Mind Wave Controlled Robot

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering / Technology degree in Electronics and Communication Engineering

By

RUTH BALAJI (39130382)

SUBHARAJA CHELLAM.A (39130443)

SNEHA.S (39130434)

DEVADHARSHINI (39130108)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade “A” by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI- 600 119

APRIL- 2022

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI,

CHENNAI - 600 119

www.sathyabama.ac.in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATION

This is to certify that this Project Report is the bonafide work of RUTH BALAJI (39130382), SUBHARAJA CHELLAM.A (39130443), DEVADHARSHINI (39130108) and SNEHA.S (39130434) who carried out the project entitled "MIND WAVE CONTROLLED ROBOT" under my/ our supervision from March 2022 to April 2022.

Internal Guide
MR.L.JEGAN ANTHONY MARCELIN

Head of the Department
DR.T.RAVI, M.E., Ph.D.

Submitted for Viva voce Examination held on____________________

Internal Examiner External Examiner

DECLARATION

We, Ruth Balaji (39130382), Subharaja Chellam.A (39130443), Sneha.S (39130434) and Devadharshini (39130108) hereby declare that the Project Report entitled **"MIND WAVE CONTROLLED ROBOT"** done by us under the guidance of **"Mr.L. JEGAN ANTHONY MERCLIN"** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering/ Technology degree in **Electronics and Communication.**

DATE:
PLACE: Chennai

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

We are pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

We convey our thanks to **Dr.N.M.NANDHITHA.,M.E.,PH.D.** Dean, school of Electrical and Electronics Engineering and **Dr.T.RAVI., M.E., PH.D.** Head of the department. Dept. of Electronics and Communication Engineering for providing me necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to my project guide **MR.L.JEGAN ANTHONY MERCLIN** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of our project work.

We wish to express our thanks to all Teaching and Non- teaching staff members of the Department of Electronics and Communication Engineering who were helpful in many ways for the completion of the project.

PROJECT DETAILS

PROJECT TOPIC: Mind Wave Controlled Robot
PROJECT GUIDE: MR.L.JEGAN ANTHONY MERCLIN

STUDENT 1:-
NAME OF THE STUDENT: Ruth Balaji
REGISTRATION NUMBER:- 39130382

STUDENT 2:-
NAME OF THE STUDENT: Subharaja Chellam
REGISTRATION NUMBER: 39130443

STUDENT 3:-
NAME OF THE STUDENT: Sneha.S
REGISTRATION NUMBER: 39130434

STUDENT 4:-
NAME OF THE STUDENT: Devadharshini
REGISTRATION NUMBER: 39130108

ABSTRACT

Paralysis is a persistent vegetative state of a human being or a few motor organs of him for a long or short period of time. Patients who are paralyzed still exhibit Electro Encephalogram (EEG) patterns indicating brain activity. In this project 'Mind Controlled Robot' has been proposed for supporting paraplegics, quadriplegics, people affected in accidents relying on other people even to move from one place to another. This robot is capable to move and to change direction of wheelchair based on attention level and meditation level of mind and to control home appliances like light , fan through eye blinks The proposed work uses a NeuroSky biosensor as the Brain Computer Interface. The sensor data is used to control a robot possibly a motorized wheelchair. There by a paralysed person with no or partial muscular activity can independently move without depending upon anyone.

TABLE OF CONTENT

TABLE OF FIGURE

CHAPTER - 1

INTRODUCTION

1.1 Introduction

According to a survey on 2011, 11,79,963 individuals with disability were found in the southern state of India, Tamil Nadu. The disability rate was around 1635 per 100000 people. Around 24% total disabled number had disability in movement. Males recorded a higher rate of disability over women(1819 v. 1451 per 100000) and the rural population suffered a higher disability rate than the urban(1670 v. 1599 per 100 000). Also, married, working population and literate population have a lower disability rates. On the community based study it is revealed that the Scheduled Castes in India suffer a much higher Disability rate at 1763 per 100000 than any other social group. People with multiple disabilities were found to be higher in the age groups 0-19 years and 60 years and above. To support these people who already have got their own challenges, wheelchairs were invented in the 5th century in China. Earlier they were using wheelbarrows designed to move heavy objects to help the disabled people move. With evolution and advancement of technology wheel chairs have improved tremendously. Off late, electric and battery-powered wheelchairs entered the market. As a further method of improvement, we in this work try to incorporate the power of brainwaves and eye blink to help doctors and patients to address the motor handicaps in a better way.

1.2 Study of EEG Waves

EEG Waves

In order to understand how the Brain sense Headset works, in terms of what EEG data is captured by its sensor and how it is able to identify the user’s attention and meditation levels, a basic understanding of the different EEG Frequency Bands that the Brain sense Headset can detect is needed. The five main brainwave frequencies include: Gamma, Beta, Alpha and Delta.

Gamma Waves

The below figure is Gamma Wave Waveform. The frequency range of Gamma Waves is from 25 Hz to 140 Hz and is related with learning and processing new information, the 40-Hz point being of particular interest.

Beta Waves

The below figure is Beta Wave Waveform. The frequency range of Beta Waves is from 12.5 Hz to 30 Hz and is related with intense, logical, and analytic thinking.

Alpha Waves

The below figure is Alpha Wave Waveform. The frequency range of Alpha Waves is from 8 Hz to 12 Hz. These waves help in overall coordination of mind, calmness, alertness, integration and learning of mind/body. Its value is high during flowing thoughts, and in meditative states.

Delta Waves

The below figure is Delta Wave Waveform. The high amplitude waves of the brain are Delta Waves whose frequency range is from 0.5 Hz to 4 Hz. These waves are useful in specifying the depth of sleep.

