Brainwave Controlled Automation

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Research Article

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ABSTRACT

The main purpose of this project is to remove the dependency of disabled people on controlling of home electrical things. This project is based on the human brain, as we all know that human brain is itself a complex neurological network of neurons which are connected end to end, inside the brain various frequencies are being generated on doing different activity like eye blinking, concentrating, attention etc. This activity has been taken as an advantage to control the electrical things at home. The disabled people which do not have hand, legs or are in wheelchairs. All these people want a third person to control the light, fan etc., by using this project the brain activity of these disabled people are used to control various things, when he or she thinks about to switch on the something (say lights) then he or she will concentrate on that particular activity then a particular frequency is being generated and this frequency is being measured by the 'Electroencephalogram sensor' and it is send to a 'Think gear AM module'

this module process and send the signal to another bluetooth module which is connected to home electrical system for controlling, so the disabled peoples will control the things just only by brain activity and they will not depend on another person.

INTRODUCTION

At the present time, there are more than 21 million people who are disabled some of them are on wheelchair some are paralyzed fully or partially and many more, but these people have one thing in common which is working normally as other non-disabled peoples have that is the brain. Brain had approx. 86 billion neurons which are connected to each other in a very complex manner these neurons generate electrical signals; these signals are send to other parts of the body to perform various actions [1]. According to a study the people which are disabled had more efficient brain activity as compare to others, the attention and concentration capability of a person is more as compare to other. The attention, eye blink, relaxing, happy or sad, calm etc. when these types of activity performed by the person, then various frequencies are being generated in human brain, these frequency is characterized by various type of wave ranging from 1 Hertz to 30 Hertz, these waves are being sensed by the sensor which is placed on the scalp of the disabled person and frequency is being measured by an EEG sensor and this sensor covert the waves in to different electrical pulses and these pulse are being processed and send wirelessly *via* bluetooth to another bluetooth module which is connected to programmable microcontroller and it processed the signal according to program in the microcontroller and give the switching on or off signal to the electrical home system and hence the device will get on and off according to the disabled person want [2].

## MATERIALS AND METHODS

Proposed idea

In this proposed work, brainwave headset is the major part of this project in which this is being fitted in the head of the disabled person such that the EEG sensor touch the scalp of that person. The EEG signals can be recorded on the scalp of human head *via* appropriate electrodes and they provide important information about brain electrical activity. In these head models, it is usually assumed that the scalp has the same conductivity as the brain, while the skull has a much lower conductivity [3].

EEG detect the electrical field produced by the neurons, because neurons are the electrical signal carrier from different part to the brain when the person pays attention then a particular frequency is being generated, so attention comes under beta waves. If the disabled person will not be able to pay attention then there is substitution of attention that is eye blink and this will be sensed by the sensor and the signal is being send wirelessly by a bluetooth to another bluetooth which is connected with the home automation system.

Then the microcontroller process the signal and send to relay and at the same time the small LEDs which shows the concentration reach to 100% the relay switches on the electrical device say light or fan and the system work

continuously in the same manner again and again depending upon the way and which electrical device is to be switch ON (Figure 1) [4].

Figure 1. Brain frequencies.
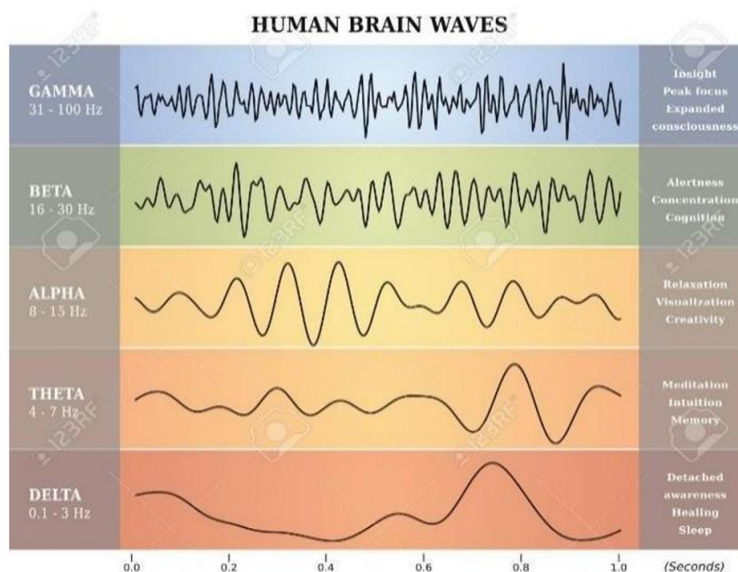
RESULTS AND DISCUSSION

Problem and its solutions

As we all know that the people who are disabled they cannot do all the day to day work themselves they want someone's help to do such thing like controlling the home appliances, fans, light etc. If the disabled person want to switch say light and at that instant of time due to some reasons the disabled person is not able to pay attention or concentration to make the system on so it is a problem its solution is that for each and every appliances control there will be two ways like is not able to pay attention then with eye blink one can do the same operation. If the disabled person did not know where to stop concentrating then a buzzer is installed as to tell the person to stop concentrating. There automatic on system in the headband as it is on the person head it automatically gets on and get pair to the home automation system (Figures 2 and 3) [5].

