EEG BASED HOME APPLIANCE CONTROL FOR PROVIDING GUIDANCE TO PARALYZED PERSON

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Abstract- This paper proposes a method for the brain computer interfacing for EEG based brain controlled wheelchair for severely disabled people in their daily life. In this paper, we provide the basic techniques for interfacing the brain to the external environment such as controlling home appliances, extracting information about surroundings through voice playback system and movement of wheelchair as desired by the disabled person sitting on the wheelchair. We will first review and classify the waves which are encountered during EEG. Since EEG is the reflection of brain activity and is widely used in clinical diagnosis and biomedical research, it is used as the main signal. The proposed system integrates EEG headset, microcontroller, laptop, accelerometers, and the wheelchair. Neural signals are obtained from human brain using wireless EEG headset and are processed through real time data acquisition in MATLAB. The wheelchair consists of microcontroller, to execute the command, accelerometer, voice play back system, and RFID card reader.

Keywords- Brain Computer Interface, Home Appliance Control, Wheelchair, Alpha Waves, Voice Playback System, RFID.

I. INTRODUCTION

Brain-computer interface technology allows users who are impaired or paralyzed to communicate with the external environment such as controlling home appliance which includes switching on/off fan, lights, television, changing television channels, etc. The disabled individuals can therefore convey their intentions or operations to these interfaces. The basic idea of BCI is to translate user produced patterns in EEG.

To operate home lighting systems manually using switches may be difficult to be performed by some paralyzed people. Even though using a remote control may also be a difficult task. Nowadays, a lot of improvement has been made in the development of lighting system.

It is also believed that eye blink is one of the mechanisms to help disable people in their everyday routines. This eye blinking activity can be detected from EEG (electroencephalography) signal via a brain computer Interface (BCI) that allows people to communicate without using many gestures.

There have been several studies using the signals of brain activity to control machines. For example, these systems were constructed to control wheelchair.

The proposed system is an extension to consisting of wheelchair which is incorporated by a data acquisition system, data processing system, microcontroller, motors for the motion of wheel chair, buzzer, RFID reader, voice playback system, IR LED, pressure sensor, GSM Module. It will eliminate the need of using camera and much additional functions are added.

II. METHODS AND METHODOLOGY

a) EEG (electroencephalography): The EEG is the measurement of the activity of large number of neurons, these recordings are painless, non invasive and do not interfere much with any user's ability to move or perceive stimuli.

The EEG electrodes measures voltage difference at the scalp in the microvolt range. EEG signal are acquired with the electrodes that are placed on the scalp surface. Silver chloride electrodes are the widely used electrodes because of its low price and low contact impedance. The Ag/AgCl electrodes need to remove outer skin layer and then a gel is filled between the electrodes and scalp and these are known as wet electrodes. This result in discomfort for the users and also takes much time. The shortcoming of wet electrode is eliminated by dry electrodes as they do not use gel and skin cleaning. Only disadvantage of using dry electrodes is that the contact impedance increases.

The electrodes are placed according to the 10-20 international system that means electrodes are located on the scalp at 10% and 02% of a measured distance from the reference sites.

The brain's electrical charge is maintained due to billion of neurons. Neurons are polarized by membrane transport proteins that are responsible for pumping ions across their membranes. Our brain is connected to the outside world through the sensory organs which act as a transducer converting physical energy, such as auditory pressure waves or light waves into a series of pulses which are conveyed along the nerve fibers to the brain. The brain not only responds to sensory stimulus but also thinks. Both

activities invoke cognitive processing at the neuronal level, thus both are reflected in EEG.

The basic building block of the nervous system is the neuron. These neurons are arranged in many complicated ways so as to process the information and to take decisions. Dendrites carry information to the neuron. An axon carry information away from neuron.

The similarly charged ions repel each other and when such ions are collected and are pushed out and hence they form a wave. When this wave of ions reaches the electrode on the scalp, they push or pull electrons on the metal on the electrodes.

Since metal is a good conductor and therefore push and pull of voltages between any two electrodes can be measured.

EEG typically has amplitudes ranging from 10 to 100 microvolt and in the frequency range of 0.5 to 40 Hz. Different waves are classified as below:
1) Delta - 0.5 to 3.5 Hz
2) Theta - 3.5 to 7.5 Hz
3) Alpha - 7.5 to 12.5 Hz
4) Beta - above 12.5 Hz

b) Signal acquisition and processing:

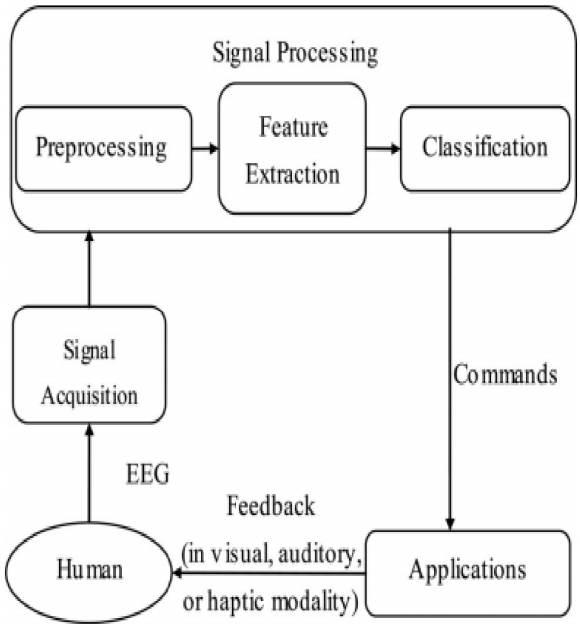


Fig.1 shows the block diagram for interfacing brain with external environment.