The below figure shows the all the EEG Waves Signal Comparison

Comparison of EEG Bands

Type	Frequency (Hz)	State of Occurrence
Delta	0.5-4	a) adults slow wave sleep b) in babies
Theta	4-8	a) young children b) drowsiness or arousal in older children and adults c) idling
Alpha	8-13	a) relaxed state b) eye blinking
Beta	13-40	a) alert/working b) active, busy or anxious thinking

Fig 1.1 EEG Waves comparison

The below fig show EEG waves waveform comparison

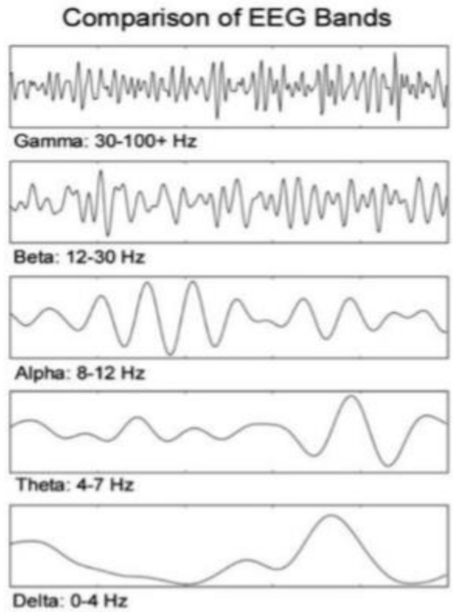


Fig1.2 EEG waves waveform comparison

1.3 Motivation

This project is aimed towards quadriplegics, paraplegics, people involved in freak accidents that have left them without an extremity or any for that matter and people with motor conditions severe enough to impair movement of the extremities, it will give them an alternative way of controlling traditional wheelchairs.

From the above literature we can say that the Brain wave controlled Instrument can used to be run or controlled by the mobile device, It uses a short distance for connectivity, It requires lead acid battery etc. For the functioning. But this motivated us to find certain different ideas so these drawbacks can be overcome and It does need to be dependent on the above ideas.

CHAPTER- 2
LITERATURE SURVEY

Bluetooth Remote-Controlled Car

Hector Domingue[1] developed a Bluetooth controlled remote car. The Project has a Bluetooth device that sends and receives signals to communicate with Android application that works as remote controller of the RC car. PWM signals were used for driving the DC motors of the car. The application use an Android Bluetooth API and constructed using Java and XML.
One limitation is that the range off connectivity is very less not greater than 10 meters.

Mobile-controlled wheelchair

Roger Achkar[2] developed a wheelchair controlled by a smart phone. They stored a pre-defined path for moving the wheel chair automatically. It also required the measurement of the time needed for the wheelchair to get from the source location to its destination and the turns it would have to take along the way. An IP cam mounted on top of the wheelchair and Android
application of this work are wirelessly connected to a router that is in turn in connection with the Arduino board. The mounted camera does give a video monitoring facility to the administrator and enables him to monitor the patient's location.

Limitations of this project include motor-handicapped people with no limbs have no way of using the wheelchair as it requires them to use a smartphone to control it. This wheelchair is essentially limited to patients with fully-functional hands.

Android-controlled monitoring toy car via WIFI

Rosevir Ceballos[3]developed an Android RC car with an enabled video streaming capability via Wireless Fidelity (WIFI). The Android app they developed made use of the smartphone's internal accelerometer and gyroscope sensors to control the movement of the RC car. Authors used these senor data to control the steering mechanism of the car and they also saved the video in an internal memory of the IP camera for streaming purpose.

Limitation in Ceballos' project was the motorcycle lead-acid battery they used to power their car. It could only power the system continuously for short periods of time before requiring to be charged again. Using other types of batteries more suited for RC cars such as lithium polymer ones will improve battery life.

Biomedical Applications

Jobby K.Chacko [10] proposed a roadmap for research in BCI technology. It overwhelmingly focus on the medical applications. With many BCIs one can intend for replacing the Central Nervous System's (CNS) functionality that was lost due to a disease an ailment or an injury. The paper also focus on therapeutic and rehabilitation of motor skills after illness or trauma to the CNS, in diagnostic applications and BCIs are being used in affective computing for biomedical applications. These technologies can also reduce the time and cost of care.

Limitation in the development of such systems is the need to design accurate technologies which can deal with the possibly atypical brain responses which can be the result of illnesses such as stroke.

Gaming

BCI is originally developed for gaming industry by Atanasios Vourvopoulos [6]. As an alternative for conventional game controllers like joystick and steering. EEG data was employed to control the level of difficulty in multiplayer mode, by using Dynamic Difficulty Adjustment (DDA) that provides higher level of difficulty for a strong player and lower level of difficulty for a weaker player.

The main drawback of these algorithms, that govern the behavior of the game is a Sensors that cause significant problems when building such systems.

Industry and Transport

Naveen R.S, Anitha Julian (7) in Industrial robotics is another area of application for EEG-based BCIs and such technologies can improve safety in the work place by keeping humans away from dangerous activities. Such systems could replace tedious button and joystick systems used to train robots in industrial settings, and they can also be used to monitor when a user is too tired or unwell to operate the machinery and take appropriate steps to mitigate any danger, such as by stopping a piece of machinery .Similar BCIs which monitor awareness can also be applied to transport, in order to monitor the fatigue of drivers and to improve the performance of airline pilots.

