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EEG Based Wheelchair Navigation for Paralysis Patients

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ABSTRACT

Assitive Robots are used now a days to assist the disabled people,But severely disabled paralysis patients cannot convey their intention or operation to these interfaces.The Brain computer Interface(BCI) and electroencephalography(EEG) have been used to address this challenge.BCI is the conventional interface for communication. It interfaces the human brain and the physical devices by translating different patterns of brain activity into commands. With these Instruction is mobile robot can be controlled. The Overview 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 the brain wave patterns are analyzed. The human brain posess millions of neurons which are highly interconnected with one another. The Structure of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this Brain Wave signal pattern will be changing which in turn produce different electrical waves. A Total Chin of muscle contraction will also generate a unique Voltage signal. All these Brain waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium. The analyzer unit will receive the brain wavepattern and it will extract and process the signal using GUI platform. The human thoughts will be converted as control commands and it is transmitted to the robot wheelchair module to navigate in specified directions. This wheelchair robot move according to the intention or thought of the paralysis patient and it can be turned by blink muscle contraction.

***Index Terms*:** BCI, EEG based wheelchair,Assistive robot

I. INTRODUCTION

In the international meeting on Brain computer Interface technology research held in 1999 at the ensselaerville Institute near Albany, New York, it was defined as follows: “The Brain computer interface is an innovative system which provides direct interface between human brain and the external devices ,it does not depend on brains normal output pathways of peripheral nerves and muscles”.

Inaccordance with the above definition, BCI will be able to detect the patient’s intention and commands while the patient remains silent and immobilized. There are several techniques to monitor the brainwave signals, From these methods EEG gives continuous recordings of the brain activity, which is required for real-time BCI. The single neuron recording, on the other hand, requires that the electrodes are inserted inside the skull. Therefore, almost all of BCIs reported to date have been based on EEG. How can BCI then detect the user’s commands from the EEG.There are two dominant approaches, In the first approach the subject concentrates on a few mental tasks (for example, imagining the left hand movement or the cube rotation). Concentrations on these mental tasks produce different EEG patterns.In the second approach the user should follow a self regulative approach, for example change the rhythm amplitude. According to Allison there are at least five components necessary for effective BCI system: Knowing what to look for:

- Knowing the relevant physiological signals;
- Gathering the data from the user;
- Extracting useful information from the raw signal;
- Interface design.

The Brain computer Interface can segregate the two major mental tasks and can provide a feedback. It has also “reject” option, if the probability of the classification does not exceed some predefined level. The purpose of this chapter is to explain the concept of the BCI. First, the other part of the interface, the human brain, is examined. Then, the basic principles of electroencephalography (EEG) are explained. BCIs are divided into two above mentioned approaches. Then, the EEG measurement and the components of BCI system are defined. Feedback, human training issues and BCI performance measurement are explained after that.

II. METHODOLOGY

Rhythmic Brain Activity

Depending on the level of consciousness, normal people's brain waves show different rhythmic activity. The EEG is capable of detecting the different sleep stages and in awakened stage. The waves or rhythms are caused due to the different actions,states and thoughts. For example, If we plan a movement can block or attenuate a particular rhythm. These rhythms (alpha, beta, delta and theta) are explained later in this section according to Niedermayer. Many other rhythms have been proposed in EEG literature. The newly proposed wave or rhythm is called Mu wave.

Delta Brain Wave: The frequency of EEG wave which is below 3.5 HZ is called as Delta brain Wave.Infants below 2 years posess irregular delta wave activity(2-3.5 HZ) (amplitudes 50-100 _V) in the waking state. In adults delta waves (frequencies below 3.5 Hz) are only seen in deep sleep and are therefore not useful in BCIs.
Theta Brain Wave: Theta waves have their own frequency ranges from 4 to 7.5 HZ.It plays a dominance in every human's childhood. In normal adults theta waves are seen mostly in states of drowsiness and sleep. In the awakened stage the brain has only minimal amount of theta activity and no organized theta rhythm.
Alpha Brainwave: Clinical Neurophysiology have been furnished the range as 8 to 13 HZ which mostly occurs during awakened stage at the posterior head region, generally with higher voltage over the occipital areas. Amplitude is variable but is mostly below 50V in adults. Best to be seen with highly relaxed stage with closed eyes.
Beta Brainwave: It ranges from 13 to 30 HZ. Beta rhythm amplitudes are seldom larger than 30V. Beta rhythms can mainly be found over the frontal and central region. A central beta rhythm is related to the mu rhythm. It can be blocked by motor activity and tactile stimulation.