It shows the interfacing of the wheelchair with brain through the EEG. We acquire EEG signals by EEG headset and are processed in real time after amplifying and filtering the incoming EEG signals. After fetching the desired EEG signals we can extract results as per the desire of the paralyzed user.

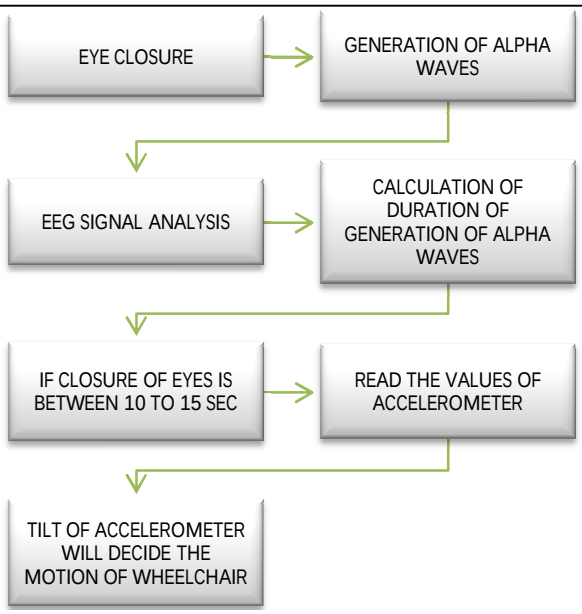


Fig.2 shows the block diagram of procedure to move the wheelchair

Alpha waves are generated when the eyes are closed and it disappears when eyes are opened. We will be analyzing the P3-01 and P4-02 electrodes which are connected to posterior side of head where alpha waves are more dominant. A shown in fig. 2 the deflection generated in FP1-F3 and FP2-F4 is due to the eye blink, as the electrodes are placed near forehead region where eye blink effect is more pronounced. Therefore, when the user closes his eyes, alpha waves are generated. We will be calculating the eye closure delay and different operations will be performed depending on the duration of eye closure.

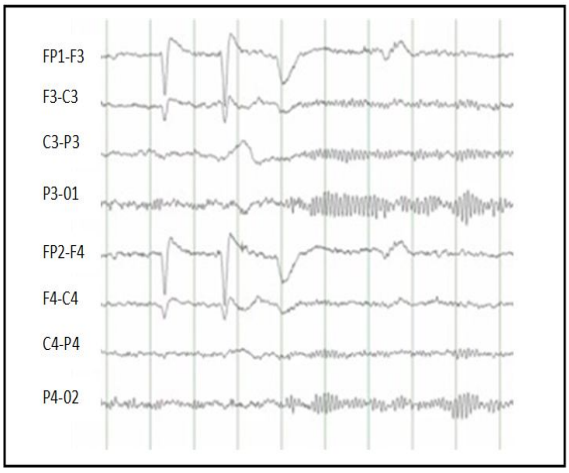


Fig. 3: Recording Of EEG

c) Working
If the closure of eye is between 10-15 seconds, then the signal will be sent from Matlab to the microcontroller. An accelerometer will be placed on the cap of disabled person which has been interfaced with the microcontroller. After receiving command from Matlab, microcontroller will check the status of

output of accelerometer and it will perform functions as shown in Table.4 below by sending commands to motor of wheelchair:

	GESTURE	OPERATION EXECUTED
1.	Head in forward direction	wheelchair will move forward
2.	Head in backward direction	wheelchair will move backward
3.	Head in right direction	wheelchair will move right
4.	Head in left direction	wheelchair will move left

Table. 4 Instructions for motion of wheelchair

If the user has to stop the movement of wheelchair, then the user can do this by again closing his eyes for 10-15 seconds, because of which alpha rhythms will be generated and the processor will check if it is for 10-15 seconds or not.

If it is for this duration then it will send command to the microcontroller and microcontroller unit will stop the motors of wheel chair.

On entering different rooms, RFID tag will be read by RFID card reader which has been already attached to the wheelchair.

On reading RFID card, microcontroller will fetch the information from the reader and it will give information about that room through the voice playback system attached to the wheelchair and the instructions will change on entering different rooms as shown in Table.5.

	GESTURE	OPERATION EXECUTED
1.	Head Forward	Switch on light
2.	Head Backward	Switch on fan
3.	Head Right	Switch on television
4.	Head Left	Switch off all appliances
5.	Close eyes for 10-15 sec	Back to the motion of wheelchair

Table.5 Instructions for controlling home appliances

If on entering room user chooses to switch on the television, then voice playback system will start giving instructions as given below in Table.6.

	GESTURE	OPERATION EXECUTED
1.	Head right	Change channel
2.	Head left	Vary volume
3.	Head forward	back to control home appliances

Table.6 Instructions for operating television

Television will be operated as shown in Table. 6 above using IR LED attached to the wheelchair and it will be programmed to perform the basic functions of a T.V remote as microcontroller will send instructions to IR LED after reading the status of accelerometer.
In case of any emergency, if the disabled person wants to call anyone for assistance, then he can do this by blowing through a straw at end of which a pressure sensor has been placed. When the pressure sensor will sense pressure, it will send command to microcontroller and microcontroller will turn on buzzer and will send the SMS to desired person through GSM module attached to the wheelchair.

In this way many difficulties will be eliminated from the life of paralyzed and disabled person and would help them to communicate to external environment.

CONCLUSION

The proposed system helps paralyzed and disabled people efficiently as it do not require any sort of complex wiring and no such muscular power to operate it. It will prove to be beneficial to these people as only eye blink and head movement are needed in this proposed system, which are much easier gestures as compared to other gestures of the body. An alarm is provided for any emergency cases which will eliminate chances for the occurrence of accident. Therefore, communication will be done between the disabled person and external environment through which a paralyzed and disabled person can communicate efficiently.

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