Poor decisions can be expensive in terms of both the human life and monetary burdens on the entities involved. Thus, a key issue in such BCIs is to ensure robustness, reliability and constituent high accuracy despite the fact that EEG data is highly nonlinear and noisy, and prone to inter and intra-individual changeability.

Non-Biomedical Applications

Vijay Raghav Varada (5), the economic potential of BCI technologies has emerged, particularly in the areas of entertainment, gaming and affective computing.While medical or military applications require researchers to focus on robustness and high efficiency, technologies aimed at entertainment or lifestyle require a heavier focus on enjoyment and social aspects.

A key challenge in the design of such systems is how to identify appropriate and interesting systems that would be appealing to commercial users, as well as ensuring they are robust enough for being marketed to a wide and varied audience which is very difficult to achieve and if achieved difficult to maintain.

Controlling electrical devices with human brainwaves

Keerthana, et al. (11) had developed a way of switching electrical appliances on and off using brainwaves. The project uses a Brain sense Headset for brainwave sensing and transmission. The system flow of this project starts with the Mindwave Mobile. Raw brainwave data are fed into the Mindwave Mobile and put through a series of processing algorithms to make it suitable for microcontroller use. The resulting translated data is fed into a microcontroller that has an electrical appliance connected to it via a relay. Using brainwaves, the user is able to turn the electrical appliance on and off. Apart from the switching on and off of the electrical appliance, this project also tested the Mindwave Mobile's accuracy in terms of translating brainwave data into usable ones. A series of tests for varying intensities of Beta and Gamma waves was made and the Mindwave Mobile managed to pass all of them. This project did not use other features of the Mindwave Mobile such as blink detection.

Limitations of this project include the maximum transmission range of Bluetooth is 5 meters that the Mind wave Mobile can sense. The Mind wave Mobile is probably the most affordable EEG headset available to student, developers, albeit having a less robust and comprehensive feature set.

CHAPTER- 3
AIM AND SCOPE

AIM:

The aim of the project is to help the people who are depended on other people to move from one place to another.

PURPOSE:

Paralysis is a persistent vegetative state of a human being or a few motor organs of him for a long or short period of time. Patients who are paralyzed still exhibit Electro Encephalogram (EEG) patterns indicating brain activity. In this projecr 'Mind Controlled Robot' has been proposed for supporting paraplegics, quadriplegics, people affected in accidents relying on other people even to move from one place to another. This robot is capable to move and to change direction of wheelchair based on attention level and meditation level of mind and to control home appliances like light , fan through eye blinks The proposed work uses a NeuroSky biosensor as the Brain Computer Interface. The sensor data is used to control a robot possibly a motorized wheelchair. There by a paralysed person with no or partial muscular activity can independently move without depending upon anyone.

CHAPTER- 4

EXPERIMENTAL OR MATERIALS AND METHODS

4.1 Problem Statement and Design Objective

This project aimed to help solve the following issues:

1. Complete dependency of people with no limbs or those with motor-related diseases with similar effects.

2. Partial paralysis that only leaves the affected access to only the most basic of motor movements such as eye-blinking.

3. Inability of people with motor-related handicaps but with fully functioning brains to independently move around.

The primary goal of this project is to develop a miniature wheelchair prototype that is controlled via the user's blinks and brainwave data. Other goals are the following:

1. Translate brainwave data and blinks into wheelchair movements.

2. Develop an Android application that will serve as a data receptor for the Mind wave Mobile and a data transmitter for the miniature wheelchair.

3. Receive attention and blink strength levels wirelessly via Bluetooth from the Mind wave headset.

4. Develop an algorithm based on the Mind wave Mobile's blink detection to effectively detect forced and involuntary blinks for wheelchair control.

4.2 Proposed System

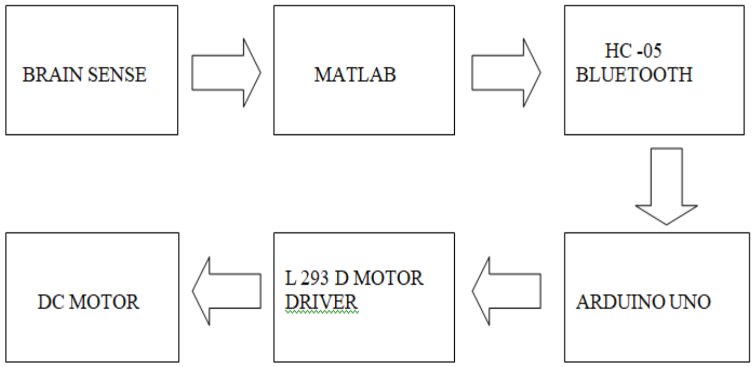


Fig.4.1. Control flow diagram of the Mind Wave controlled Robot

The above Fig 2.1 is a Control Flow Diagram. A Brain-Computer Interface (BCI) is the conventional connection tract that can be used to interface the human brain to electronic devices connected externally. BCI helps users to command the external devices directly using brain signals. In this work, Neurosky Mind wave Mobile is used and is one of the fewest affordable BCI. It is a EEG headset used to measure the brainwave data and to convey that data through Bluetooth. The non-invasive, dry electrodes present in the device helps in setting the electrodes directly on the scalp without the need of applying gel of the brain.

It is used to monitor attention and meditation levels as well as detect blinks. Based on Beta waves of the user, eSense Meter of the device gives a value that are measured by Neurosky Mind wave Mobile. Attention is associated with the focusing of a single thought by the user. Electro Oculo Graphy (EOG) is the method for storing electrical changes caused by eye movements. Thus EOG is used to find events such as blinks which is used to support the physically challenged to control home appliances (light, fan, TV) .

