Comatose Patient Monitoring System using Neural Oscillation and Mind Wave

Arun K P[1]. Aswin Suresh[2] . Jibin M T[3] . Jithin C[4]
[1.2.3.4.]Final year Biomedical Engineering
Dhanalakshmi Srinivasan Engineering College.Perambalur

Abstract **: Unconsciousness is a state of unawareness of self and environment of those mental activities by which people are made aware of themselves and their environment, coupled with a diminished responsiveness to environmental stimuli.**

Mind Wave headset is an advanced technology to capture the activities of the brain. It uses electrophysiological monitoring method to record electrical activity of the brain. It looks like a normal headset and easy to wear. The Mind Wave headset mainly consist of three parts, the sensor arm, adjustable head band and ear chip. It measures voltage fluctuations resulting from ionic current within the neurons of the brain. Diagnostic applications generally focus on the spectral content of neural oscillations (popularly called "brain waves") that can be observed in Mind Wave headset. This system designed and developed a reliable, energy efficient for monitoring a person in coma state. The system uses Mind Wave headset , Bluetooth module ,GSM Module,Arduino Microcontroller, LCD display and Alerting device like buzzer.

I.INTRODUCTION

Now a day, humans have fantasized to communicate and interact with machines through the thoughts and also create devices that work with human's mind and thoughts. The human mind imagination is captured in the form of modern science fiction stories and ancient myths. However, cognitive neuroscience and brain imaging technologies have recently started to provide people with the ability to interface with the human brain. Using sensors some of the physical activity that occurs within the brain that corresponds with forms of thought can be monitored. For the needs of people in growing societal recognition on, researchers have used this technology to build brain computer interfaces (BCIs), communication systems, i.e., a computer system that does not depend on peripheral muscles and nerves of the brains.

Brain–Computer Interface (BCI) is used to build a direct control channel between user's brain, i.e., user's intension and computer system. Among different techniques for the non-invasive measurement of electrophysiological signals of brain oscillations, the electroencephalography (EEG) is commercially used and has excellent results, which enables real time interaction through Brain Computer Interface (BCI) [7]. Electroencephalography (EEG) refers to an electrophysiological monitoring method which will record the electrical activity which is occurring at the surface of the brain using electrodes/sensors placing on the scalp of the brain. EEG measures electrical signals from the brain in voltage fluctuations currently occurring within the neurons of the brain. This action, in turn, will appear on the screen of the computer which in turn connected to electrodes implanted in the brain as waveforms of varying amplitude and frequency measured in voltage or as digital values.

II.OVERVIEW
LITERATURE SURVEY

Salle Dhali -"Study of Brainwave eSensing Activity"

Neurosky Mindwave device allows monitoring the electrical signals generated by the brains neural activities. The easy access of this devices opens a new area of researching fields not only in the gamification and disable people but also to understand the cognitive behavior of human beings. The purpose of this study is to investigate the consistency and effectiveness level of a non-invasive consumer product BCI. We investigate the output of the headset data both in quality and quantity of that gathered data and determine how it could be used for human involved research settings. A sample of two participants in terms of an interview and an interviewer interchangingquestionnaires. The cognitive tasks and EEG output signals captured by the participants both attentive and meditation values.

The data we collected produces mixed results. The meditation or relaxing level provide a consisting output while the attention level need more to explore due to the nature of every individuals and also the surrounds such as noise, mode distraction levels etc.

A brain-computer interface (BCI) often calls a brain-machine interface (BMI) is a communication channel between our brain and external devices. Until the recent years the advancement of Information Technology (IT), cognitive neuroscience and brain signals capturing technologies by external devices both in non/or invasive allow us to interact with human brain directly. BCI device capture brainwaves and transform into actions, unlocking new worlds of interactivity. Neurosky MindWave logs the wearers mental state in the form of NeuroSky's embedded properties such as Attention and Meditation with the help of eSense algorithms not an open source platform. For decades human has fantasized to communicate and interact with machines via thoughts itself and moreover expectation was that the devices will be able to reveal human minds, feelings, meditation and attention as well. The use of sensors make it possible monitor brains neuron process activities that can relates to certain form of thoughts as for instance how much

focused we are in certain objects from an interview to interviewer for get out the thoughts as an analogue values and convert it to digital signals output produced by human brain. NeuroSky MindWave also capable to capture the raw brain wave and information about the brainwave frequency (Hz) bands. It can be used with supported video games, research software, improve the quality of disable people's everyday activities also developing applications for enhancing user experience. This paper we will investigate how the gathered data from users can be measured for determining the consistency level of both the focusing and easiness levels of the cognitive behavior for researching of human settings.

