

Approach of Mental State Analysis using EEG

Chaitali Bhattacharyya*, Trisha Paul*, Susmita Das**, Soutrik Karmakar*, Shyam Sundar Banerjee*

*Electronics and Instrumentation Engg., Narula Institute of Technology

**Electronics and Instrumentation Engg., Narula Institute of Technology

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Abstract- Electroencephalogram (EEG) signals from human brain have ground-breaking impact in the field of health care industry. EEG is one of the most actively used bio signal as measurement tool in Brain-Computer Interface (BCI) to implement “thoughts or intention” based human and machine interaction. In the medical field, EEG based interaction is also used for computer aided diagnosis for the patients and also to help in detecting emotions and body movements. In this paper, the beneficial aspect of EEG is demonstrated which can be the great help for paralysed patients. The study of characteristics of the signals while the person is moving and when the person is intending to move to be diagnosed through BCI can be controlled for humanoid movement through EEG.

Index Terms- EEG, BCI, HMI, Brain waves.

I. INTRODUCTION

The Electroencephalogram (EEG) is a method known as an electrophysiology for monitoring and recording the electrical signal activity of the brain. This EEG read the electrical signal acquired from the scalp of the brain. EEG can give several types of clinical indications such as for the patients applied with anesthesia and observing the output waveforms of EEG to detect the consciousness level of the person [1]. Brain Computer Interface (BCI) [2] is the main focusing area for the advanced implementation of mental state prediction through Human Computer Interaction (HMI). The EEG [3] obey and maintain the differential voltage amplification principle where two types of bio-electrodes are used. One electrode is main or active electrode which collects the output of EEG and another part is reference electrode. The measurement unit of EEG is in microvolt with respect to the brain frequencies i.e. delta, theta, alpha, beta frequencies.

II. METHODOLOGY

In this study, especially the consciousness of human beings through analysis of the values of EEG [6] to predict the physical condition of that particular human is observed. By analyzing the EEG values the prediction of the particular physical fitness of human being can be detected. The most important and functional [7] organ is brain. Brain works as the coordinator and controller of the muscles and nerves in the human being’s body. Different parts of the brain control [8] different actions. Cerebellum is located behind the top part of the brain and it is responsible for the movements, balance and muscular activities. The specialized cells in Cerebellum transmits information via electrical signal [9]. As different nerves are responsible for different functions, it is important to know the functional behavior and the location of the coronial nerves to place the electrodes for EEG [10][11] recordings.

Table 1: Brain Wave Classification [5]

SL. No.	Brain-Wave Type	Frequency (Hz)
1	Delta Wave	0 -4
2	Alpha wave	8-12
3	Theta wave	4-8
4	Gamma Wave	40-100
5	Beta	12-40

Brain waves are detected by the sensors placed on the scalp. The signal changes according to the level of concentration. If the brain wave has lower frequency means at drowsy state and higher frequency brain waves means in focused condition. Brain waves are usually sinusoidal and measured from peak to peak which normally range from 0.5 to 100 μ V.

III. Results and Discussions

The output measurements are taken from esense meter present within the brain signal collecting device used in this work.

Table 2: Concentration Level Measurement Data [4]

Time (msec)	Esense output (mV)	Esense output (mV)	Esense output (mV)	Esense output (mV)	low gamma (Hz)	high gamma (Hz)	high alpha (Hz)	low alpha (Hz)	high beta (Hz)	low beta (Hz)	Delta (Hz)	Theta (Hz)
0.167812	0	0	90	84	1508	949	3203	15514	8016	10146	133736	38691
0.180342	0	0	84	70	3783	2777	3485	10768	5870	18148	573495	18388
0.193154	0	0	96	56	9032	7513	15279	14077	11496	13129	1179111	17200
0.205996	0	0	100	64	29317	7823	25351	61559	25780	92004	436123	377586
0.21689	0	0	100	75	4104	3243	3700	9609	10694	10152	1084586	36726
0.229007	0	0	100	66	10283	3179	8039	5281	12855	12045	70447	32239
0.240852	0	0	100	61	33718	3740	10555	24986	25508	23732	1293020	166294
0.252404	0	0	90	37	1238	1470	124	2192	3295	937	28083	14104
0.265383	0	0	100	40	28517	88436	80344	30035	19225	23309	1436290	177130
0.276735	0	0	91	54	4307	29775	4808	10617	3281	11809	114825	29867
0.288082	0	0	69	61	11526	90991	20050	30755	17000	2993	72776	84383
0.29801	0	0	69	75	16287	77329	32048	8935	18732	20975	104286	95003
0.31089	0	0	64	83	15751	71115	63879	1378	11293	12388	1365915	59958
0.320636	0	0	69	90	6730	4119	21590	14780	23021	9032	807542	179603
0.330916	0	0	77	74	4956	4589	25318	7055	26464	8370	64830	4086
0.342872	0	0	90	77	938	928	10497	18319	4187	2472	120615	57520
0.355476	0	0	70	84	1192	781	21972	11615	4556	6700	186409	36881
0.367898	0	0	63	84	7839	3518	12183	6902	6836	30233	1025026	53015
0.380892	0	0	57	91	6580	3994	438	97096	17512	45730	1874658	172174