Bluetooth technology follows a worldwide wireless communication standard IEEE 802.15 for connecting devices wirelessly over a definite distance. The maximum transmission range Bluetooth devices is 100m based on the class. In this work, HC-05 Bluetooth module is used , whose transmission range is10m.

Arduino Uno is one of the popular microcontrollers based on the ATmega238p. It has a total of 14 digital IO pins, where six pins are PWM outputs and other six pins are analog inputs.

It also has a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button.

In this work, L293D Motor Driver is used to amplify the signal received from the Arduino into an appropriate value for controlling motors of the wheel chair due to it small size. Two H-Bridge circuits present in the L293 D are used to rotate two DC motors independently.

4.3 Hardware Requirements

BRAINSENSE

The below Fig 2.2 is an Brain Sense Headband .Brain sense is the device that works under the Principle of BCI - Brain-Computer Interface, that is analyzing brain with EEG – Electroencephalography, the study of the electrical activity of brain neurons and developing brain actuated applications using this device.

In this generation, every industry is trying to build AI bots that are highly intelligent than Humans, which may be a threat to Humans. On the other hand, some industries are working to enhance the human, using this BCI technology. Industries such as Neuralink by Elon Musk, designing thinner electrode, can be planted around the skull, can be used to monitor the brain activity.

The Brain sense is also one of the BCI devices, which has Non-invasive types of electrodes i.e, Electrodes can be just placed in the scalp of the brain, instead of injecting the electrode into the brain tissues and also it is a dry electrode, which doesn't require any gel before use.

Fig 4.2 Brain Sense Headband

Technical specification

- Module – TGAM 1
- Electrodes – Main Electrode & Ear clip electrode(Ground)
- Type of Electrode – Non-Invasive | Dry
- Battery – 3 AAA Battery
- Standup Time – 6 Hours run time
- Connectivity – Bluetooth v2.1 class
- Compatability – Windows | Linux | Android | Raspberry Pi | Arduino
- Measure – Meditation | Attention | EEG Bands (Alpha, Beta, Gamma, Delta & Theta) | Raw EEG with Eyeblink

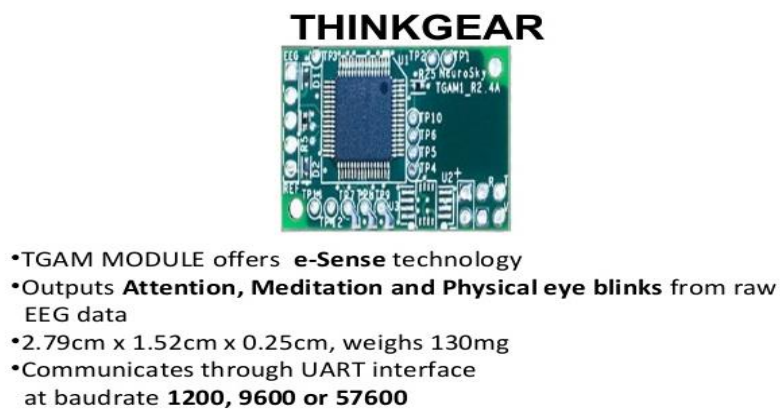


Fig 4.3 Thinkgear Module

HC-05 BLUETOOTH MODULE

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

Pin Description

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate.When enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

Vcc: Supply Voltage 3.3V to 5V

GND: Ground pin

TXD & RXD: These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator. When the module is not connected to / paired with any other bluetooth device, signal goes Low. At this low state, the led flashes continuously which denotes that the module is not paired with other device. When this module is connected to/paired with any other bluetooth device, the signal goes High .At this high state ,the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

BUTTON SWITCH:

This is used to switch the module into AT command mode.To enable AT command mode,press the button switch for a second.With the help of AT commands,the user can change the parameters of this module but only when the module is not paired with any other BT device.If the module is connected to any other bluetooth device, it starts to communicate with that device and fails to work in AT command mode.

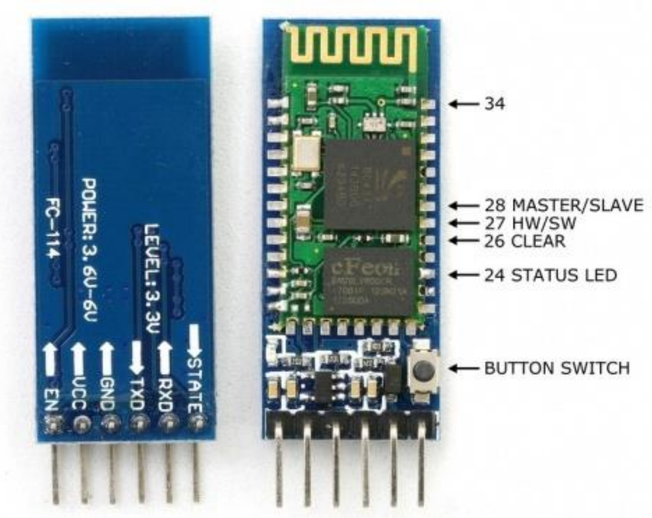


Fig 4.4 Bluetooth

ARDUINO UNO:

Arduino Uno is a microcontroller board based on the ATmega328P . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Fig 4.5 Arduino

L298N MOTOR DRIVER:

L293N is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293N is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293N IC. In a single L293N chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently-bridge is a circuit which allows the voltage to be flown in either direction. H-bridge IC are ideal for driving a DC motor. Due its size it is very much used in robotic application for controlling DC motors. This Motor driver can only control two DC motors simultaneously compared to other DC motors.

