ISSN 2047-3338

EEG Headset Based Robot Controller

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***Abstract*— Brain Computer Interfaces are the communication devices between the brain and the applications where these applications can be robotic hand/leg control, wheelchair control, mouse emulator, game control etc. Their primary advantage is supplying a more livable environment to the handicapped people. As mentioned above, they do not serve only to the biomedical science but also started to be used for entertainment purposes too. Neurosky has recently released a headset and an interface that communicates with that head, which can be used to generate any input as the user wishes to have in his/her application. Writing e-mails or playing computer games became possible by only thinking about the commands or by mimicking. The enhancements in this area are leading our world to be a soon after 'mind-controlled'. In this project, we examine the Neurosky Mindwave headset and its built-in filtering and classification system with an application that is used for navigating a toy car. We worked on the classification of cognitive actions which is followed by expressive actions.**

***Index Terms*— EEG, BCI, Dry EEG Electrode and Cap**

I. INTRODUCTION

OUR brain is the core part of our nervous system. Brain controls all the activities of our body. Cerebellum is the major part of our brain which ensures the body posture and synchronize the body movements. There are several parts of human body and each part has its own unique motion. Body movements are controlled from different areas of Cerebellum using parallel systems of muscle control. In Brain Computer Interface the brain signal from various portions of brain are extracted using sensors processed in some computing device to control applications. BCI which is also known as direct neural interface or sometimes known as machine-brain interface provides communication between an external application and human brain [1].

There is two ways of communication in BCI. One is known as one-way communication and other is known as two-way communication. In one-way communication signals only send from brain towards application. Two-way communication provides exchange of data between application and brain.

Electroencephalography is the basic method for measuring human brain activity. The electrical signals in brain are produced by the movement of cranial nerves which can be measured from the scalp. Complex interaction of chemical processes storage and electrical signal processing determine the thinking process in our mind. The activities of body are related to certain parts of brain, e.g. Visual cortex in human brain is responsible for the processing of eye signals. Brain contains such electrical processes throughout of it. Such electrical processes measured with electroencephalography, Electrodes are replaced with EEG caps or headsets, which can approximately measure voltage of a few millionth volts. After recording with EEG, these signals are filtered and processed by some computing device. EEG is used in medical applications. Diagnoses are made by the doctor by comparing brain activity of healthy one with ill person's brain activity [2].

The importance of Brain Computer Interface (BCI) is based upon four factors. The first factor includes those people who are affected due to paralysis or body disorders such as some injury caused due to some accident. Such people have lost their brain communication with other parts of the body; BCI enables them to lead their lives by providing control and communication mechanism. The second includes vast study of human nature and biology concept which support research and development in the field of BCI. The third one includes the real-time analysis of human brain activity which can be monitored on some cheap computer system. The fourth part includes the recognition part of certain activities based on signal that are monitored earlier [3].

There are two major categories of mobile robots in BCI. These categories are based on their operational modes. One of these categories is named as "direct control".

- In direct control EEG signals are translated into motion commands to control the motion of robots. In this category, computational cost is low and no intelligence of robot is required. Users can add as much movements as required in this category.
- The second category is named as "Shared Control". In this category, the control is shared between the user and the artificial intelligent controller. Although this

category has more level of control but it losses its importance due to high communication and computation cost [4].

To calculate EEG convential method is the use of simple electrodes. For applying simple electrodes first skin of the user need to be prepared by applying gel for better conduction. This seems to be a difficult process. Later, different companies like Emotive and Mind flex introduced their headsets for EEG. These headsets are expensive enough that only research organizations and big institutes are enable to have them. One of the alternative is the use of applying dry electrodes that are cheap enough to be used by anyone with a cost around 3$ per electrode [5]. But handling such a weak signal itself is a difficult task.

The performance of EEG depends upon simultaneously recording far as many as regions as possible. If large no of channels is introduced chances of interpretive error decreases. The minimum standard to calculate EEG is 16 channels [6]. Experiments suggest that gold disk electrodes or silver chloride on base of acquisition proves to be best. These are easy to install because they require no conducting jell. Some of other electrodes are needle electrodes, electrode cups etc.