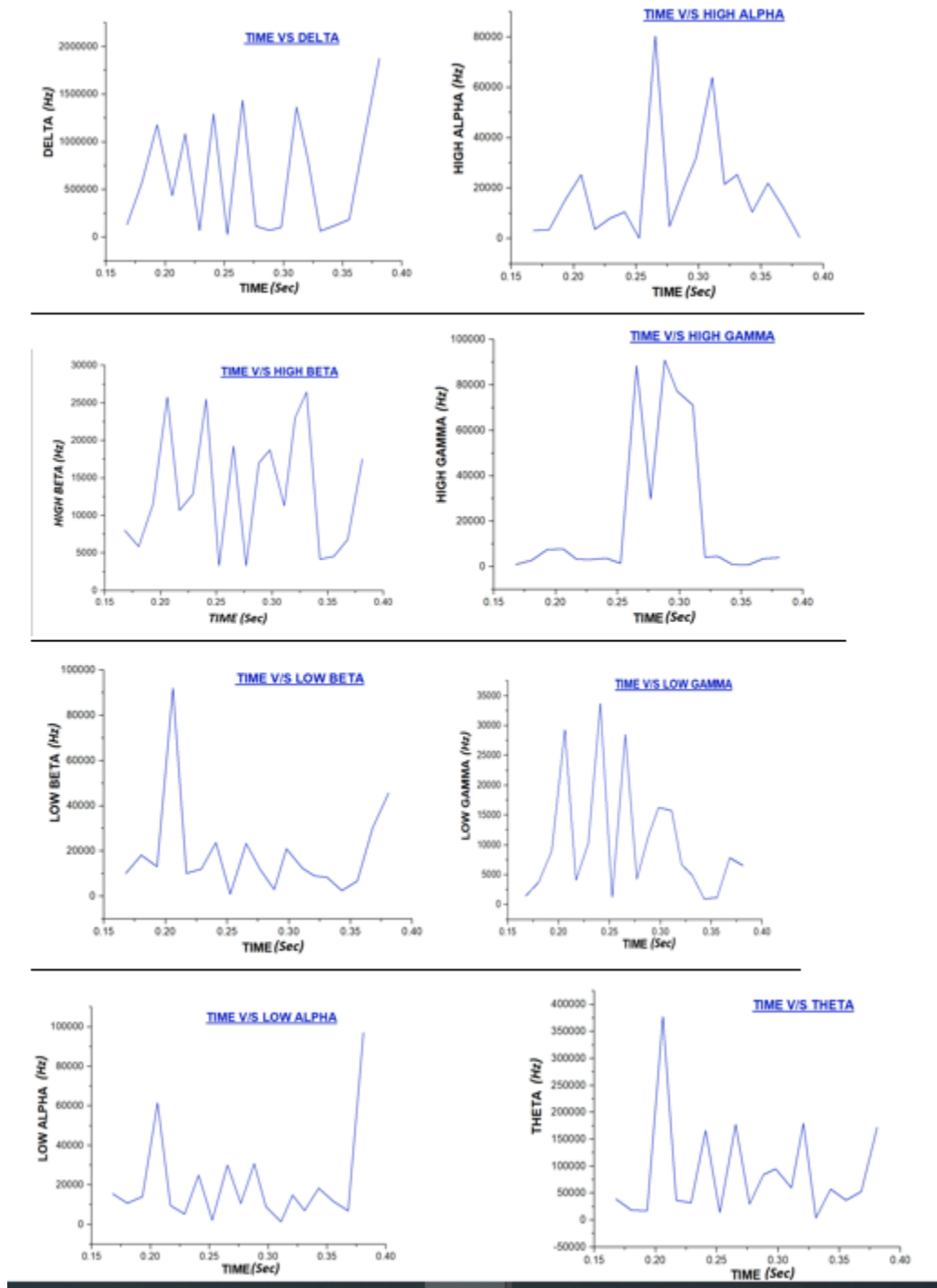


Fig. 1: Graphical output presentation of Concentration level data taken from human Brain

The mental state of the person has been observed from the values of low gamma, high gamma, high alpha, low alpha, high beta, low beta, delta and theta and the output graphs. The peak values of these graphs are greater than the standard values of each parameters. So, it can be predicted that the person's mental state is in concentrated mode.