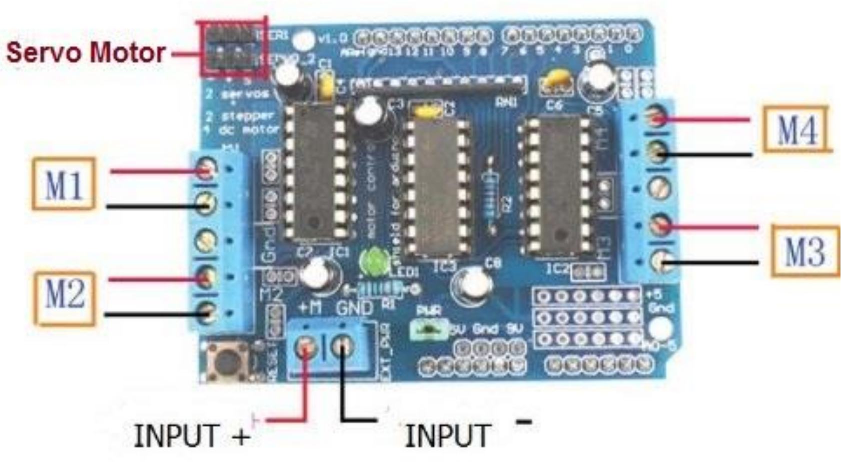


Fig 4.6 Motor Driver(L293N)

DC MOTOR

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

Fig 4.7 DC Motor

PC CONFIGURATION

The Personal Computer (PC) used in this Project is an Windows 10 Operating System (OS) which has an Intel i7 Processor which is faster and more efficient than the other Intel processors, It runs at 1.80-1.99GHz.The Random access Memory (RAM) is an 8GB and it can Boost or Run Complicated Programs without any drag. The purpose of using this PC is that it can run the Brain sense program in a smoother manner without any drag and other problems.

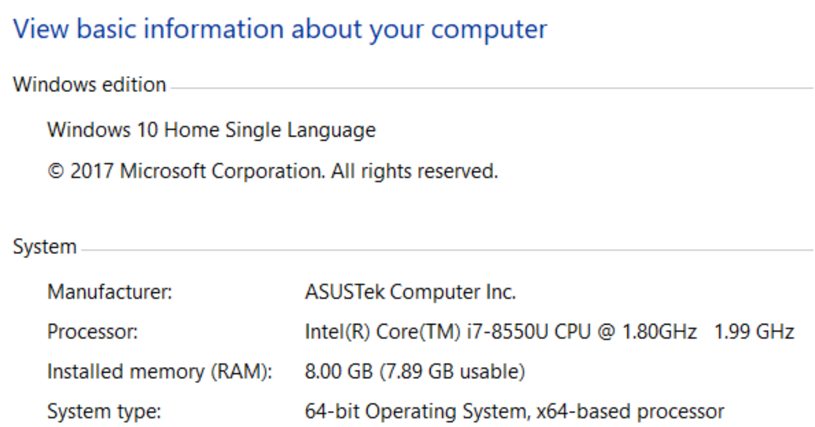


Fig 4.8 PC Configuration

4.4 SOFTWARE REQUIREMENTS

NEURO VIEW

Neuro view is an software that helps in displaying the live recording brain waves which is been sensed from the silver chloride electrode.Initially the electrode must be placed on the forehead and it begins to read the brain waves these waves are transmitted to the Neuro view via Bluetooth.For activation or reading the Brain wave first we have to set the baud rate to 57600 and select the appropriate COM port where the Brain sense and Neuro view are connected

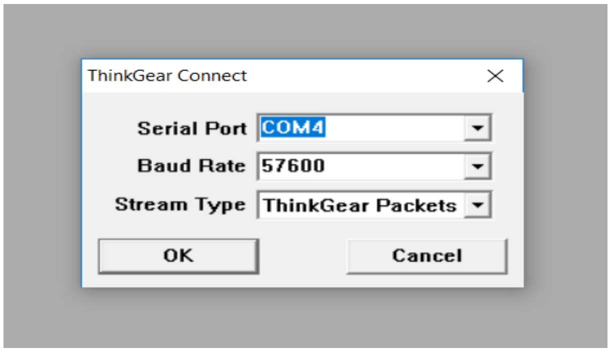


Fig4.9 NeuroView

Once they are connected the Brain waves will start to be displayed and it is flowing in an low amplitude waveform.If we blink then the signal starts to increase in amplitude and with this amplitude change due to blink level we can drive the motor using Matlab software.

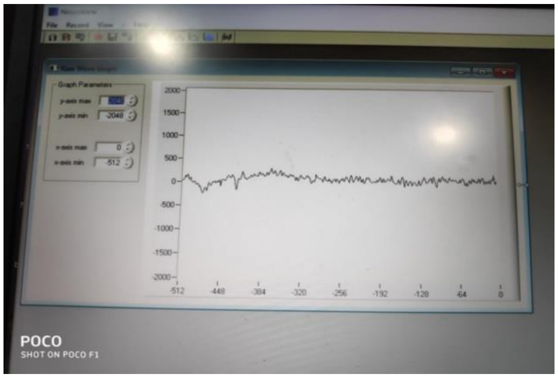


Fig 4.10 Normal EEG Waves

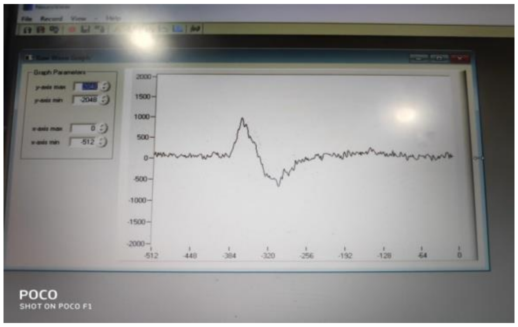


Fig 4.11 EEG Waves When Blinked

MATLAB

MATLAB (*matrix laboratory*) is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

MATLAB 2018 supports structure data types. Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. In addition, MATLAB supports dynamic field names (field look-ups by name, field manipulations, etc.).