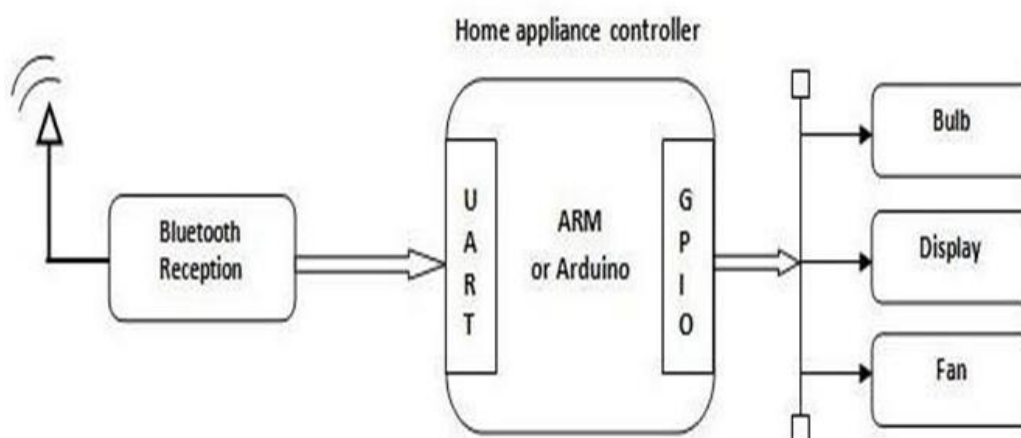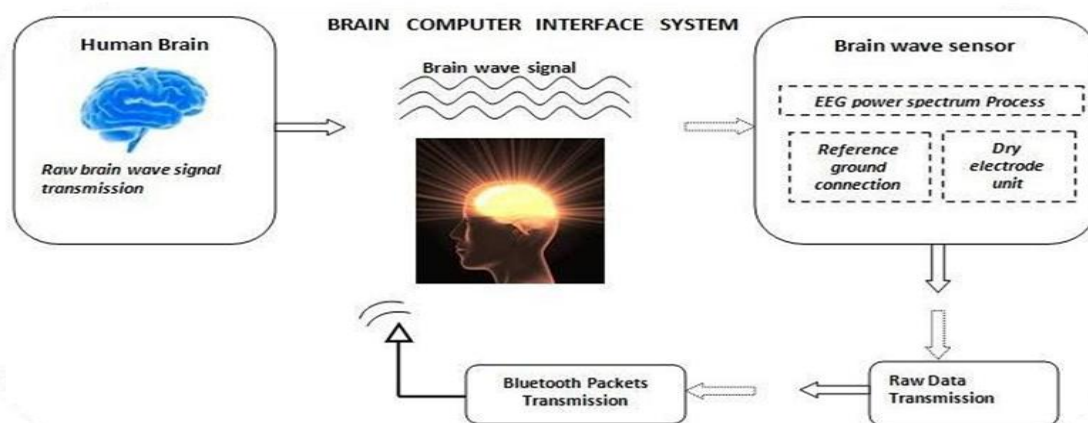Figure 2. Home appliance controlling block diagram.

Figure 3. Home appliance controlling working.

In Brain Computer Interface (BCI) we are using a brainwave headset which has an EEG sensor, TGAM module, Bluetooth module. The brainwave headset is being fitted on the head of the disabled person [6]. As the disabled person want to a particular device on he or she concentrate or pays attention the activity in the brain get started and a particular frequency wave had been generated this frequency wave is being read by the EEG sensor and after sensing a brain graph is being generated which show the concentration or attention of that person. The signal is now send to TGAM module which process it in various parameters which are in build and convert the baseband signal (the signal which is being measured by EEG sensor) in to bandpass signal, this bandpass signal is fully ready to be transmitted *via* bluetooth and this bluetooth 1 send the data to another bluetooth both the bluetooth 2 are being connected as supply is given to both of them, these bluetooth are being connected automatically because of the 'Attention command' (AT commands) both the bluetooth act in a master slave operation only when the address of master bluetooth which is in headset is saved in the slave bluetooth by AT+BIND command for pairing, then the bluetooth 2 which is slave receives and send the signal to the Arduino Uno which process it and as it found that the concentration of that person reaches above 70% the buzzer will make a beep sound so that the disabled person get to know that this much concentration or attention is sufficient, then the microcontroller send the signal to the relay to ON the electrical device, as it gets on the concentration breaks and the device is ON as much as person wants and if he or she wants to OFF it then re concentration on that particular device as the concentration levels goes up to 70% the buzzer will make a beep sound and again the device gets OFF, to show the concentration LEDs are being used to visualize the concentration by naked eyes, these LEDs will help the disabled person to understand the that to pay more attention or not. The interfacing of the system with brain and home automation system is not as much easier [7].