II. LITERATURE REVIEW

The nervous network or the anxious system of a living being is the organ framework which allows them to sense the external or internal environment, process the information perceived from the outer world. By using cellular network pass the signals to different parts of the body which drives the muscle and organ activities. Except sponges all the animals also have this system. There are basically two types of such systems: Central Nervous System (CNS) and Peripheral Nervous System (PNS) [8]. CNS plays a role of “administrator" and “chief”. It comprises of the cerebrum and the spinal string or in more broad words it comprises of all the neural organs inside the scalp and the spinal rope though the fringe apprehensive framework, which supplies the neural transmission between the CNS and the body organs, comprises of every other nerve and neurons that don't exist in the CNS.

A) Brain Structure

Brain or Mind is the most important and the largest organ in a scalp. It is also known as the center of Central Neural System (CNS). The largest part of human brain is known as cerebral hemispheres which are placed on above of all brain structures. Cerebral hemisphere is also known as cerebrum, large-brain, or the fore brain. Brain-stem is placed under the cerebrum. The purpose of brain-stem is to provide a connection between spinal cord and the large brain. Functions like blood circulation, digestion system evacuation and respiration are also the responsibility of brain-stem. Motor control an important phenomenon is the responsibility of Cerebellum. Cerebellum is also placed under the cerebrum and near to brain-stem. Activities like posture stability, legs and arms movement are controlled by cerebellum. Cerebellum is also responsible to control the cognitive functions like meditation, language and attention. Pleasure and fear responses are also controlled by cerebellum [9].

Right and left hemispheres are almost mirror images of each other. The cerebral cortex is almost like them. Both right and left hemispheres interact with one side of body in reversed manner. Just like left portion of brain interacts with right side of body and right portion of brain interacts with left side of body. Higher cognitive actions need both hemispheres. Mathematical, language logical, verbal and analytic material activities are performed in left brain. Analyzing of objects shape, volume, scale, creativity in other words artistic behavior functions are performed in right brain [10]. Behavior of both brains is shown in Fig. 2.

Human brain consists of four different kinds of lobes. They are named after the bones of the human skull; occipital, frontal, temporal and parietal bones. Every lobe has its own unique functionality. Occipital lobe consists of visual processing unit of brain. Temporal lobe consists of auditory perception unit. Parietal lobe by processing emotions determines the shape and location of objects. The most important lobe is the frontal lobe. It is also known as primary motor cortex. All the decision making and cognitive behavior are performed in frontal lobe. Cognitive behavior like attention and meditation are also performed by the frontal lobe.

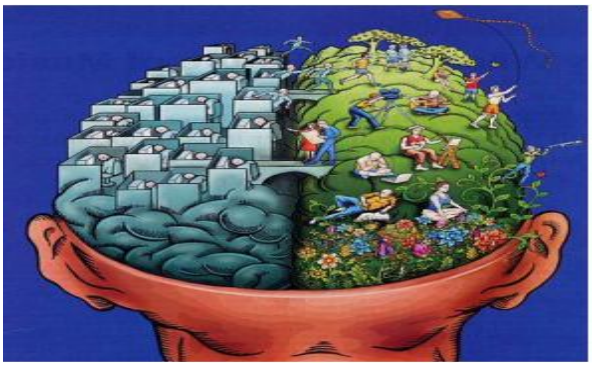

Fig. 1: Right vs. Left Brain [10]

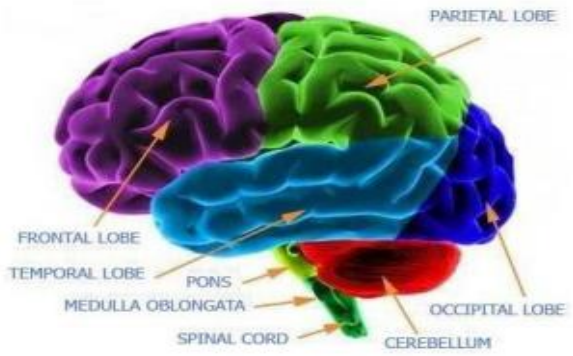

Fig. 2: Human Brain [11]