Functions

When creating a MATLAB function, the name of the file should match the name of the first function in the file. Valid function names begin with an alphabetic character, and can contain letters, numbers, or underscores. Variables and functions are case sensitive.

Function handles

MATLAB supports elements of lambda calculus by introducing function handles, or function references, which are implemented either in .m files or anonymous nested functions.

Classes and object-oriented programming

MATLAB supports object-oriented programming including classes, inheritance, virtual dispatch, packages, pass-by-value semantics, and pass-by-reference semantics. However, the syntax and calling conventions are significantly different from other languages. MATLAB has value classes and reference classes, depending on whether the class has *handle* as a super-class (for reference classes) or not (for value classes).

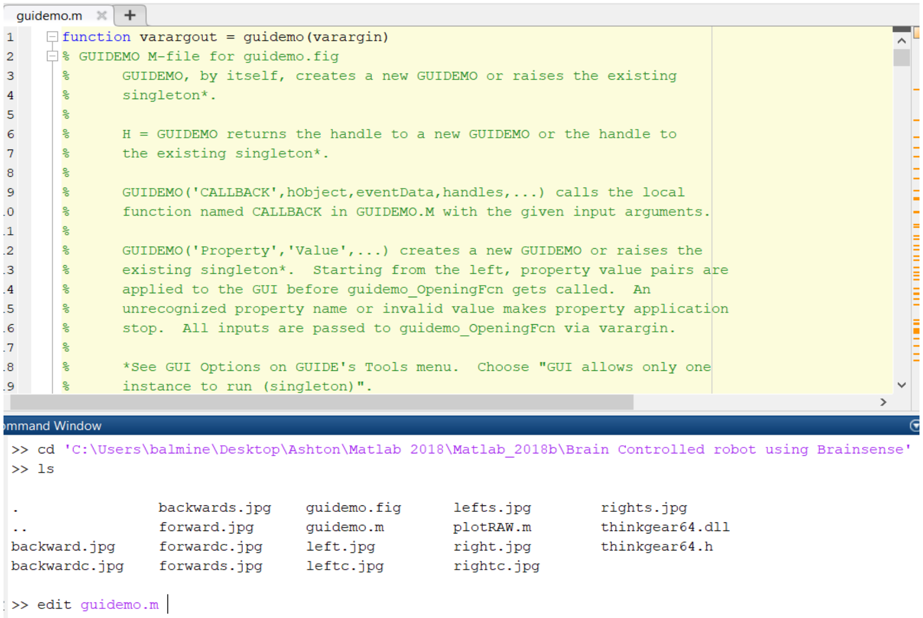


Fig 4.12 Matlab

CHAPTER 5

RESULTS AND DISCUSSION

The major modules of the proposed Mind Wave's Controlled Robot are the Neurosky Mind Wave Mobile, HC-06 Bluetooth module, an Android application , an Arduino microcontroller and a motor driver module. Neurosky Mind Wave Mobile is used to detect the level and frequency of brainwaves and to detect eye blinks.HC-06 Bluetooth module is used to transmit the acquired brain data wirelessly to an Android application.Arduino microcontroller is then used to extract data from the Android application and to control the motors of wheelchair.The modules work jointly to give a person command over the wheelchair using mind and with eye blinks.

5.1 MODES OF MIND WAVE CONTROLLED ROBOT

The proposed system works in two modes namely, Chair mode and Light mode.The Blink to switch icon is initially present in Chair Mode. If the user fails to blink within 0.5 sec then the Blink to switch icon shifts to light mode which is shown in fig 11. This icon keeps switching between the two modes with a time of 05.sec until the user blinks at the particular mode. As shown in Fig 3.1, it has Direction Arrows and Raw EEG displaying Graph. There are also 3 buttons (Start, Status, Stop). Once the initialization is completed, the raw EEG Data is displayed on the EEG displaying graph column. This happens through the connection between the Bluetooth and Brain sense.

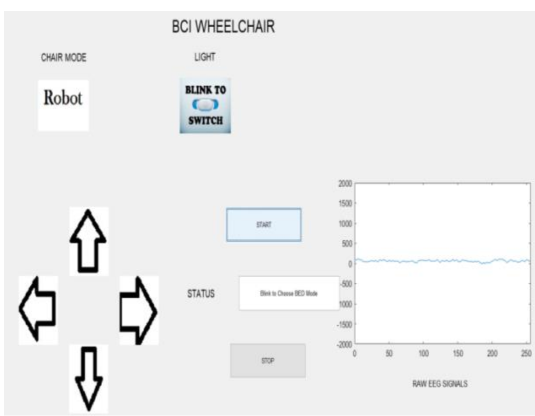


Fig 5.1 Screen shot of the API showing Modes of Robot

Neuroview is the software that helps in displaying the live recording of brain waves which is sensed through the silver chloride electrode. The electrodes are placed on the forehead and it begins to read the brain waves these waves are transmitted to the Neuroview via Bluetooth. For activation or reading the Brain wave, the baud rate is initially set to 57600 and the appropriate COM port at which the Brain sense and Neuro view connected is selected.