Event-Related Potentials (ERP) Event-related potentials is a common title for the potential changes in the EEG that occur in response to a particular "event" or a stimulus. This removes the "random" fluctuations of the EEG, which are not stimulus-locked. Event-related potentials can be divided into exogenous and endogenous. They depend on the properties of physical stimulus (intensity, loudness etc.). The potentials from 100 ms onward are called endogenous. They depend largely on psychological and behavioral processes related to the event. Generally ,familiar Event Related Potential is P300 This positive deflection in the EEG occurs about 300 ms after the stimulus onset. In this the paralysis patient has been induced to respond to a infrequent stimulus, which occurs randomly and infrequently among the other, frequent stimuli. Evoked potentials (EPs) are the small portion of a subset of the ERPs,which provides a huge response to a certain physical (visual, auditory, somatosensory). A unique evoked potential is the Visual evoked potential that clearly represents the output features of the entire visual pathway. The EEG over the visual cortex varies at the same frequency as the stimulating light.

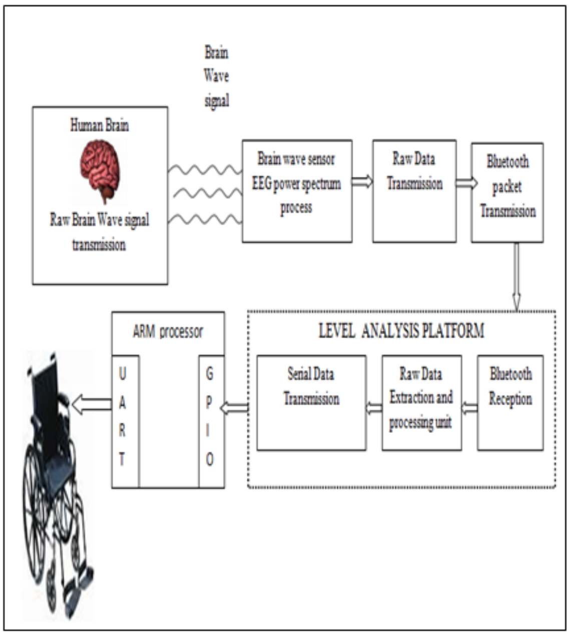

Fig 1.Block diagram of EEG based wheelchair Robot Navigation

III. FUNCTION FLOW

This explains the entire process of the project. Using the Brain computer interface Technology the human brain is interfaced with the PC. The brain wave sensor captures the brainwave signal Here the brain wave patterns are analyzed. The human brain posess millions of neurons which are highly interconnected with one another. The Structure of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this Brain Wave signal pattern will be changing which in turn produce different electrical waves. A Total Chin of muscle contraction will also generate a unique Voltage signal. All these Brain waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium.In the analyzer unit the data is now converted into commands. These commands are injected to the wheelchair via microcontroller,so that the wheelchair will now navigate in all four directions based on the patient's intention or thought to move in that direction. . The wheelchair will switch over to the driving mode by blink muscle contraction.

IV. RESULT

The figure describe the initialization of the code that is checking for errors and if its over Its starts the execution of code.

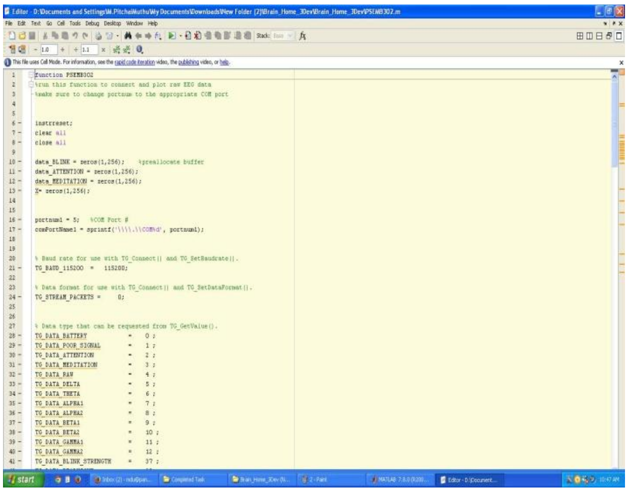

Fig 2. Initialization of Code

The figure describes the starting status of the code execution and eyes detection calculation. The calculation is done for every blink. The eye detection is calculates the depth of the eye blink these are sensed by the electrodes that present in the sensor. The eye blinks are tested in order to initiate the robotic module to driving mode.