B) Electroencephalograpy(EEG)

There are many techniques available to measure brain activity of a human being but electroencephalography (EEG) is used as an input of Brain Computer Interface(BCI) from the early days of invention of BCI. EEG has a bandwidth of 0-40Hz. Being EEG method cheap makes them preferable for individual to use [12]. Such systems have the same strategy acquiring and analyzing of EEG data, translate the data, provide output and give some user feedback. The main problem of such systems involves classification and feature extraction of EEG data in real time [13].

Electroencephalography (EEG) is the electrical action recording along the scalp; it essentially mirrors the cerebrum movement. The guideline behind the EEG estimation is to compute the potential contrast between two electrodes. EEG waves are observed to be made by the terminating neurons in the mind. In 1875, a British researcher Richard-Caton utilized a galvanometer and put two terminals over the scalp of a human and recorded the mind action as electrical signs surprisingly. Throughout the years, the ideas of electro-, encephalo-and graphy were consolidated so that the term EEG was utilized to mean "electrical neural movement of the mind" where "electro-" alludes to the enrollment of cerebrum electrical exercises; "encephalo-" alludes to radiating the signs from the head and "graphy" alludes to drawing/ composing [14].

The revelation that the human cerebral can be electrically invigorated was finished by two researchers Fritsch (1838-1927) and Hit-zig (1838-1907). In 1877, Danilevsky researched the cerebrum action taking after electrical incitement notwithstanding unconstrained electrical movement in the mind of creatures. Different names who have worked around there in this area, German physiologist and specialist Hans Berger (1873-1941) is said to be the pioneer of the presence of human EEG motions in 1924. He started his examinations in 1920 with extending the beforehand work done by Caton and others and he turned into the designer of the EEG which was portrayed as "a standout among the most amazing, wonderful and earth shattering advancements in the history of clinical neurology" [14].

Because of these researchers, they gained EEG signals from a human or from other creatures that have comparable sensory systems as people might be utilized for examination of the accompanying clinical issues [15]:

- Checking sharpness, unconsciousness and mind demise.
- Checking psychological engagement (alpha beat).
- Finding zones of harm taking after head damage.
- Testing afferent pathways (by evoked possibilities).
- Checking mental health.
- Testing drugs for convulsive impacts.
- Testing epilepsy tranquilize impacts.
- Exploring rest issue and physiology.
- Exploring mental disarranges.
- Delivering biofeedback.
- Controlling anesthesia profundity (servo anesthesia).
- Researching epilepsy and finding seizure root.

Our minds produce various types of waves relying upon our state of mind, relaxation state or our mood. In adults, the amplitudes and frequencies of such signals change starting with one condition of a human then onto the next, for example, attentiveness and rest. The normal for the waves likewise change with age, implying that the EEG perusing from another conceived infant is not quite the same as the grown-up EEG. The EEG flag itself is somewhat a perplexing sign, which can be disintegrated into 5 unique groups. These groups can be recognized by their frequency ranges. The comparing frequencies are given in Table II.

The "alpha" and "beta" waves were presented by Berger in 1929. "Gamma" was utilized by Jasper and Andrews in 1938. Walter presented "delta" in 1936 and the idea "theta" wave was additionally presented by him with Dovey in 1944.

Table I: EEG signals and Frequency

Signal	Frequency
Delta.	0-4. Hz.
Theta.	4-8. Hz.
Alpha.	8-13. Hz.
Beta.	13-30. Hz.
Gamma.	>30. Hz.