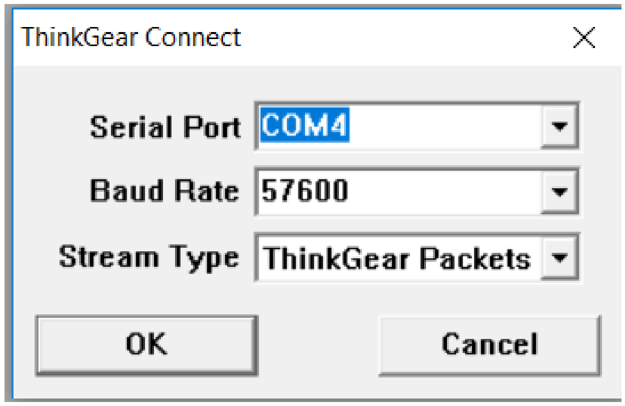


Fig. 5.2 The Baud rate setting of Neuroview

Next, the Bluetooth module HC-05 of the Personal Computer (PC) is connected with the Brain sense headband.

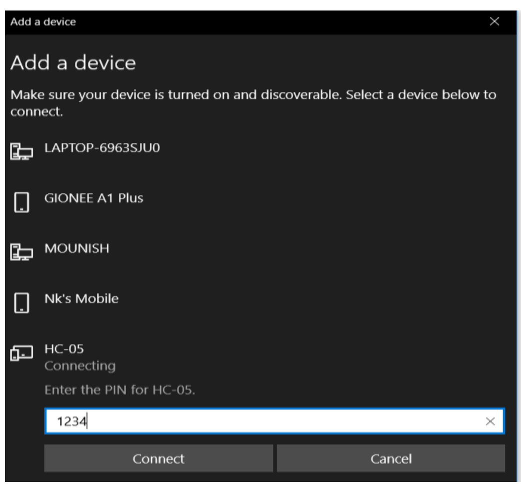


Fig.5.3 Connecting Neurosky headband to the HC-05

Then the Matlab software is opened, in the command window the directory of file location is copied. This directory file consists of Code and Header files. Once they are copied the file name is typed and the code is set to run. Once the connection and configurations are completed the device is ready to function.

As the user blinks, the highlighted option gets selected and the code moves into the Chair mode loop. Based on the input EEG from the HC-05 the code highlights one of the four directions. The four arrows in the API are indicative of the four geographical directions east, west, north and south.

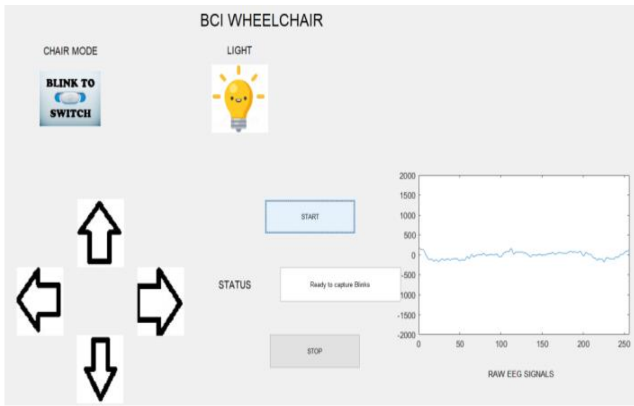


Fig. 5.4. Chair mode enabled through a blink

Fig 3.4 Shows the selection of Chair Mode, where the Blink to Switch icon is present below the Chair Mode. If the user blinks the Blink to Switch icon gets enabled and therefore selecting the Chair mode. After the Chair Mode is selected the Blink to Switch moves into the mode and starts to move around each arrows which states the direction that the wheel chair can move. Initially the North facing arrow gets highlighted first and if there is no activity from the user(Blink), Then the East facing arrow gets highlighted and if there is still no activity from the user the south facing arrow gets highlighted and so on. The inter gap between each arrow getting highlighted is about 0.5 seconds.

EEG signal is read and displayed on the Raw EEG signal column. Once Raw EEG signal column shows some activity recorded by the Brain sence headband the control code scripted in Matlab classifies the type of activity and movement direction is indicated. Once blinked the control comes out of chair mode. The figure below indicates movement of Wheel Chair in Forward direction (North).

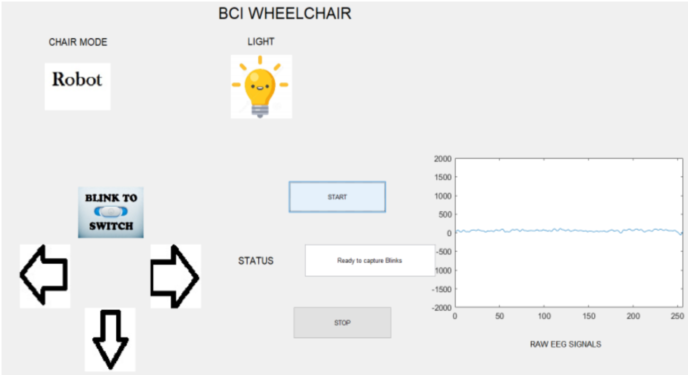


Fig.5.5. Chair Mode selected to move in North direction

If any obstacle is existing in the way of movement, then due to detection of the obstacle by Ultrasonic Sensor the movement of the chair is stopped and goes back to mode selection stage.

