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APPLICATION OF NEUROSCIENCE IN THOUGHT CONTROLLED AUTOMATION USING BRAIN COMPUTER INTERFACE AND EEG SENSORS

Prasad S. Nilajkar[1], Kunal R. Nawade[2], Jayesh N. Badhaye[3]

[1]*UG Student, Department of E&TC,Jawaharlal Darda Institution of Engineering & Technology, Maharashtra, India,* ***prasadnilajkar15@gmail.com***

[2]*UG Student, Department of E&TC,Jawaharlal Darda Institution of Engineering & Technology, Maharashtra, India,* ***nawadekunal143@gmail.com***

[3]*UG Student, Department of E&TC,Jawaharlal Darda Institution of Engineering & Technology, Maharashtra, India,* ***jayeshbadhaye@gmail.com***

Abstract

In this paper we propose a system that uses complex neural signals generated by our human brain for real world automation. The concept of brain computer interface (BCI) is bridging the way to communicate with the external peripherals/objects/devices using our brain waves. The human brain generates different frequency waves like alpha,beta,theta,and delta. And these waves are nothing but representation of thoughts of a human being. So the brain waves can be distinguished and used as different functionalities in the process of automation. The NeuroSky Mindwave EEG sensors are used for detection of brain waves. The brain waves are then further amplified and feed to controlling system for processing. We are using Arduino microcontroller for this purpose. With the help of wireless transmission technology the processed information will be transmitted to the desired automation circuit. So it will be possible for us to connect the physical devices with our thoughts.

Index Terms:*Brainwaves(alpha,beta,theta,delta), Brain computer, interface (BCI),electroencephalogram EG),Neurosky Mindwave sensor*.

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1. INTRODUCTION:

Till now we were using remote control devices to control external devices. But now we can control the external devices using our thoughts. Brain computer interface is a platform that enables us to control the external peripherals using waves generated in our brain. Human mind consist of many types of neurons these generates a response for a particular stimuli and an equivalent electrical signal. BCI gathers these response from our mind using sensors and give commands to computer interface as well as operates different appliances. The wave detection unit in BCI gets a raw wave in the form of input and it will convert that into a signal using BCI graphical user interface (MATLAB). And use of EEG sensors also help in monitoring the neural activities that relates to certain thoughts like concentrating, relaxing and leading to get out the thoughts as ananalogue value and convert it to digital signals brain wave output.

And then further getting an output from the EEG sensor and BCI, the data can be wirelessly send to controller. As it is our interface between the BCI and external devices. So this technology can indeed prove a great step towards advance automation.

2. PROPOSED SYSTEM MODEL:

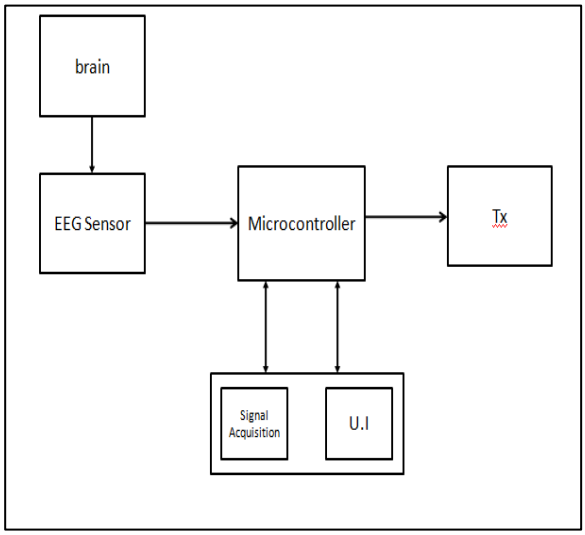

Fig.1. Proposed system model

3. COMPONENTS:

3.1ARDUINO MICRO-CONTROLLER:

In this system we are using ArduinoUno micro-controller which is based on ATmega328. This is a good development platform as it is easy to program and is an open source hardware. It supports serial communication, so the brain wave signals are received using Bluetooth module. And then these signal will be send to driver circuit.

3.2 NEUROSKY TECHNOLOGY:

The Mindwave sensor is used for identifying the pattern and the waves generated in our mind. The
Neurosky ThinkGear Technology converts these analog electric signals into digital signals. And after that Neurosky transfers these signals to desired application.

eSense is Neurosky's proprietary algorithm to determine and compute the mental states. To calculate eSense, the NeuroSky Think Gear technology boosts the raw brainwave signal and eliminates noise and muscle movement. This eSense meter values do not fetch an exact number, but instead resolve ranges of activity. The eSense meters shows how effectively the user is focusing (concentration) or meditating (relaxation). The eSense meter shows the level of a user's mental "calmness" or "relaxation". Its value ranges from 0 to 100. The Meditation is a measure of a person's mind states, not physical levels, so instantly relaxing all the body muscles may not instantly result in sudden change of meditational levels.