Table 3: Meditation Level Measurement Data [4]

Time (msec)	Esense output (mV)	Esense output (mV)	Esense output (mV)	Esense output (mV)	low gamma (Hz)	high gamma (Hz)	high alpha (Hz)	low alpha (Hz)	high beta (Hz)	low beta (Hz)	Delta (Hz)	Theta (Hz)
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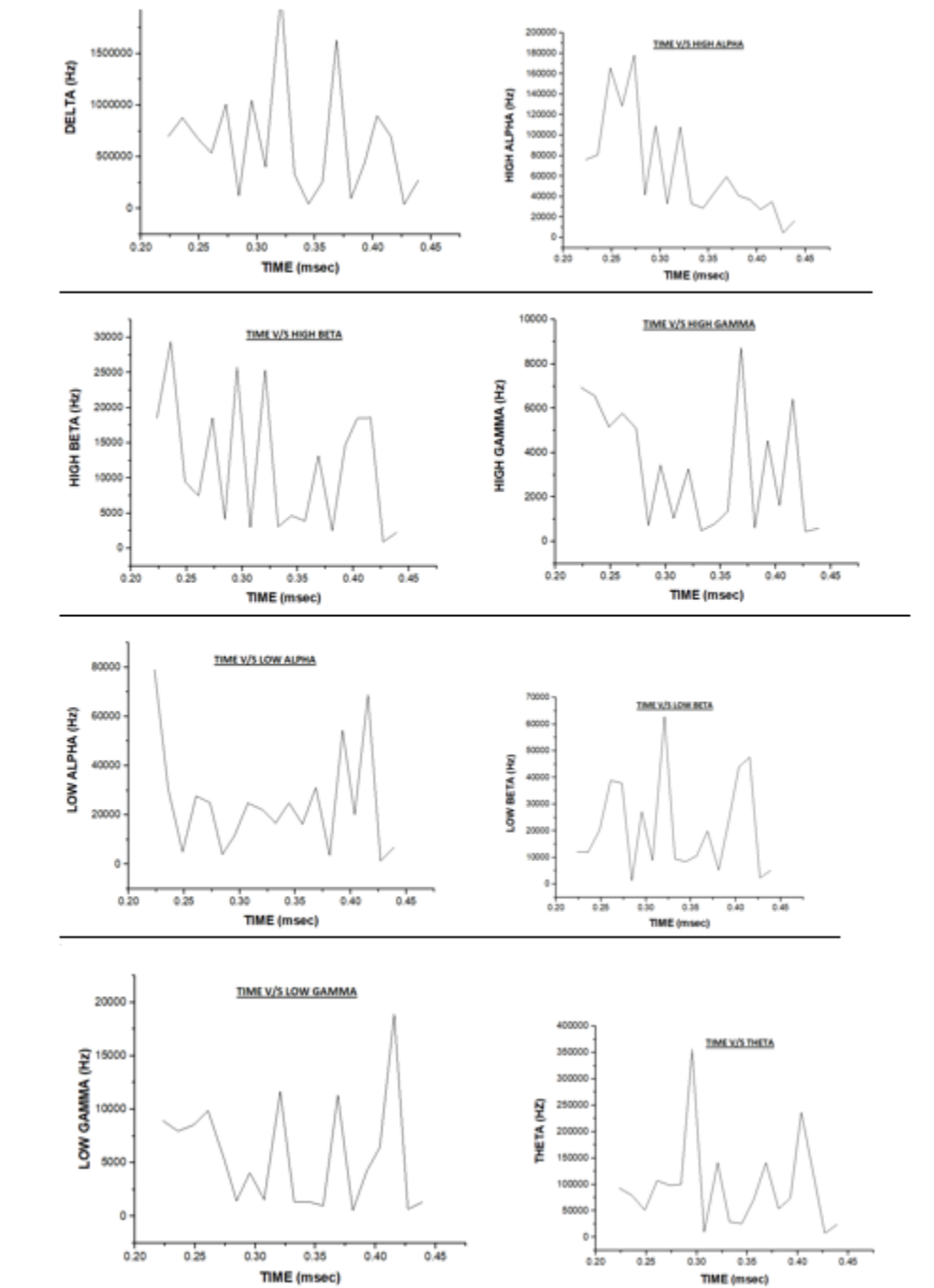


Fig. 2: Graphical output presentation of Meditation level data taken from human Brain

The mental state of the person has been observed from the values of low gamma, high gamma, high alpha, low alpha, high beta, low beta, delta and theta and the output graphs. The peak values of these graphs are greater than the standard values of each parameters. So, It can be predicted that the person's mental state is in meditated mode.

IV. CONCLUSION

The collection of data from EEG can be used for research and development of various disease detection and the treatment based on the analyzed data can be started. By using EEG method, prediction of person's imagination can be done. For the better and accurate result the EEG is not only used in medical field but also used in crime detection sector and bio robotics and so on. The recognition of consciousness levels have been performed through the present concept.

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AUTHORS

First Author – Chaitali Bhattacharyya, B. Tech Student, Narula Institute of Technology.

Second Author – Trisha Paul, B. Tech Student, Narula Institute of Technology.

Third Author – Susmita Das, Assistant Professor, Narula Institute of Technology.

Fourth Author – Soutrik Karmakar, B. Tech Student, Narula Institute of Technology.

Fifth Author – Shyam Sundar Banerjee, B. Tech Student, Narula Institute of Technology.

Correspondence Author – Susmita Das, Assistant Professor, susmitad2011@gmail.com, Narula Institute of Technology, 8017205403.