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EEG -Based Brain Controlled Home Automation System

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ABSTRACT: Smart home Automation system by sensing human brain attention level. This system can be an effective solution to assist the disability people, who suffering from speech and motion related troubles. The system is based on BCI (Brain computer interface) Technique. The BCI is a recent and unique transmission medium between the human brain and an external device such as Bulb, fan, TV etc. The human brain wave signal contains the millions of neuron pattern. This pattern interaction is generating a thought motion which consists of different type of electrical waves. Neurosky headset consists a sensor to sense human attention level which means human focus occurs during intense concentration and directed mental activity. This signal converted into raw data packet and transfer to the arduino (microcontroller unit) through the Bluetooth medium. The Arduino process the received signal and drive the relay circuit of the device to make ON and OFF automatically. For demonstration here are used bulb, fan along with the voice module.

KEYWORDS: Brain Computer Interface(BCI) System, Electroencephalograms (EEG), Neurosky, Non-invasive.

I. INTRODUCTION

In this current world most of the peoples are suffered from more number of real time problems. One of the problems is physically challenged and elder people struggling to access the electrical appliances in the home. The BCI gives an effective solution for the hurdles faced by the people. The BCI systems linked the human brain wave signal and external devices. To control the device by sensing human attention level, which come under the non- invasive method of brain wave signal measurement . The non invasive method is a without surgical operation to access brain neural activity by placing the electrodes on cortex area of the scalp. The human attention level ranges from 1 to 100. This level may be measured by neurosky brain wave sensor. Neurosky headset is act as a brain wave sensor and it's composed electrodes, amplifier and signal processing unit and it's contain the certain algorithm is based on the human brain neural activity and also consists of AAA battery is prefer to the sensor for power utilization. The sensor will sense the human brain neural activity before the electrodes will capture the EEG signal on the cortex. This EEG contains various type of signal. Such as a Alpha (8-13Hz), Beta (13-30Hz), Theta (4-8Hz), and Delta (0.5-4Hz). The signal will generate according to the human thought motion. This signal varied from Hz to GHz frequency ranges, each of the frequency ranges signal to produce a certain type of state that is focus, dreaming, sleeping, meditation etc. The electrodes will capture the one these states signal. Normally these signals are much minuted to view so the signal will be amplified by the amplifier .And then the signal is converted into raw data by the brain sensing algorithm. The raw data will be divided into the data packet. These data to be transfer to the Arduino -Uno (microcontroller unit) through the bluetooth interface medium. The interfacing device Arduino – Uno contain the certain coding technique which to control the home appliance. This coding technique (instruction) is used to operate the home section modules (bulb, fan etc...) the project controlled with human brain neural activity and the ON, OFF condition of external device. It is depend on the interaction of neuron pattern and change the muscle movement with brightness (blinking). Normally the BCI is to transfer the human brain generate the neuron patterns into respect commands (Arduino coding). The BCI is consists of signal acquisition, feature extraction. Classification and signal processing. The control of these home appliances is depending on auditory signal received from the user. After the system is measured .

The proposed system aims to control home appliances (like, bulb, fan etc...) with the help of human attention level which comes under non-invasive method of brains signal measurement .this attention is being measured by Neurosky



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headset . Attention level values are ranges from 1 to 100. In invasive BCI approach; the brainwave sensor chip is implanted directly onto the grey matter of human brain during neurosurgery. Invasive devices produce the highest quality signals of BCI device but this method is prone to scar –tissue .In the partially invasive BCI approach, the brainwave sensor chip is placed inside the skull but rests outside the grey matter of the human brain. This method produces a better resolution signals. In the non-invasive BCI approach. The brainwave sensor chip will be placed outside the skull i.e., on the scalp. Here ,dry electrode will be used to sense the brain signals and a references electrode ear clip is used for the reference point .

Here dependent means we can say, one output is dependent on another output. Therefore, dependent BCI system relies on output from brain signal and other muscular signals like eye movement or orientation of an eye, so this system requires some extra activities to generate Electroencephalogram (EEG) signals. We can describe here using below example. Suppose we are showing to user a matrix of letters which flashes one letter at a time. If user selects one letter by focussing on it with measure concentration then Visual Evoked Potential (VEP) recorded from users scalp over visual cortex. So Visual Evoked Potential produced by this focussed letter when it flashes is much greater than other letters whenever they are flashing. However independent BCI system is something which is not dependent on brains normal output pathways as we saw in dependent System. E.g. Consider that previous flashing letter system. When user selects specific letter, then whenever that letter flashes then P300 Evoked Potential produced. In this case the output channel of brain is EEG and the generation of EEG signal mainly depends on users intent and not orientation of eyes. So here is no role for output pathways of nerves or muscles, since independent BCI system is providing you the brains new output pathways. It seems of greater theoretical interest than dependent BCI system.