Sunny T.D., Aparna T, Neethu P, Venkateswaran J, Vishnupriya V, Vyas P.S- "Robotic Arm with Brain Computer Interfacing"

Brain Computer Interfaces (BCI), is a modern technology which is currently revolutionizing the field of signal processing. BCI helped in the evolution of a new world where man and computer had never been so close. Advancements in cognitive neuro-sciences facilitated us with better brain imaging techniques and thus interfaces between machines and the human brain became a reality. Electroencephalography (EEG), which is the measurement and recording of electric signals using sensors arrayed across the scalp can be used for applications like prosthetic devices, applications in warfare, gaming, virtual reality and robotics upon signal conditioning and processing.

Brain Signal Processing is a technology which evolved in the recent years and has lead to path breaking inventions in the field of engineering and technology. This technology ultimately reduced the distance between human brain and the computers and has led to the evolution of Brain Computer Interfaces (BCI).

A Robotic Arm is a very versatile robot which can be used for a variety of applications. A robotic arm is probably the most mathematically complex robot that could be built. The design of a robotic arm depends on a number of parameters among which Degree of Freedom (DOF) being the most basic one. Each degree of freedom is a joint on the arm, a point upon which it can bend or rotate or translate. The number of DOF will be equal to the number of actuators on the robot arm. The Denvit-Hartenberg (DH) [7] convention is the accepted method of drawing robot arms in Free Body Diagram (FBD's). Rotation and translation are the two motion that a joint can perform. The connection between two actuators is named as a link. Hence, considering all the 3 axes, the maximum number of DOF that a joint can exhibit is six. The action of end effectors is not considered as a DOF.

V. Rajesh kannan, K.O.Joseph- "Brain Controlled Mobile Robot Using Brain Wave Sensor"

In a brain controlled robot controller is based on Brain–computer interfaces (BCI). BCIs are systems that can bypass conventional channels of communication to provide direct communication and control between the human brain and physical devices by translating different patterns of brain activity into commands in real time. With these commands a mobile robot can be controlled. The intention of the project work is to develop a robot that can assist the disabled people in their daily life to do some work independent of others. Here, we analyze the brain wave signals. Human brain consists of millions of interconnected neurons. The pattern of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this pattern will be changing which in turn produce different electrical waves. A muscle contraction will also generate a unique electrical signal. All these electrical waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium. Level analyzer unit (LAU) will receive the brain wave raw data and it will extract and process the signal using MATLAB platform. Then the control commands will be transmitted to the robot module to process. With this entire system, we can move a robot according to the human thoughts and it can be turned by blink muscle contraction.

Pradnya Patil1, Dimple Chaudhari –"NeuroSky Mindwave BCI System: To Save Lives during Transportation"

Ordinarily biosensor technologies examining the neurophysiological activities of driver in an operational environment are adapted with unadorned measurement encounters. This research has taken birth from studies that result into subjective measures wherein sudden variations cannot be detected vehicle-based measures in which environmental and geometrical factors of road and vehicle are involved behavioral measures wherein driver state cannot be associated to driving performance physiological measures wherein self-controlled operation of vehicle is absent. The research has introduced the brain wave sensor which incessantly scrutinizes neuron pattern of brain and conveys the result to BCI system. Output from BCI system is linked with predefined vigilance level and in view of that alert is given. The proposed system thus contributes to reduce number of accidents.

In 1929, the German psychiatrist Hans Berger had given a historical breakthrough introducing a new neurologic and psychiatric diagnostic tool termed as Electroencephalography (EEG) . Hans Berger was the founder of first Human Electroencephalogapher in which he used a "small" string galvanometer with photographic capability, provided by Edelmann. With the device, Berger was able to make permanent recordings of 1-3 min. He was able to observe EEG from a 17-year-old boy who had a trepanation while undergoing surgery for a suspected tumor in which the front parietal surface of the cortex was exposed .Further, a device, called a brain computer interface (BCI) was introduced. This was the only effective way to communicate with the environment since it can read brain signals and convert them into control and communication signals . A BCI is an artificial system that bypasses the body's normal efferent pathways, which are the neuromuscular output channels.