Delta waves: Their frequency range lies in between zero to 4 hertz. Among the all wave patterns Delta waves have the highest amplitude. Due to high amplitudes, they are the slowest brainwaves. Deepest stages of sleep are represented with delta waves known as "slow wave sleep". Delta waves can also be present in walking state. Muscles of the skeleton also produce large amplitude signals. Since muscles are near to surface of the skin, there is a chance to be confused delta signals with muscles (artifact) signals. The rhythm of delta waves is decreased with age. So, it is not a good idea to observe them in old people.

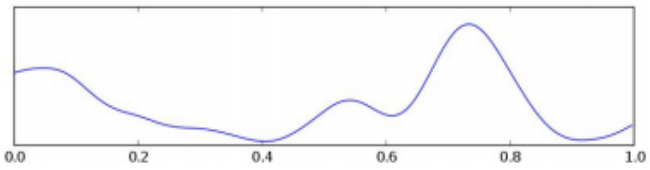

Fig. 3: Delta Waves [16]

Theta waves: Their frequency range lies in between 4Hz to 8Hz. These signals are normally visualized in young children. Accessing theta for age represents abnormal activity. Relaxation, creative thinking, unconscious materials and deep mediation can be determined using theta waves.

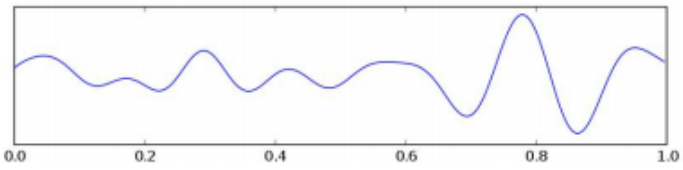

Fig. 4: Theta Waves [16]

Alpha waves: The frequency range of alpha waves lies in between 8Hz to 13 Hz. They can be found on occipital area of brain because they appear on posterior part of brain. When individual is mentally relaxed and eyes are closed at that stage they are best observed. Mental effort can be traced using alpha waves due to its amplitude.

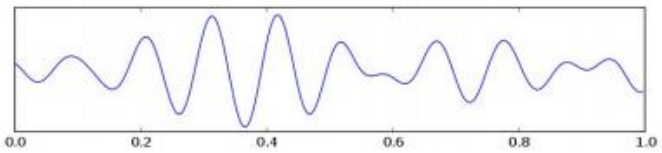

Fig. 5: Alpha Waves [16]

Beta waves: The frequency of Beta waves lies in between 13Hz to 30Hz. Motor behavior and attenuated active movements are represented by beta waves. Beta waves can be measured from central regions and frontal of the brain. It can easily found in normal adults. Focus on the outside world, active attention, active thinking or solving concrete problems are usually associated with Beta waves.

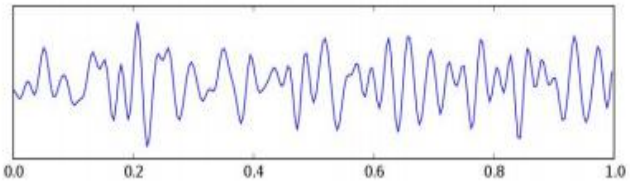

Fig. 6: Beta Waves [16]

Gamma waves: The frequency range of gamma waves lies in between 30Hz to 100Hz. These waves have very low amplitude. These waves are also known as "Fast beta rhythm". They are very difficult to observe. Gamma waves are used to detect motor functions and cognitive activities.

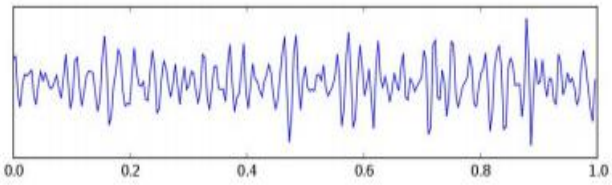

Fig. 7: Gamma Waves [1]

C) Signal Processing

The difference between voltages of two electrodes is represented by EEG signal. Referential and Bipolar montage are the two measurement techniques to measure EEG. Montage is known as EEG channel representation. In Bipolar montage, each electrode has its own individual ground electrode. In Referential Montage, all electrodes have a same reference ground electrode. The placement of electrode is very important such that it must not be affected by any other muscles or skull activity that causes electrical current.

