



ANALYSING THE SEVERITY OF HUMAN ATTENTION BASED ON AGE FLUCTUATION

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Abstract

Based on the age, the person's focus, memory recall, attention, thinking, working performance, ability to do the given task and concentration level varies. In working platform, it is mandatory to monitor the person's attention and commitment towards the work to raise the productivity. Here the person's concentration and attention to the given task are analyzed using EEG signals. Based on the thinking of individual, the activity of brain varies and it leads to change in the brain waves. It is monitored by using EEG. The signals are monitored for group of people under two different ages whereas the persons under the age of 20 to 23 are considered as group 1 and the persons under the age of 29 to 31 are group 2. The EEG signals are collected for all the persons while doing various activities. From the collected EEG signal, the features are extracted using mean, standard deviation, median and root mean square. On comparing the extracted features for various aged people the concentration level is determined.

Keywords: Concentration, Electroencephalogram (EEG) signal, Lab VIEW

I. INTRODUCTION

Brain is composed of various lobes whereas prefrontal cortex region of the brain is responsible for concentration and thinking. EEG of various persons with different tasks is analyzed and the features are extracted from the EEG signal to determine their concentration. It can be implemented in gaming industry for monitoring the gamer's thinking, attention and involvement to the game for the improvisation and innovation of new games.

A. Brain

It is composed of three main parts as cerebrum, cerebellum, and brainstem. The cerebrum is divided into four lobes called frontal lobe, temporal lobe, parietal lobe and occipital lobe. Each lobe is responsible for several activities. The frontal lobe is responsible for problem solving, concentration, judgment and motor function. The parietal lobe manages sensation, handwriting, and body position. The temporal lobe is involved in memory and hearing activity. The occipital lobe contains the brain's visual processing system.

The prefrontal cortex region is primarily involved in concentration.

The various lobes which are present in the brain and the functions of each lobe are described in the Fig. 1

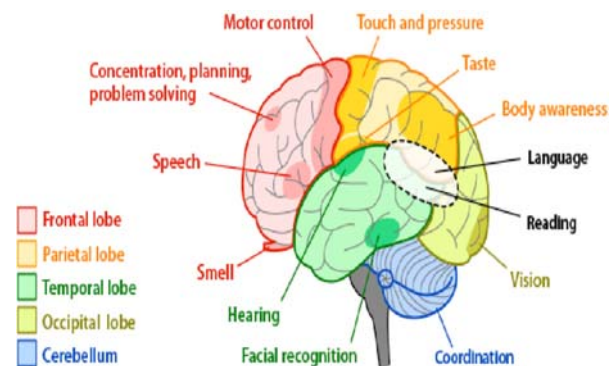


Fig. 1 Functions of Brain and its Lobes

B. EEG Signal

Electroencephalogram (EEG) is a measure of brain waves. It tracks and records the brain wave patterns. The brainwaves change according to the persons feeling and their movements.

TABLE I. EEG WAVES

WAVE	FREQUENCY	STATE
Delta	Below 4 Hz	Dreamless sleep, loss of bodily awareness
Theta	4-8 Hz	Reduced consciousness, deep meditation, light sleep
Alpha	9-13 Hz	Physically and mentally relaxed, awake but drowsy
Beta	14-30 Hz	Awake, alert and consciousness
Gamma	Above 30 Hz	Heightened perception

When slower brainwaves are dominant, it shows that the persons are feeling tired, slow, sluggish, or dreamy. When the higher frequencies are dominant, it shows that the persons are feeling wired, or hyper-alert. Brainwave speed is measured in Hertz (cycles per second) and they are divided into bands. EEG signals are classified as alpha, beta, theta, delta and gamma waves based on their frequency range is shown in the Table I.

II. RELATED WORK

Some literature survey has been focused on EEG signal analysis and its feature extraction and classification. Di Xiao proposed the measurement of degree of concentration level of humans by determining the focus value R [9]. Chetna Nagpal uses frequency distribution, standard deviation, variance for feature extraction and fuzzy logic for the classification of EEG signals that are measured from the rats [8]. Tae Jin Choi implements a method for the estimation of concentration state using multiple EEG channels. Eight channels are used for the measurement during resting and concentrating periods. Kalaivani proposed to diagnose the abnormalities present in the brain using EEG signals. It includes pre-processing, feature extraction, feature selection and classification. The discrete wavelet transform is used to decompose the EEG signal and the features are

extracted using mean, standard deviation, maximum and minimum. The signals are classified using k means classifier as normal or abnormal condition [12].

III. ANALYSIS OF EEG SIGNAL

The main aim of proposed work is to analyze the concentration level of humans based on their brain activity. As the root of thoughts, emotions and behaviors the communication occurs between neurons within the brains. Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with each other. Electroencephalography uses electrical leads placed all over the scalp to measure the collective electrical activity of the cerebral cortex. This spontaneous activity is classified based on the frequency produced at the time of activity as alpha, beta, gamma, theta and delta.

EEG 10-20 amplifier system is used for the measurement of the brain analysis. It consists of silver cup electrodes which are placed over the scalp. This system has three leads one is ground and the other two are active and reference electrodes. These three electrodes are used for monitoring the EEG signal of various persons during different activities. The electrodes are placed over the forehead of the testing person and their brain activity is monitored by using DSO.