Chetan Umale, Amit Vaidya- "Feature Extraction Techniques and Classification Algorithms for EEG Signals to detect Human Stress"

EEG(Electroencephalogram) signal is a neuro signal which is generated due the different electrical activities in the brain.Different types of electrical activities correspond to different states of the brain. Every physical activity of a person is due to some activity in the brain which in turn generates an electrical signal. These signals can be captured and processed to get the useful information that can be used in early detection of some mental diseases. This paper focus on the usefulness of EGG signal in detecting the human stress levels. It also includes the comparison of various preprocessing algorithms (DCT and DWT.) and various classification algorithms (LDA, Naive Bayes and ANN.). The paper proposes a system which will process the EEG signal and by applying the combination of classifiers, will detect the human stress levels.

Stress is generally defined as a response of a person to the environmental demands or pressures. It results from interaction between a person and his/her environment that are perceived as straining or exceeding their adaptive capacities and threatening their well-being. It can be understood from above definition that stress is part and parcel of today's life style. If ignored, stress can lead to chronic diseases. The risk factors for stress related diseases are a mixture of personal, interpersonal and social variables. Thus, it can affect various phases of our life. So it is necessary to detect stress at an early stage and take appropriate measures. Now, the question is, Is it possible to detect stress at early stages? Yes, it is. This is done by many psychologists or counselors. But it requires active participation from the person seeking counseling. This might not be possible in some cases when a stressed person is unable to express himself frankly. Itmakes the job of a counselor difficult . This problem can be solved, if the brain signals are recorded and analyzed to detect stress. Brain signals are neuron signals. The electrical activity of the neurons inside the brain cause electric potential to be generated across different parts of the brain. The difference between these electric potential levels can be captured and used for various applications including stress detection. These brain signals are called as EEG signals - Electroencephalogram signal. Different types of states of the brain are due to different types of electrical activities of brain neurons. So, different signal values correspond to different mental states. These signals can be captured using various available equipments which generally consists of electrodes which are placed on the scalp with a conductive gel between the electrodes and the scalp. Electrodes are placed at different positions on the scalp which capture the signals from different parts of the brain. Raw EEG signals cannot be used directly for stress detection. Pre-processing is required to extract useful features which can further used with various machine learning algorithms. The aim of the paper is to review various feature extraction techniques and classification algorithms which can be used for detection of stress levels. Based on the review, a system is proposed which will use a single electrode EEG headset(Neurosky MindWave) to record raw EEG signals which will be pre-processed using Discrete Wavelet Transform(DWT) and classified using a combination of classifiers approach to detect stress levels. Section 1 gives an introduction on how EEG signals can be used in detection of stress. Section 2 contains literature survey. Section 3 contains the proposed system for stress detection. Section 4 is conclusion and Section 5 includes future scope.

EXISTING SYSTEM

EEG-based brain-computer interface for automating home appliances
A. N. Alshbatat, P. J. Vial

An EEG-based brain-computer system for automating home appliances is proposed in this study. Braincomputer interface (BCI) system provides direct pathway between human brain and external computing resources or external devices. The system translates thought into action without using muscles through a number of electrodes attached to the user's scalp. The BCI technology can be used by disabled people to improve their independence and maximize their capabilities at home. In this paper, a novel BCI system was developed to control home appliances from a dedicated Graphical User Interface (GUI). The system is structured with six units: EMOTIV EPOC headset, personal computer, Flyport module, quad band GSM/GPRS communication module, LinkSprite JPEG Colour camera, and PIC-P40 board. EMOTIV EPOC headset detects and records neuronal electrical activities that reflect user's intent from different locations on the scalp. Those activities are then sent to the computer to extract specific signal features. Those features are then translated into commands to operate all appliances at home. The proposed system has been implemented, constructed, and tested. Experimental results demonstrates the feasibility of our proposed BCI system in controlling home appliances based on the user's physiological states.

Many environmental control systems were proposed and applied for people with disability to control their surroundings [7]. Radio frequency identification and voice recognition [8] are some of these systems. Those systems work well for people with motion disability while they will not work for people with voice or vision impairment. Other systems using human's physiological state were proposed. The author in [9] proposed a BCI system to help disabled people to input phone numbers. The system is based on the steady-state visual evoked potential where twelve buttons are illuminated in front of the user at different rates. To this end, disabled people could input a phone number by gazing at those buttons. Interaction between user's brain and computer was achieved through a number of ways: Visual Evoked Potentials (VEP), Slow Cortical Potentials [10], P300 potentials, N400 potentials, and Sensory Motor Rhythm (SMR). To this end, VEP refers

to the electrical potential recorded from the visual cortex in response to stimulation of light [11]; P300 is an event related potential (ERP, recorded in response to the occurrence of a discrete event, especially when the subject is actively engaged in the task of detecting the targets). This signal appears approximately 300ms after some infrequent stimuli and typically measured by the electrodes covering the parietal lobe [12].