B. Synchronous versus asynchronous (self-paced) BCI System

Control an electronic assistive device using only their brainwave using only their brainwaves or scientifically know as electroencephalogram (EEG) .The problem of current EEG- based brain computer interface (BCI) system is its performance in accuracy and time response .There are two types of BCI; synchronous and asynchronous. The proposed synchronous and asynchronous control algorithms are tested on the P300 based BCI system designed for an environment control application. According to the results of the study , compared to the synchronous BCI ,asynchronous BCI has superior performance in terms of task completion duration.

II. LITERATURE REVIEW

For controlling Home Appliances varies techniques were used. In A Brain Computer Interface for Smart Home Control paper they used Emotive neurosky headset to capture EEG signal and virtual environment had created. If user wants to select any device from that home then user had to raise an eyebrow. In another paper they displayed varies devices on computer screen in both invasive method and non invasive method. If user wants that flashed device to operate then user had to create signal in the brain.

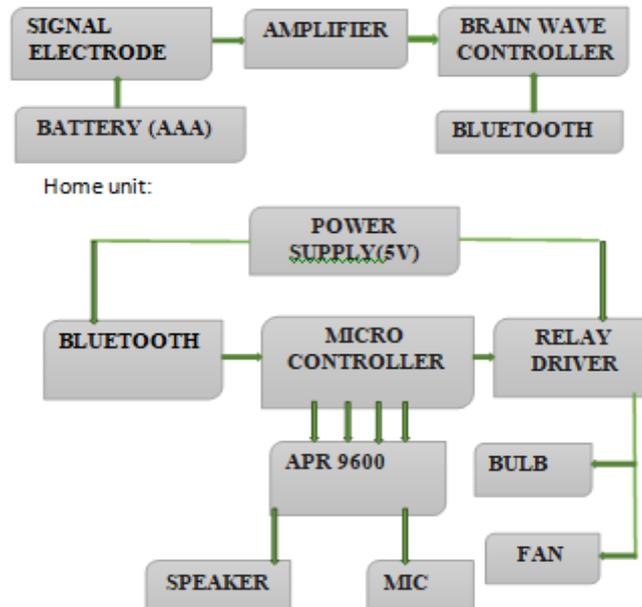
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A. Block Diagram EEG Head set:



1) Signal acquisition:

The NeuroSky Mindwave sensor is brainwave sensing headset which uses a medical probe to capture patterns and translate them to PC for further use with computer development platforms. NeuroSky Mindwave contains single sensor to make the contact on user's forehead. This Mindwave device consists of a headband, an ear clip and sensor arm. The headsets reference and ground electrodes are on the ear clip and the EEG electrode is on the sensor arm, resting on the forehead above the eye. It uses a single AAA battery with 8-10 hours of battery life. The headset image is shown in This Mindwave has the ability to provide raw data along with two custom values such as attention meter values and meditation meter values. Attention level meter values indicate the user's mental focus as shown in and meditation level value indicates users mental calmness. So here, mental calmness is not directly related to relaxation of muscular body parts, but ideally once body muscles gets relaxed then mind is getting relaxation as per medical tests. Together the attention and meditation meters referred as NeuroSky Sense meters.

Mind wave Mobile:



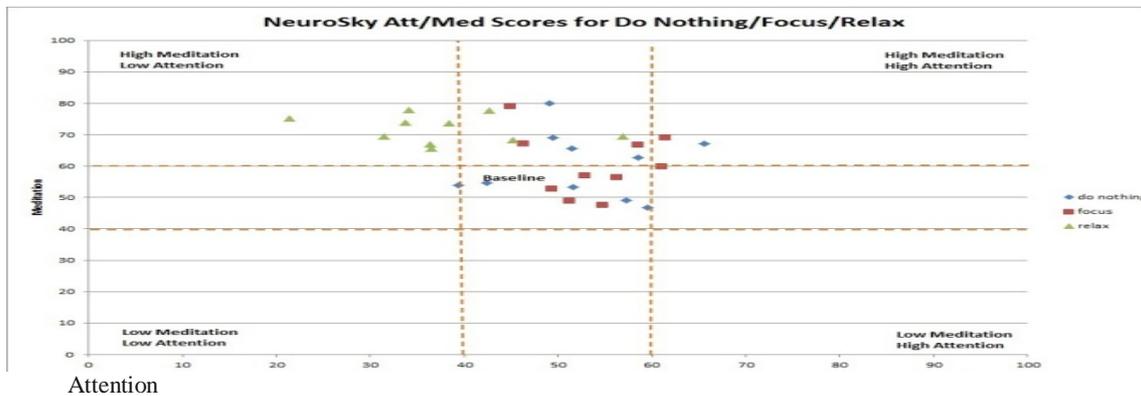
Headset Diagram

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Non invasive Attention Meter Values

2)Bluetooth (HC-05): The acquired signal from headset is transferred through Bluetooth to personal computer. Signal transmission between HC-05 and microcontroller. Bluetooth HC-05 could be a wireless communication on protocol.

3)Relay driver (ULN 2003):Relay Driver IC ULN2003 .The IC UL n2003 comprises of 7 NPN Darlington pairs typically used to switch inductive loads and drive stepper motor. The capable of Darlington transistors is 500mA, 50V output .It is a high voltage, High current transistor array IC used especially with Microcontrollers where need to drive high power load.