The notch filter is used for removing noise present in the raw EEG signal [3]. The notch is a very selective filter with a very high rejection just for a tiny frequency band around the selected frequency. The proposed system consists of various stages for analyzing the brain waves of humans as data collection, feature extraction and feature selection.

A. Data Collection

Based on age, the individuals involvement, paying attention, thinking and concentration changes. The data's are collected for group of people under different age category. The persons under the age of 20 to 23 are group 1 and the persons under the age of 29 to 31 are group 2, 15 participants are tested with various activities. For every individual certain tasks are given like reading books, solving puzzles, hearing music and counting numbers in reverse manner for the duration of 10 minutes and their EEG signals are monitored.

The EEG waveforms are monitored and recorded as shown in the Fig. 2. Based on the person's activity, the neurons in the cortex region get activated [13]. If for example a person is hearing music, the sound waves will hit the ear drums and the signal will be transferred to brainstem and reach the cortex region of the brain and it gets activated that will be monitored using the EEG 10-20 amplifier system. Similarly for all the activities performed by the individual, the cortex region of the brain gets activated.



Fig. 2 Measurement of EEG Signal

B. Feature Extraction

The features are extracted from the EEG signal to minimize the loss of important information embedded in the signal. Different methods have been widely used to extract the features from EEG signals. Most commonly used are determination of mean, standard deviation, median and root mean square [14].

a) EEG Signal Preprocessing

The raw EEG signal is converted into frequency components using power spectrum. The notch filter is used to remove the unwanted noise present in the raw EEG signal. It occurs due to the movement of the persons during the recording of EEG signal and while performing the given activities.

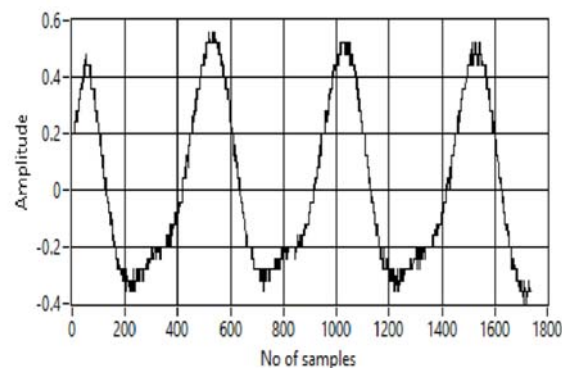


Fig. 3 Raw EEG signal for Person 1 in Group 1

The raw EEG signal which is obtained while reading book for one person under the age group 1 that is under the age of 20 to 23 is shown in the Fig. 3. Similarly, Fig. 4 shows the raw EEG signal which is obtained for the person 1 in group 2 that is the persons with age of 29 to 31. Likewise for all the persons in two different age groups, the EEG signals are recorded while performing various activities like hearing melody, counting numbers in reverse, reading book and solving cubes. After recording of the original signals, the noises are removed by using notch filter in LabVIEW.

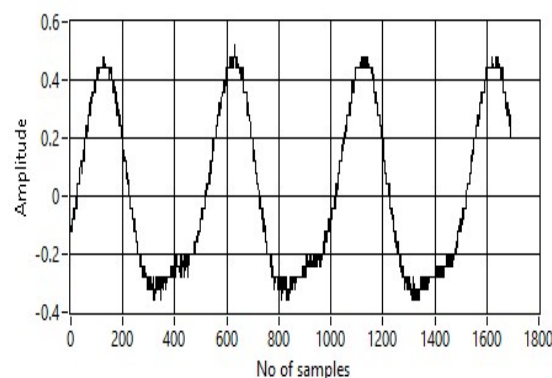


Fig. 4 Raw EEG signal for Person 1 in Group 2

b) Parameter Estimation

The features are extracted by evaluating the parameters like mean, standard deviation, root mean square and variance for the determination of the individual persons concentration during their various activities.

The Table II shows the different estimated parameters while reading book of first person in both the age groups that is age group 1 and 2. The data represents maximum for the person 1 in group 1 of reading book and minimum for the first person in group 2 [8]. From this method of feature extraction, it is

evident that the person under the less age group is concentrating towards the reading book rather than the person in the second group with high age.

TABLE II. FEATURE EXTRACTION FOR READING BOOK

PARAMETERS	PERSON 1 GROUP 1	PERSON 1 GROUP 2
Mean	0.4	0.008
RMS	52.409	19.79
S.D	52.4081	19.7928
Variance	2746.6	391.755

Similarly for all the tested participants their concentration level is analyzed for the entire task of relaxed state, reading books, counting numbers in reverse order, solving puzzles and hearing melody.

C. Feature Selection

This is the process of eliminating the features containing negligible information. The feature with more information provides better results and accuracy. On comparing the results of feature extraction, high accuracy parameter is estimated.

IV. RESULTS AND DISCUSSION

The EEG signal is measured at the fore head where the prefrontal cortex region presents. Based on the individual activities, the activity of neurons in the brain changes.

The concentration level of different age persons are monitored to determine the person's ability, commitment towards work, focusing, memory recall and their job performance. From the above analysis it is evident that, the persons with lower age are concentrating on their given task more than the persons with higher age that is persons belongs to second group.

V. CONCLUSION AND FUTURE SCOPE

The concentration level of various persons with different activities are monitored. Based on the persons attention to the given task, the spectrum range and the parameters of EEG signal varies. From the collected data after extracting

the features of each signal, the persons concentration level is determined.

In future, the concentration level can be classified as normal, high and low concentration using fuzzy logic algorithm.

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