Several techniques were used in the previous methods to extract and classify features form brain signals. Wavelet-based feature extraction algorithms were introduced in [13]. Artificial Neural Network (ANN) has been used by [14] for cortical control of arm prosthetics. Moreover, Power Spectral Density (PSD) [15], Band Powers (BP) [16], Adaptive Auto Regressive (AAR) [17], were also used for feature extractions. A great variety of classification algorithms was also used to design BCI systems. Linear Discriminant Analysis [18], Support Vector Machine (SVM) [19], and Hidden Markov Model [20] are some of those classifiers presented in the literature.

PROPOSED SYSTEM

AIM AND OBJECTIVES

Main objective of this project is to observe the comma patient, and produce an alrm and a notification message to the physician when the patient get in to normal.

device can detect patient's focus level, meditation level and blinks. The more focused patient have the higher "attention" level becomes, the more relaxed patient have, the higher "meditation" level becomes.

Hence this project is very useful to analyses of the comma patient with cost effectively and by using non-invasive technique."Comatose patient monitoring system using neural oscillation and mind wave"is a boon to such patient for their medical treatment and achieve to measure their concentration level.

III. BLOCKDIAGRAM

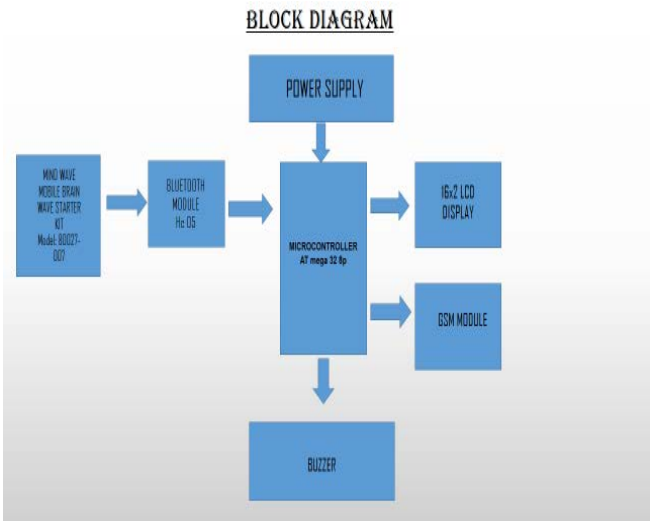
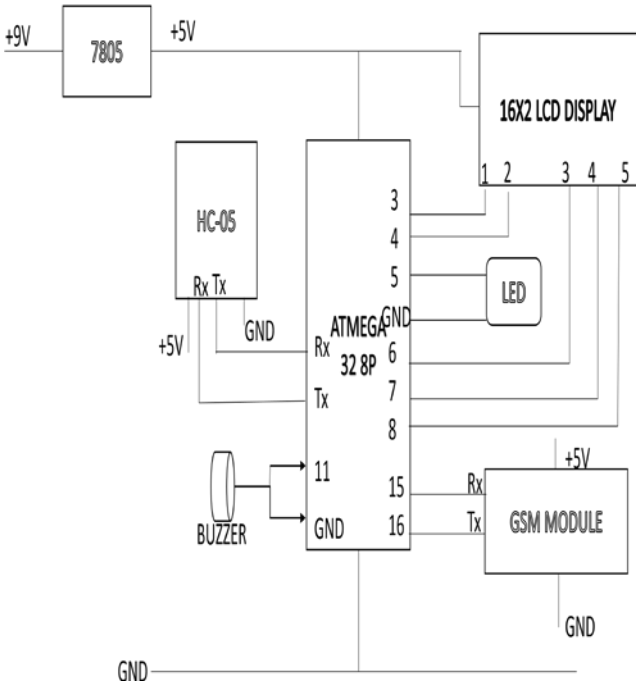


Figure shows the block diagram of the system. It consists the following blocks

1.MINDWAVE HEADSET
2.BLUETOOTH MODULE(HC-05)
3.MICROCONTROLLER
4.POWER SUPPLY
5.LCD DISPLAY
6.GSM MODULE
7.BUZZER

Mindwave headset is an advanced technology to capture the activities of brain. It measures the voltage



fluctuations resulting from ioni current within the neurons of the brain. Mindwave headset has an inbuild bluetooth system itself.The captured signal is transferred to the microcontroller (AT 32 8P) through the another bluetooth module(HC-05).