3.3 ELECTROENCEPHALOGRAM (EEG):

Electroencephalography is an electrophysiological monitoring method to record electrical activity of the brain. It is typically non-invasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used such as in electrocorticography. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp. Diagnostic applications generally focus either on event-related potentials or on the spectral content of EEG.

Fig.2. EEG signals

3.4 GRAPHICAL USER INTERFACE (GUI):

This user interface is an interface which gives a pictorial view to user about the current status of the devices. And it will allow user to choose the device that he wants to control. Also it willdemonstrate the various parameters analysed using EEG on the user interface screen.

3.5 BLUETOOTH MODULE:

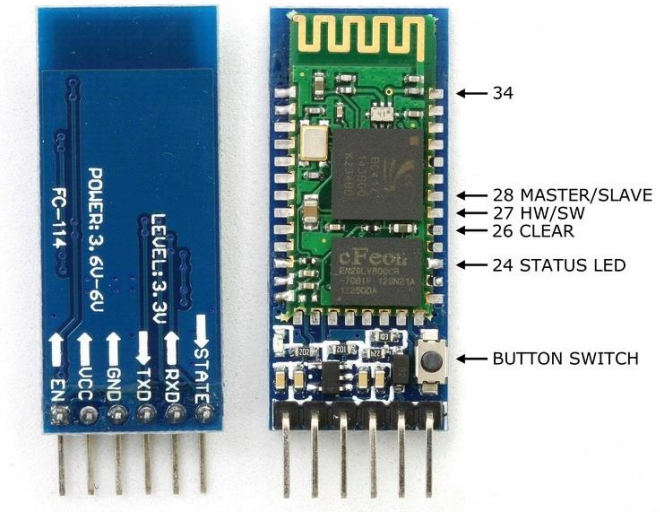

Fig.3.HC05-Bluetooth module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication.

4. WORKING:

Human brain consist a wide network of neurons that creates electrical signals in the form of brain waves. Our brain generates different waves in response to different mental states. These waves can be distinguished and analyse using the EEG. Neurosky Mindwave sensor fetches this data and it will send the data to the controller and BCI assembly. The BCI consist of signal acquisition unit and a user interface, signal acquisition unit stores the signals and also can be used to analyse these brain waves.

User interface provide a graphical view of the system and current status of the devices.as well as it will also show the dynamics of brain oscillations that generate EEG signals. And according to the received signal and programming logic of microcontroller the signal will send the desired output block using Bluetooth technology. The receiver block will contain a Bluetooth receiver and also a microcontroller. This according to programming logic will generateoutput for the driver circuit.The driver circuit will switch the devices turn on and turn off. So we can define a system that will be operated by our Mindwaves.

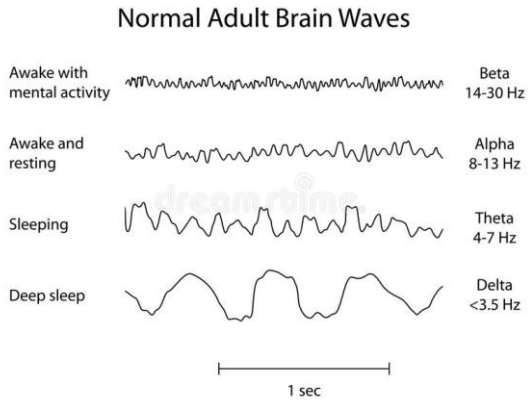

Fig.4. Brain waves

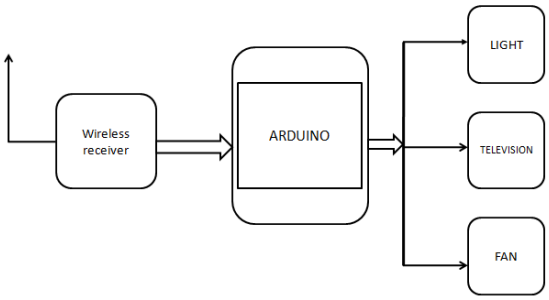

Fig.5. Receiver block

3. CONCLUSION

In this paper we have proposed a distributed framework for controlling devices remotely. This consist the interaction of our brain wave directly with devices. The EEG sensors and the concept of BCI had provided the platform for development of brainwave controlled automation. And this methodology certainly directs us to a new path towards automation technology.

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