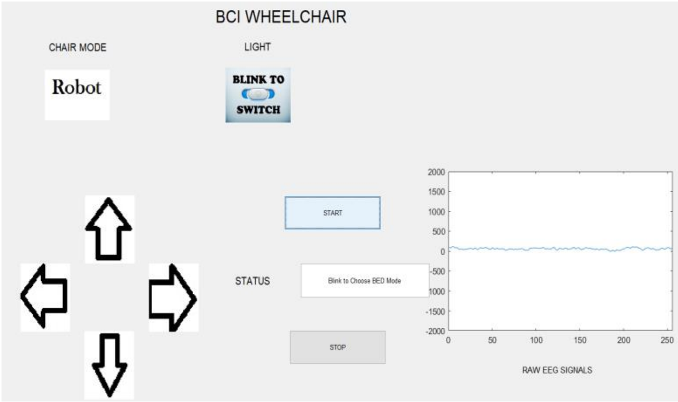
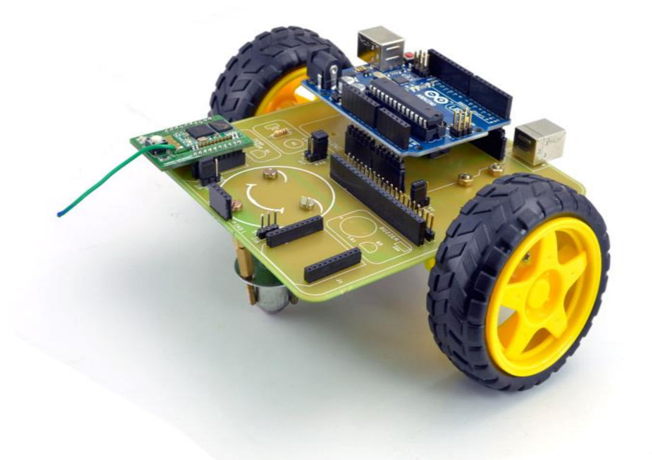


Fig 5.6. Light mode enabled through blink

The above Fig 3.6 shows the Light Mode. Case 1: Here the Blink to switch icon is present on the light Mode and if the user blinks the light mode gets selected .Case 2: Once the light mode is selected by the user, the blink to switch icon moves back to the Chair mode after 0.5 sec, so the user can move around in the wheel Chair while the light is on. Case 3: After a duration of 0.5 sec the Blink to switch icon moves back again to the Light mode so the light can be turned off by the user.

PICTURES OF MIND WAVE CONTROLLED ROBOT



Robot with components

Mind Wave Headband

CHAPTER-6

SUMMARY AND CONCLUSION

The proposed ‘Mind Controlled Robot’ is capable to move and to change direction of wheelchair based on attention level and meditation level of mind and to control home appliances like light, fan through eye blinks. By selecting a suitable microcontroller and circuit design, cost effectiveness of overall project is optimized. The blink detection algorithm needs improvement to improve the precision of operation. The present modal can be modified with adjustments such as lifting, slanting, balancing etc so it will be easy for disabled people to be placed on a resting platform and picked up from the platform without the help of others. Alert sound system can be added to denote if there is any obstacle while turning on either direction.

REFERENCES

1. Tom Carlson, Member IEEE, and Jos´e del R. Mill´an, Senior Member IEEE, “Brain controlled wheelchairs: A robotic architecture” IEEE Robotics and Automation art, 20(1):65-73, March 2013.

2. Siliveru Ramesh, M Gopi Krishna, “Brain Computer Interface System for Mind Controlled Robot using Bluetooth”, International Journal of Computer Applications (0975 – 8887) Volume 104 – No 15, October 2014.

3. Butt, A., Stanacevic, M.,“Implementation of Mind Control Robot” Systems, Applications and Technology Conference (LISAT), 2014 IEEE.

4. Imran Ali Mirza, Amiya Tripathy, “Mind-Controlled Wheelchair using an EEG Headset and Arduino Microcontroller”, 2015 International Conference on Technologies for Sustainable Development (ICTSD-2015), Feb. 04 – 06, 2015, Mumbai, India, 2015.

5. Vijay Raghav Varada, Deepshikha Moolchadani, Asil Rohit, “ Measuring and processing the brain’s EEG signals with visual feedback for human machine interface”, International Journal of Scientific and Engineering Research on Non biomedical , Vol.4, Issue 1, Jan., 2013.

6. Atanasios Vourvopoulos, Fotis Liarokapis, “Brain controlled NXT Robot: Teleoperating a robot through brain electrical activity”, IEEE conference on Games and virtual worlds for serious applications, Athens, Greece, 2011.

7. Naveen R.S, Anitha Julian, “ Brain computing interface for Transport”, 4th ICCNT, 2013.

8. K. Sudheer, T.V.Jnarhana Rao, C.H.Sridevi, M.S.Madan Mohan, “ Voice and gesture based electric powered wheelchair using ARM”, International journal of research in computer and communication technology, vol.1, issue 6, November 2012 .

9. Mohan Kumar R, Lohit H.S, Manas Ranjan Mishra, Md Basheer Ahamed, “ Design of Multipurpose wheel chair for physically challenged elder people”, SASTECH, Vol.11, Issue 1, April 2012. Pp;107-117.

10. Jobby K.Chacko, Deepu OoMMEN, Kevin K.Mathew, Noble Sunny, N.Babu, “Microcontroller based EOG guided wheelchair”, International journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical Engineering, vol.7, no.11, 2013.

11. FRDM-KL25Z User’s manual.

12. Naveen R.S, Anitha Julian, " Brain computing interface for Transport", 4^{th} ICCNT, 2013.

13. Anupama H.S, N.K.Cauvery, Lingaraju G.M, "Brain controlled wheelchair for disabled", International journal of Brain wave science engineering in EEG waves such as Alpha,Beta,Gamma,Delta", Vol.4, 2, April 2014, pp-156-166.