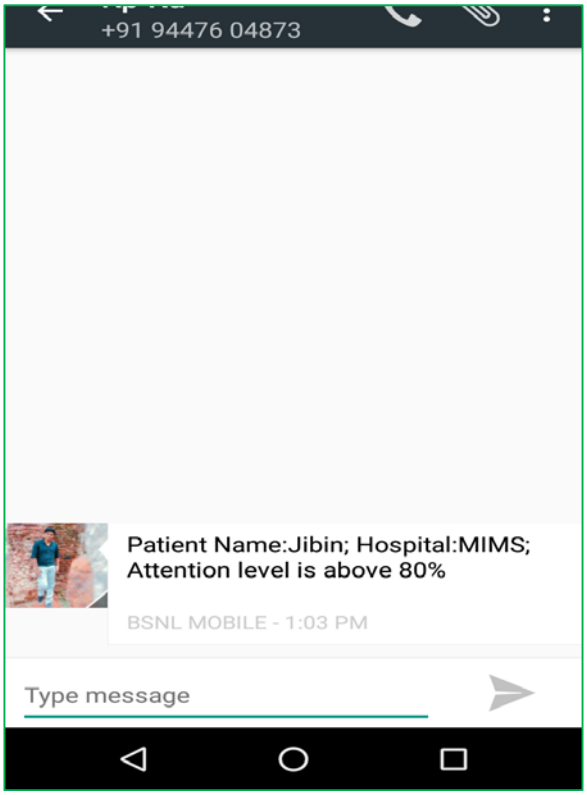
Microcontroller is the heart of this project. It processes the signals we use 9V battery supply but microcontroller operates at 5VCC. A voltage regulator(7805) converts the 9V in to 5V.

Human mind concentration level is converted in to digital value and monitored in to the LCD display.Here we set a minimum value of the concentration level in the programme. When this value cross the limit the buzzer is produce a beep sound at the same time help message is send to the physician's mobile using GSM module.

IV. CIRCUIT DIAGRM

RESULT AND DISCUSSION

The mind wave headset captures the signal and transferred to the microcontroller and it converts the human attention level in to a digital value and monitored in to the LCD display. When this value cross the limit as we set, it produces a beep sound and the same time send a help message to the physician's mobile phone as shown in the figure.



V. CONCLUSION

Comatose patient monitoring system is an advanced technology to capture the activities of the brain. It uses electrophysiological monitoring method to record electrical activity of the brain. It looks like a normal headset and easy to wear. This system designed and developed a reliable, energy efficient for monitoring a person in coma state. Diagnostic applications generally focus on the spectral content of neural oscillations that can be observed in Mind Wave headset.

In this study, a real-time EEG-based brain-computer system was proposed for monitoring the comma patient. The system consists mainly of an EMOTIV EPOIC headset and an embedded module. The embedded module is based on the AVR chip and some peripherals. EMOTIV EPOC headset was used to record EEG signal and transmits that data to the computer via a Bluetooth module. The received EEG data was processed by the software provided by EMOTIV and results were transmitted to the embedded system to analyse the condition of the patient.