B. Result

In proposed system user can turn ON and turn OFF the used home appliances. a) For Bulb:

To turn ON the Bulb, user should put their attention towards object. In program total 20 values of attentions are taken for each device then make average of first five values again make average of next five values like this total five values are displayed out of 20 which are final value, this averaged values are shown in Fig.5. Now take average of those final values and if average is greater than threshold value then turn ON the Bulb. In this system threshold value is 40. This value is taken by trial and error method. Means that if user’s attention level is greater than 40 then perform the desired action. Same procedure is used to turn OFF the Bulb.

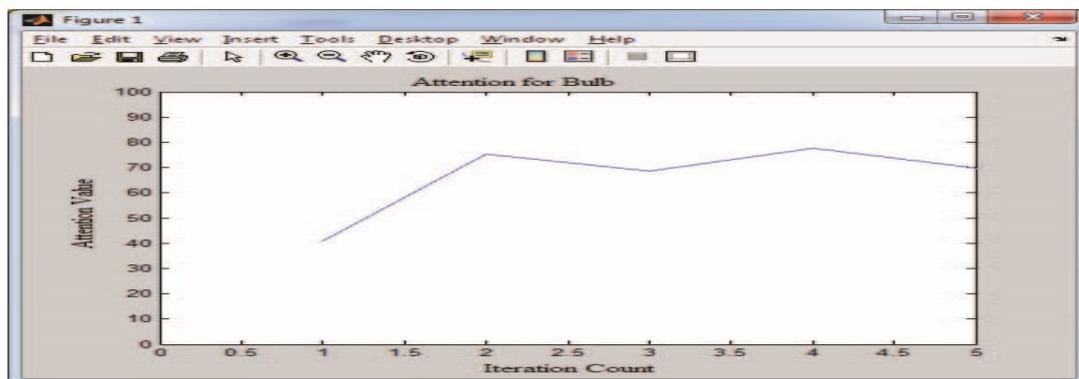


Fig. 5. Attention Graph for Bulb

b) For Fan :

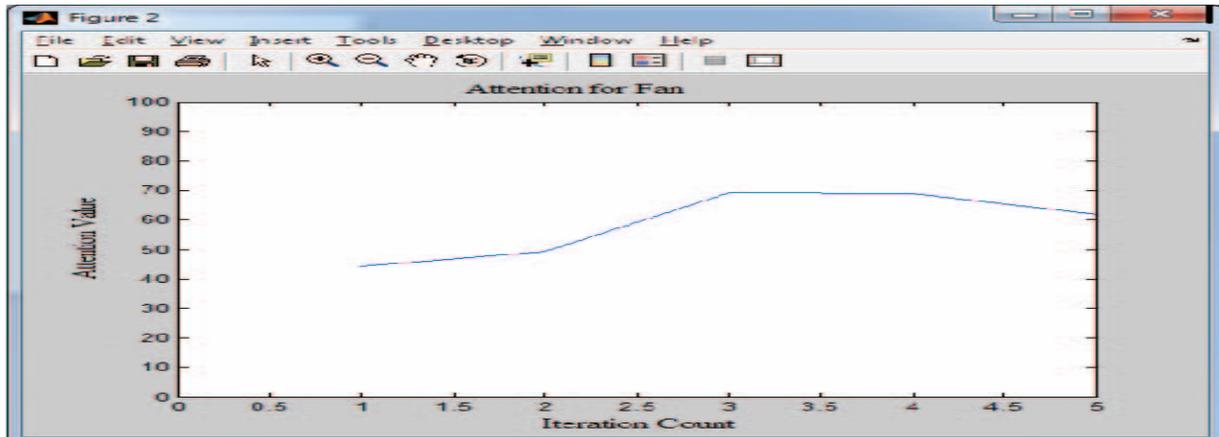
To turn ON the Fan, user should put their attention towards object. In program total 20 values of attentions are taken for each device then make average of first five values again make average of next five values like this total five values are displayed out of 20 which are final value, this averaged values are shown in Fig.6. Now take average of that final values and if average is greater than threshold value then turn ON the Fan. In this system threshold value is 40. Means that if user’s attention level is greater than 40 then perform the desired action. Same procedure is used to turn OFF the Fan.

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Attention Graph for Fan

OUTPUT:



III. FUTURE WORK

Further this system may be used for through -to-text translation or to control movements of a prosthetic limb. The umbrella term BCI covers invasive BCI, partial invasive BCI and non -invasive BCI research intends to restore enhance neural features of central nervous system by linking it to a computer system.

IV. CONCLUSION

Brain Computer System uses brain signals in form of Attention Level through Mindwave Headset to control the Bulb and Fan. We check for some threshold value to operate the peripherals. It's very easy to use the headset over the head scalp whereas there is no harm in using this. You just need to place over the scalp and check for connection status to Fitting shown in Mind Wave Mobile core UI. If headset is connected correctly then it's good to go further. Attention values get measured between 1 to 100 number values.



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