Hardware components

The components which are used to describe this model physically are:

- Brainwave headset
- TGAM module
- EEG sensor
- Ear clip
- Arduino UNO
- Relay module

- Bluetooth HC05 and HC06
- Breadboard
- Buzzer
- Battery
- LEDs and AC bulb

Brainwave headset: The brainwave headset is used to measure the brain activity and it also turns your computer into a brain activity monitor. The headset safely measures brainwave signals and monitors the attention levels of individuals as they interact with a variety of different apps. This headset is useful for OEMs and developers building apps for health and wellness, education and entertainment [8].

TGAM module: The TGAM is the world's most popular EEG solution. Together with dry-electrode, it senses the signals from the human brain, filters out extraneous noise and electrical interference and converts to digital power.

EEG sensor: An EEG machine measures the electrical activity in the cerebral cortex, the outer layer of the brain, during an EEG test. EEG sensors are placed on a participant's head and then the electrodes non-invasively detect brainwaves from the subject.

Ear clip: The ear clip acts as a ground and reference, which allows brain sense chip to filter out all of the electrical noise from the body and the ambient environment and hone in on brainwaves (Figure 4).

Figure 4. Brainwave headset.
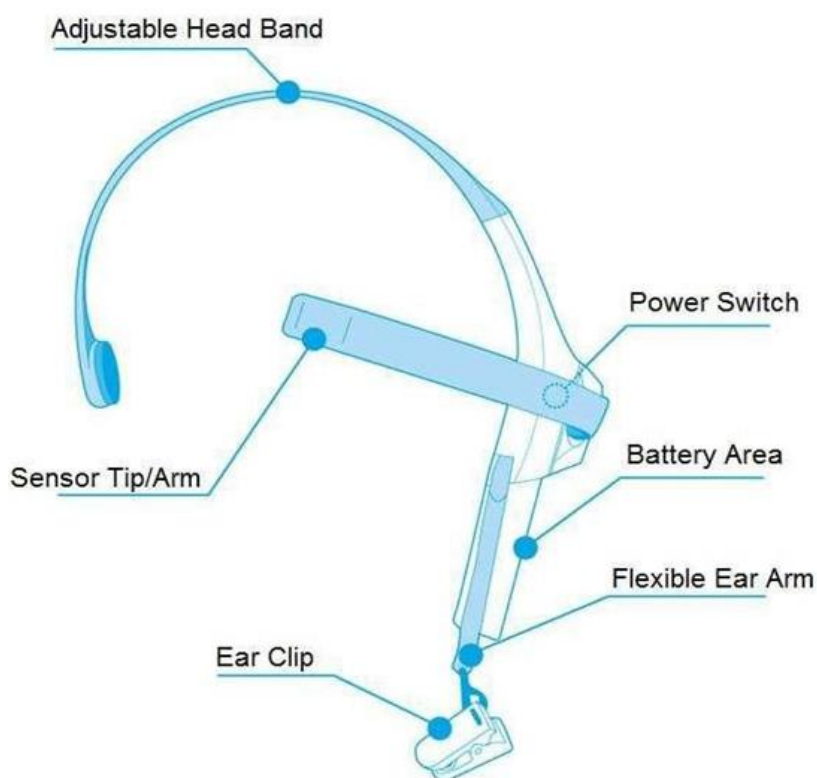
Arduino Uno: It is based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins, 6 analog I/O pins and is programmable with the

Arduino IDE, *via* a type B USB cable. It can be powered by the USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts [9].

Relay module: A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts.

Bluetooth HC0$_5$ and HC0$_6$: This module is an easy to use bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3 Mbps modulation with complete 2.4 GHz radio transceiver and baseband [10].

Breadboard: It is a rectangular plastic board with a bunch of tiny holes in it. These holes let you easily insert electronic components to prototype an electronic circuit, like this one with a battery, switch, resistor and an LED.

Buzzer: It is an audio signalling device, which may be mechanical, electromechanical or piezoelectric. Here it is used for getting beep for intruder is coming.