During EEG recording, the universally recognized 10-20 framework is normally utilized. In this framework, there are 21 electrodes placed on the scalp's surface as appeared in [17]. The position assurance is as per the following: Reference focuses are nasion and inion, which are the dive at the highest point of the nose, level with eyes level and the hard bump on construct of scalp of the head. Taking this focuses, the borders of the skull are measured in the transverse and middle planes. The areas of the electrodes are dictated by partitioning these borders into 10- 20 system. The uncommon letters A, F, Fp, T, C, P, Pg and O before these numbers remain for Ear, Frontal, Frontal Polar, Temporal, Central, Parietal, Nasopharyngeal and Occipital projections individually.

The part C demonstrates the transitional 10% terminal positions that are utilized as a part of expansion to the 21 electrodes of the worldwide 10-20 framework. The American Electroencephalographic Society institutionalized the names and the areas of the electrodes.

The signal that is recorded from the scalp must be separated keeping in mind the end goal to dispose of the artifacts. These artifacts can be caused due to few reasons, for example, the impedance of the framework, the ground circle or biological-artifacts, for example, Electromyography (EMG) –eye blinks and movements and Electrocardiography (EKG) signals. To expel the EMG and EKG signals Low or high pass filters are utilized. Settings for the high pass filter and low pass filter are 0.5-1Hz and 35-70Hz individually. Additionally, an extra step channel (60Hz for USA and 50Hz for different nations) is utilized to expel the Artifacts caused by the electrical unwanted electrical signals [18], [19].

Raw EEG signals are usually containing bad quality signals containing noise. Therefore, they need to be processed to improve or remove such bad quality signals. A small subset of data was left behind after being filtered by Artifacts. The basic purpose of feature extraction is to prepare data for classification process by simplifying the data. As discussed earlier, Waves coming out of brain are categorized into 5 frequency groups. Very high and low frequency mostly contains large noise that needs to be filtered out (Mindwave headset filters out the less relevant frequencies). Principle component analysis, Fourier transformations, common average reference, wavelet transformations, independent component analysis etc. are the possible options of feature extraction from raw EEG data.

There are several techniques that are available to classify EEG data. Classification of data can be done in both time domain and frequency domain. Some of the algorithms that can be used to classification are hidden Markov model, support vector machine, neural networks and other pattern recognition algorithms. The use of these algorithms is on the need.

III. WORKING / PROPOSED SYSTEM

For better understanding of the system, different designs are attached in this area.

A) Data Flow Diagram

Simple working of the system is described by the block diagram. As the headset is on it start searching all available Bluetooth devices in his surroundings. A HC-05 module is

present on the robotic car which is configured to be act a master in the working. Mindwave headset act as a slave. Initially a red light was blinking on Mindwave headset when it got paired with Bluetooth module a still blue light will turn on which indicates both devices are paired and ready to use. Out of 10 led's placed on robotic car first one is on which indicates robotic car is receiving brain data. The motion of car including forward, left, right and stop are controlled based upon Attention level. Attention level is marked on the scale of 0 to 100 out of which each led represents 10. After pairing Headset sends raw EEG data to Bluetooth module serially. Bluetooth sends data to Arduino controller which calculates Attention and lid up led's accordingly. Motor driver is also controlled using Arduino. When Attention level reaches in range 1 to 20 total two led's were on and Robotic car start moving towards backward. When Attention level reaches in range 21 to 60 Robotic car start moving Forward. When attention level reaches in range 61 to 80 Robotic Car starts moving Right. When attention level reaches in range 81 to 100 Robotic Car starts moving left.