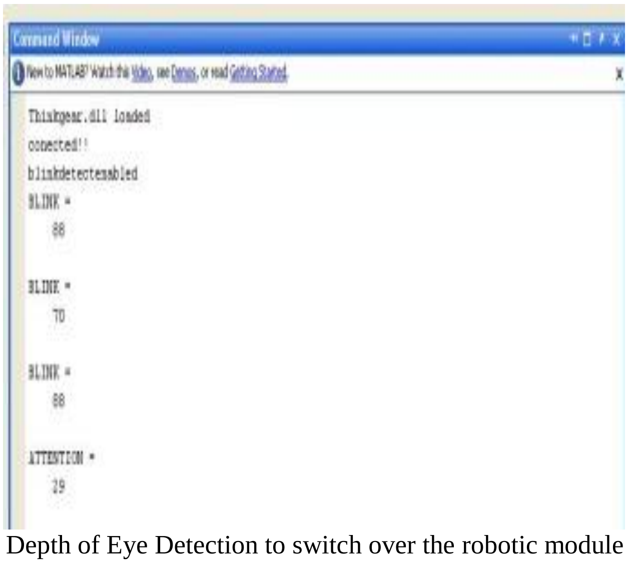

Fig 3. Calculated Depth of Eye Detection to switch over the robotic module to driving mode.

The figure is that shows the fully completed process of the attention level and the eye blinking level status. The wave with star marks the eye blinking depth detection and other wave is the level of attention of the person.

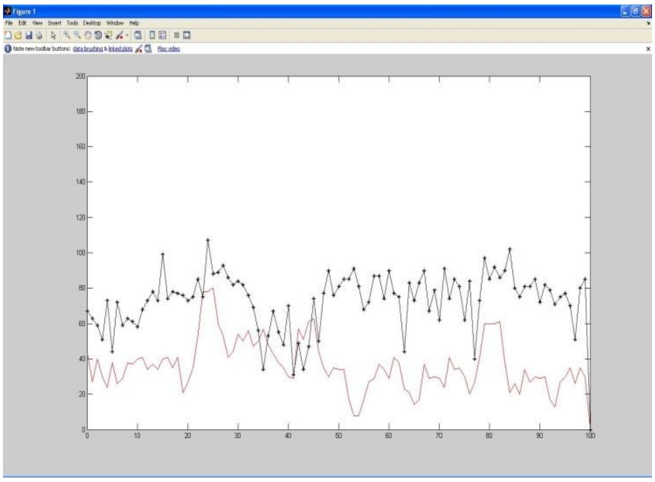

Fig 4.completed process of the attention and eye blinking

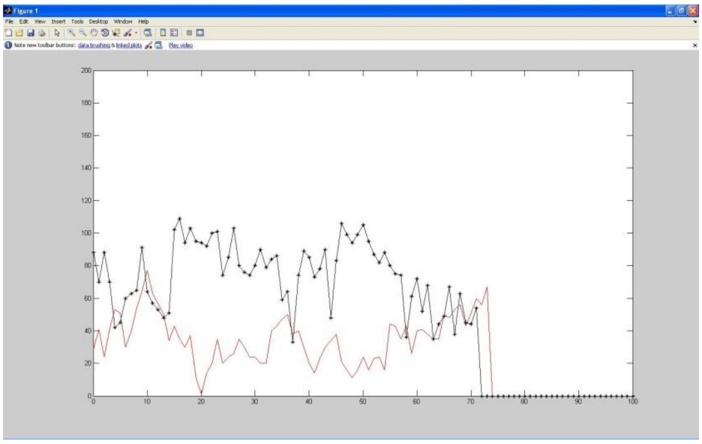

Fig 5. Non- completed process of the attention and eye blinking

The figure is that shows the Non-completed process of the attention level and the eye blinking level status. The wave with star marks the eye blinking depth detection and other wave is the level of attention of the person. The wave went completely down this may be occurs due the electrodes synchronization may be disconnected

V. CONCLUSION

In this project work ,six EEG based brain computer interface technology systems were analyzed .Several experiments were done with different humans and patients with the Brain computer Interface system.. In this work the BCI work is classified into two major approaches. First, the pattern recognition approach. second, the operant conditioning approach. The time duration for training is shorter.The results clearly depicts the attention level with the blink rate for different individual patients. On comparison with the other BCI systems, performance of the EEG based wheelchair is good because EEG is capable of detecting the different sleep stages and in an awakened stage. The results from each recording or training day should be presented in order to see the evolution of the performance.

VI. FUTURE WORK

In the future, Some of the mental tasks used in the ABI and the experiments in this work are not good. The task which is performed in the relaxed state will be easy for the classification process, but it includes eye closing.But it will not be applicable to the people suffering from locked-in-syndrome.In the future,an innovative research regarding the different mental activities will be done. a complete study regarding the movements of the hand using high-resolution electroencephalography is planned. a deeper research in brain rhythmic activity will be done.There are number of challenges in the field of Brain computer Interfacing will be addressed.one among them is controlling the ordinary computer applications using BCI.

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