke by 50%. Due to rapid advancements in biomedical technology for analyzing bio medical signals data set is obtained from EEG reading of lab study component. The stress indices of different individual reading are calculated.If the stress index is less than the threshold value results low stress,if the stress index is greater than threshold value results high stress detected and focuses on the experimental setup, materials and methods.

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