REFERENCE

1. B. Bijitha, Nandakumar Paramparambath –"Brain-Computer Interface Binary Classification using Regularized CSP and Stacked Concepte"- International Journal of Engineering Trends and Technology (IJETT), V38(5),271-275 August 2016
2. Brice Rebsamen, Cuntai Guan,- "A Brain Controlled Wheelchair to Navigate in Familiar Environments",- IEEE TRANSACTIONS ON NEURAL SYSTEMS AND REHABILITATION ENGINEERING, VOL. 18, NO. 6, DECEMBER 2010
3. Chetan Umale, Amit Vaidya,"Feature Extraction Techniques and Classification Algorithms for EEG Signals to detect Human Stress", International Journal of Computer Applications Technology and Research-,-Volume 5– Issue 1, 08 - 14, 2016, ISSN:- 2319–8656
4. Christian J Bell, Pradeep Shenoy, Rawichote Chalodhorn and Rajesh P N Rao, -"Control of a humanoid robot by anoninvasive brain–computer interface in humans",- doi:10.1088/1741-2560/5/2/012
5. D.A. Craig and H.T. Nguyen,- "Adaptive EEG Thought Pattern Classifier for Advanced Wheelchair Control",-Proceedings of the 29th Annual International Conference of the IEEE EMBSCité Internationale, Lyon, France August 23-26, 2007
6. Dwipjoy Sarkar , Atanu Chowdhury." A Real Time Embedded System Application for Driver Drowsiness and Alcoholic Intoxication Detection"- International Journal of Engineering Trends and Technology (IJETT), V10 (9),461-465 April 2014
7. Gabriel Pires, Miguel Castelo-Branco and Urbano Nunes, -"Visual P300-based BCI to steer a Wheelchair: a Bayesian Approach",-30th Annual International IEEE EMBS Conference Vancouver, British Columbia, Canada, August 20-24, 2008
8. Hong Zeng, Member, IEEE, and Aiguo Song, Senior Member, "Optimizing Single-Trial EEG Classification by Stationary Matrix Logistic Regression in Brain–Computer Interface",- Neural Networks and Learning Systems, IEEE Transactions, Vol. 27, Nov 2016.
9. Jonathan R.Wolpaw (Guest Editor), Niels Birbaumer,William J. Heetderks, Dennis J. McFarland, P. Hunter Peckham,Gerwin Schalk, Emanuel Donchin, Louis A. Quatrano, Charles J. Robinson, and Theresa M. Vaughan,-"Brain–Computer Interface Technology: A Review of the First International Meeting", -IEEE TRANSACTIONS ON REHABILITATION ENGINEERING, VOL. 8, NO. 2, JUNE 2000
10. Jzau-Sheng Linl, Kuo-Chi Chen, and Win-Ching Yang, - "EEG and Eye-Blinking signals through a Brain Computer Interface Based Control for Electric Wheelchairs with
11. Wireless Scheme", -National Chin-Yi University o/Technology Taichung, Taiwan
12. Kamlesh H. Solanki1, Hemangi Pujara, -"BRAINWAVE CONTROLLED ROBOT",- International Research Journal of Engineering and Technology, Volume: 02 Issue:04,July-2015,www.irjet.net
13. Kazuo Tanaka, Kazuyuki Matsunaga, and Hua O. Wang, -"Electroencephalogram-Based Control of an Electric Wheelchair",-IEEE TRANSACTIONS ON ROBOTICS, VOL. 21, NO. 4, AUGUST 2005
14. Kuo-Kai Shyu ,-"Development of a Low-Cost FPGABased SSVEP BCI Multimedia Control System",-IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS, VOL. 4, NO. 2, APRIL 2010
15. Lavanya Thunuguntla, R Naveen Venkatesh Mohan, P Mounika,-"EEG Based Brain Controlled Robot", Lavanya Thunuguntla et al Int. Journal of Engineering Research and Applications ISSN :2248-9622, Vol. 4, Issue 4(Version 1), April 2014, pp.195-198
16. M. Arvaneh, Student Member, IEEE, C. Guan, Senior Member, IEEE, Kai Keng Ang, Member, IEEE, and Chai Quek, Senior Member, IEEE, -" Optimizing Spatial Filters by Minimizing Within-Class Dissimilarities in Electroencephalogram-Based Brain–Computer Interface",
17. MISS. RUTUJA DHABALE -LITERATURE SURVEY ON BCI CONROLLED ROBOT- International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5, Issue 7, July 2016
18. N. Alshbatat, P. J. Vial ,"EEG-based brain-computer interface for automating home appliances", Faculty of Engineering and Information Sciences -Papers: Part A-2014- Neural Networks and Learning Systems, IEEE Transactions, Vol. 24, April 2013
19. Paola Belluom, Maide Bucolo ,Luigi Fortuna ,Mattia Frasca -"Robot Control through Brain-Computer Interface for Pattern Generation",-University of Catania, Dipartimento di Ingegneria Elettrica, Elettronica e Informatica, Viale A. Doria 6, 95125 Catania, Italy ,2014,paola.belluomo@dieei.unict.it
20. Pradnya Patil1, Dimple Chaudhari ,"NeuroSky Mindwave BCI System: To Save Lives during Transportation"- International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013).