

Brain Controlled Home Automation

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Abstract: Brain Computer Interface (BCI) is the direct connection between the computers and human brain. The BCI reads the waves for particular Attention level produced from the brain at different locations in the human head, translates these signals into actions. This system is especially useful for disabled people or people with no reliable muscular control over their body parts to interact with surrounded peripherals. The system involves two parts: an EEG sensor circuit or Mind wave headset and an Arduino board. The brain wave sensor will sense brain signals at particular attention level and this brain signals are transferred to the Arduino using HC-05 Bluetooth module and it will convert the data into packets and transmit through Bluetooth. Then the control command will transmitted to the relay circuit and appliances work. With these entire connection system can control any home appliances through brain signals, which connected to the relay circuit.

Keywords: Brain Computer Interface (BCI), Attention level Sensor, Head Set, EEG Signal, Bluetooth Module, Arduino board.

I. INTRODUCTION

Home Automation is an area where BCI can be used and our entire house can be controlled simply by our brain. BCI is a direct communication pathway between an enhanced or wired brain. By using BCI (Brain Computer Interface), we developed a system, which can help to control different appliance and security for disable. Brain compose of number of neurons is approximately 100 billion. These number of neurons are interconnected each other via trillions of synapses. Neurons communicate using electrical signals and chemical messengers called neurotransmitters that either stimulate or inhibit the activity of a responding neuron. These electrical signals are possible to record using a monitoring method, which is Electroencephalography (EEG). EEG includes a set of signals which may be categorized on basis of their frequency. Well-known frequency ranges have been defined according to arrangement over the scalp. These frequency bands are discussed to as delta (δ), theta (θ), alpha (α), beta (β), and gamma (γ) from low to high, consequently. EEG is recorded by electrodes. Attention level plays important role here and appliances work.

II. SYSTEM ARCHITECTURE

2.1 FLOWCHART

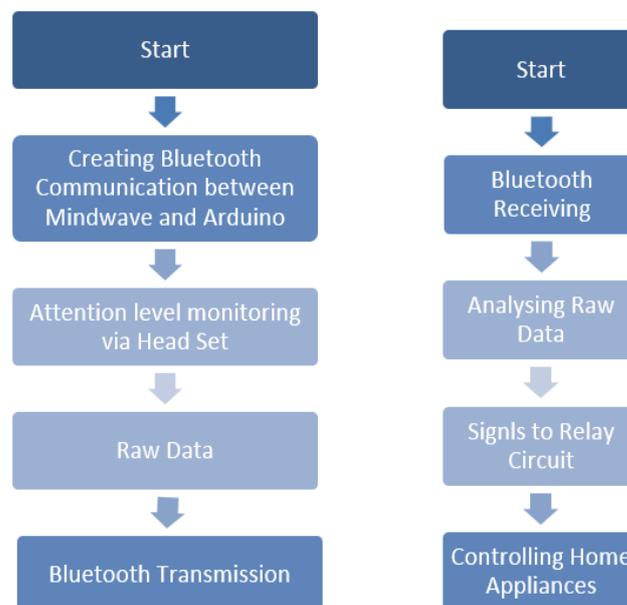


Fig1. Transmitter Section

Fig2. Receiver Section

2.2BCI SYSTEM



III. COMPONENTS

A. Arduino UNO-The Arduino Uno is an open-source microcontroller board based on the Microchip Atmega328P microcontroller and developed by arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The Arduino Uno R3 is a microcontroller board based on the ATmega328p, which can coordinate the work of each module and process the relevant data [11]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. The ATmega328 has 32 KB flash memory (with 0.5 KB used for the boot loader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). The Uno differs from all other preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 programmed as a USB to-serial converter. The ATmega328 also provides UART TTL serial communication, which is available on digital pins 0 (RXD) and pins 1 (TXD).

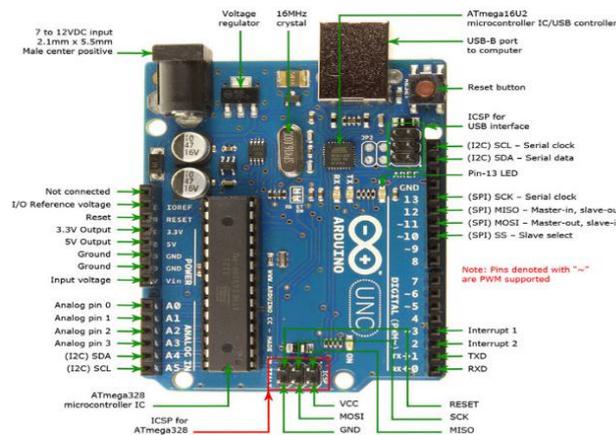


Fig 1.Pin Configuration.

B. Neurosky Headsets-The mind wave family consists of Mind wave and Mind wave Mobile 2 headsets. The Neurosky Mind Wave is a device, which is used for monitoring electrical signals generated by neural activity in the brain. For measuring the EEG signal of brain, this device is worn on the head and consists of a headband, an ear clip, and a sensor arm containing EEG electrode which rests on the forehead above the eye. Neurosky Mind Wave has a Bluetooth communication system. So, it can send its raw data to another Bluetooth controlled device. The measurement of the Mind Wave is raw signal, EEG power spectrum, meters for Attention. Here EEG power spectrum which provides information on a user's brainwave like Delta, Theta, Alpha, Beta and Gamma and meters for Attention.