Battery: The battery is inserted in the brain wave headset about 5 V is given. Arduino Uno is powered by a 9 V battery for continuation.

LEDs and AC bulb: LEDs in this project is to give a visual interpretation of attention to the user so that it can see how much his concentration is. AC bulb is requiring to demonstration of home automation.

Model description

In the above model description we can see the Arduino UNO, relay module, bluetooth HC0$_5$ are connected to each other by means of connecting wire that is jumper wire, in above figure as we can see it looks too big to implement in practical, above system will become more complex more compact when it is being implemented in house. This figure above is the slave part of the project this system doesn't do the anything without the permission of the master system. Above system will be installed in the house as a main controller for home automation and the electrical wire from the relay will go to the electrical appliance which the person wants to control, this system will be easy to handle and east to use no wiring will be present all the things are fully soldered so that the can work for longer. The brain signal from the brain wave headset is received by Arduino Uno then according to the concentration or attention the LEDs which are fitted in the breadboard will glow according to the attention of the disabled person (Figure 5) [11-13].

**Figure 5.** Brainwave headset of our project.

The master of the project, it is the brain wave headset EEG sensor, TGAM module, are being fitted inside it with a 5 volt battery which give supply to the brain wave headset the sensor send and the signal goes under various process and is being transmitted towards the slave system (Figure 6) [14,15].

Figure 6. LEDs glow as per attention.
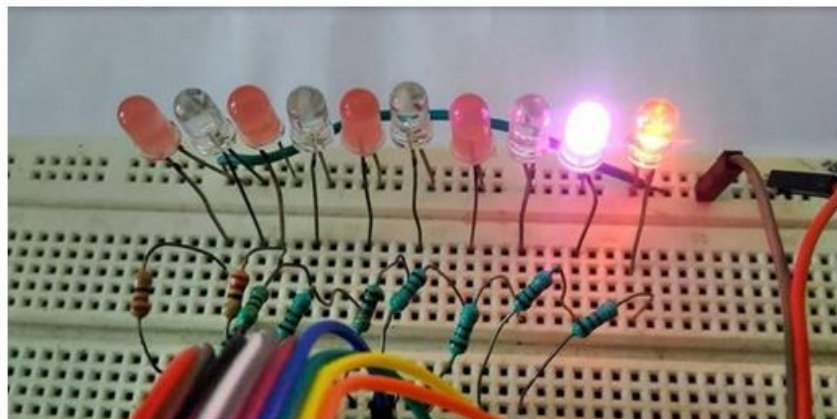
In this figure we can see LEDs on breadboard which glow according to the concentration of the person (1 LED=10% of attention) so as the attention or concentration of a disabled person goes to 100% means all 10 LEDs are glowing after that the buzzer creates a beep sound and at the same time the microcontroller send the signal to the relay and relay switch on the electrical (Figure 7).

Figure 7. Connection for relay and AC bulb.
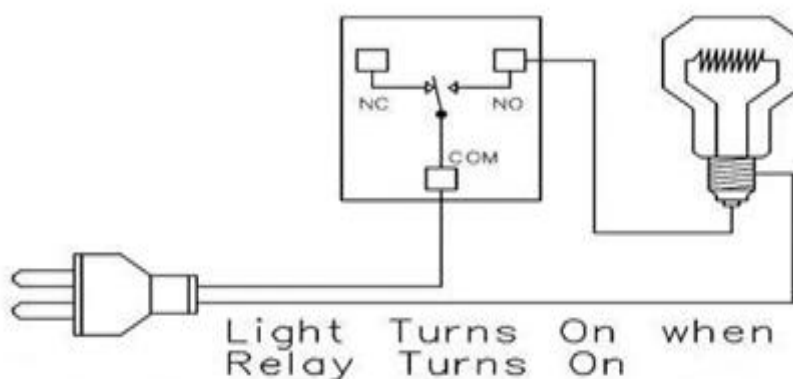
CONCLUSION

This project uses brain signals in form of attention level through brainwave headset to control the bulb and fan. We check for some threshold value to operate the peripherals. It's very close 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. If headset is fitted correctly then its goo to move further. Attention values will be measured in percentage from 0% to 100% and as if the attention reaches to 100% the bulb glows.

FUTURE SCOPE

Further this system will be used as a key to open the door for BCI (Brain Computer Interface). In future project this system can be used to control more things *via* brain, the next step of this project is to control the mechanical hands

7

and legs by which the disabled person can be able to live more than usual, the mechanical arms and controlled by brain, by just thinking the same BCI will be used but in more sensitive, compact and reliable ways. This technology is the upcoming future.

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