Fig 2.Neurosky mind wave headset

Value Description:

20-40= 'Reduced' levels

40-60= 'Neutral'/'Baseline' levels

60-80 = 'Slightly elevated' / higher than normal
80-100 = 'Elevated' / heightened levels

The Attention meter which indicates the intensity of a user's level of mental 'focus' or 'attention' to determine levels of concentration.

C. Bluetooth module HC-05-HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. It uses serial communications to communicate with devices. Serial Bluetooth module for [Arduino](#) and other microcontrollers. HC-05 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) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle [10].



Fig 3. Bluetooth module HC-05

Operating Voltage: 4V to 6V (Typically +5V)

- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode
- Can be easily interfaced with Laptop or Mobile phones with Bluetooth
- Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.

D. Relay-

A relay is an electromagnetic switch. It is operated by a relatively small electric current that can turn on or off a much larger electric current. To control high volt circuit, we use relay circuit. This circuit helps to create communication between Arduino and high voltage equipment without damaging any device. Arduino UNO r3 gives signal that is approximately 5v. In this project, we use 5v-220v relay.

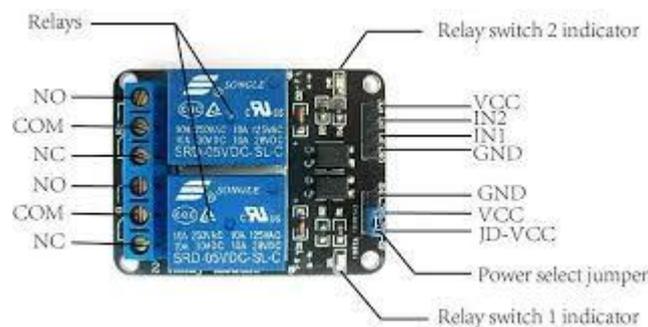


Fig 4. Relay module

- Resistance
- Lamp
- LED -Yellow
- MATLAB

IV. BRIEF

A. Matlab Program: It is frequency, amplitude and time plot on Matlab of Brain waves i.e. Alpha, beta, gamma and delta waves. It helps us to analyse brain wave according to their operating frequency range and their behaviour.

Type	Frequency (Hz)	Behavioral /Psychological State	Neurotransmitter/ Hormone	Location
Delta	0- 4	Deep rest, dreamless sleep	Human Growth Hormone, Melatonin	Frontally in adults, Posteriorly in children
Theta	4 – 8	Deeply relaxed	Serotonin, Acetylcholine, Anti-cortisol, Endorphins, Human Growth Hormone	Thalamic region
Alpha	8 – 13	Day dream, calm	Serotonin, Endorphins, Acetylcholine	Posterior regions
Beta	13 – 30	Alert, active thinking, anxiety, panic attack, focus, concentration	Adrenaline, Cortisol, Norepinephrine, Dopamine	Frontal and Parietal
Gamma	30 - 100	combination of two senses	Serotonin, Endorphins	Somatosensory cortex

Fig 5. Characteristics of Brain Wave

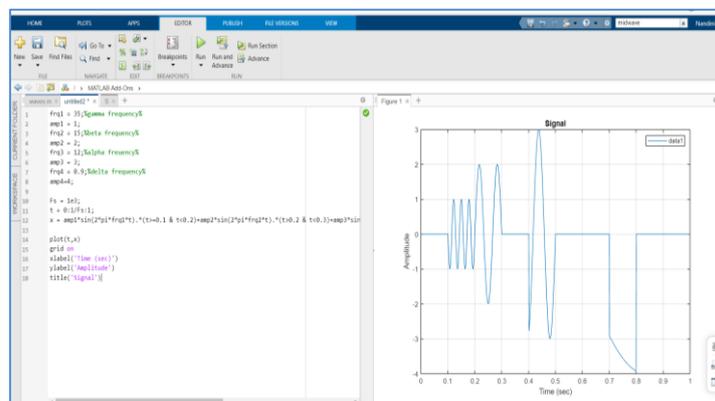
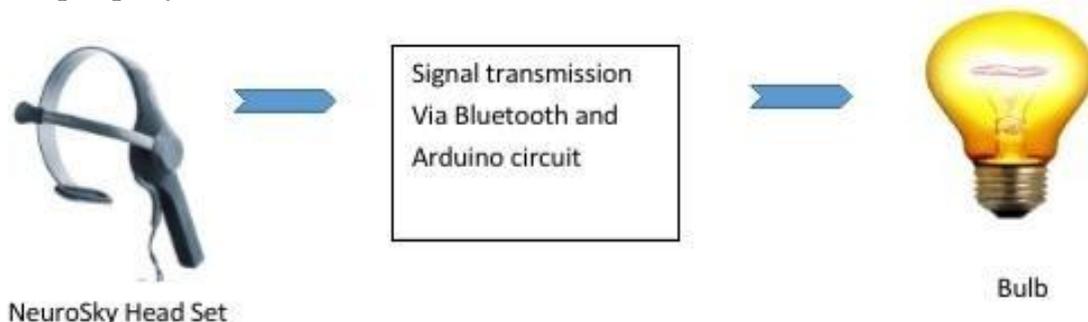


Fig 6. MATLAB Plot

B. Experiment with one bulb: According to attention headset transmits signal via Bluetooth and Bluetooth receives the signal and bulb get light up.





V. CONCLUSION

The objective of the project is to ease actions of normal as well as disabled people according to their attention levels. We check for the threshold value for the attention level and also the properties of different peripheral components. Using Bluetooth medium signals are transmitted. It uses brain signals in sort of Attention Level through Neurosky headset to regulate bulb, fan, etc., Arduino controller controls the home appliances accordingly.

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