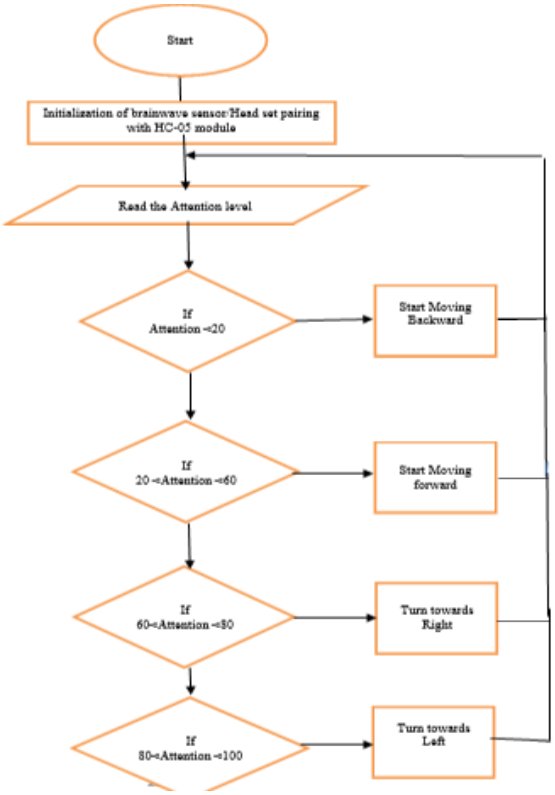

Fig. 8: Data flow diagram of System

The detailed designed to show led's is shown in figure below. It was designed in fritzing software. Bluetooth module HC-05 is wirelessly connected to Mindwave Headset. 5V from Arduino is attached to Vcc pin of Bluetooth module to power it. GND pin of Bluetooth module is attached to ground pin of Arduino. TXD pin of Bluetooth module is attached to Rx of Arduino to transmit data received from Mindwave headset to Arduino microcontroller serially. Arduino processed the raw EEG data and finds the ATTENTION to mark it on scale of 0 to 100. Ten led's are attached separately from digital pin 3 of Arduino to pin no 13. led attached to pin 3 is on as soon as we start the system which also represents the current attention level is 10. Now with each led 10 attention level is associated. For example, if 5 led's are on it means attention level is 50.

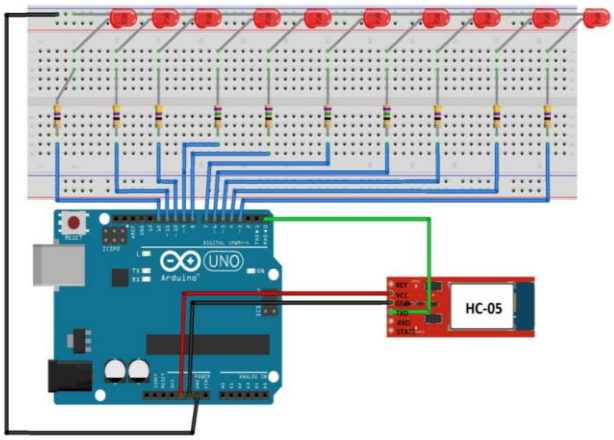

Fig. 9: Design of Attention Monitoring System

B) Schematic Diagram

The basic circuit diagram of system is designed on proteas software and is described in Fig. 10:

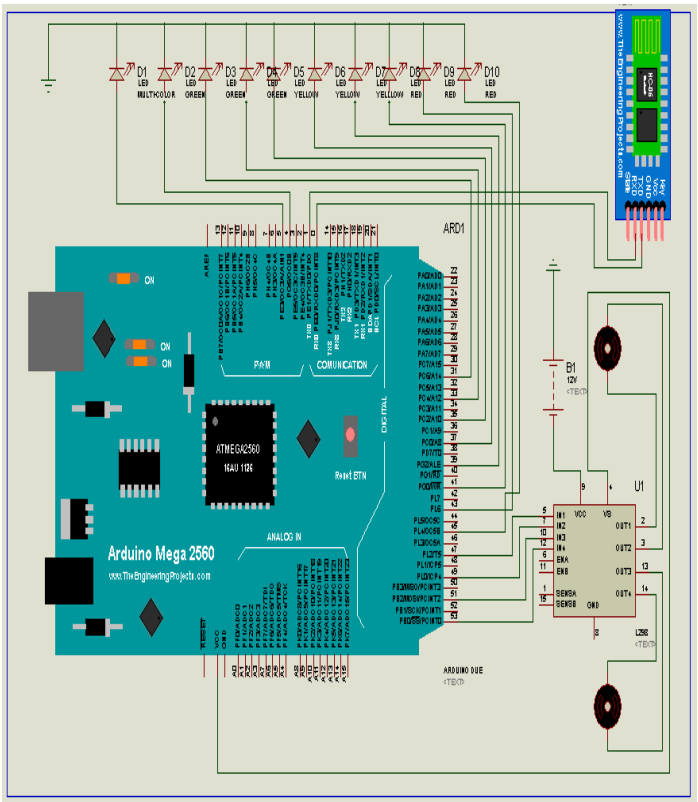

Fig. 10: Schematic Diagram

Description of different components with Arduino and motor shield board:

Table II: Connection Description

Components	Ports	Board
Multicolor Led	At port #5	Arduino
Green Led	At port #4	Arduino
Green Led	At port #31	Arduino
Green Led	At port #33	Arduino
Yellow Led's	At port #35	Arduino
Yellow Led's	At port #37	Arduino
Yellow Led's	At port #39	Arduino
Red Led's	At port #41	Arduino
Red Led's	At port #43	Arduino
Red Led's	At port #45	Arduino
Bluetooth module (Tx pin)	At port#0	Arduino
Bluetooth module (VCC pin)	At 3v pin	Arduino
Bluetooth module (Gnd pin)	At Gnd pin	Arduino
Dc Motor 1(+ve)	Out 1	L298 Motor driver
Dc Motor 1(-ve)	Out 2	L298 Motor driver
Dc Motor 2(+ve)	Out 3	L298 Motor driver
Dc Motor 1(-ve)	Out 4	L298 Motor driver
En 1	At port # 47	Arduino
En 2	At port # 49	Arduino
En 3	At port # 51	Arduino
En 4	At port # 53	Arduino

IV. IMPLEMENTATION

The basic purpose of our project is to make a prototype of RC car controlled with EEG headset based controller. For that purpose, EEG headset is used. Working of EEG is explained in literature review section. This section contains the hardware components that are used to integrate the overall system and explain working of the system.

This section below consists of all the equipment used in this project with their diagrams.

A) Description

This section below consists of all the equipment used in this project with their diagrams.

1) Mindwave Headset

Neurosky is a completely incorporated, single chip EEG biosensors fabricating organization. Neurosky offers two types of EEG items: Think-gear ASIC Module (TGAM)-EEG sensor PCB module for embedded system designers. The Mindwave group of EEG-observing headsets can be packaged into an assortment of products for system integrator and Mindwave designers. Neurosky Mindwave headsets family is intended to be utilized by designers to get the opportunity to showcase rapidly with finish EEG-checking items.

The Mindwave headset transforms your PC into a cerebrum action screen. The headset securely measures brainwave flags and screens the consideration levels of people as they interface with mind applications. The Mindwave family comprises of Mindwave and Mindwave Mobile. The Mindwave is intended for PCs furthermore, Mac. Mindwave Mobile, is good PC, Macintosh and furthermore with cell phones like the iPhone, iPad, and Android. Mindwave mobile is the world's cheapest research-review EEG headset accessible. Intended for interface with cell phones (iOS and Android) and desktop (Windows and Mac). TGAM chip inside it is responsible for clear brain signal, the bio-sensor chipset that upset an industry. It is an incredible introduction into the universe of brain computer interface.

Fig. 11: Mindwave Headset

Mindwave headset measures the brain signal from the frontal lobe using sensor arm& tip and outputs the spectrum of EEG like Beta, Gamma waves etc. Neurosky-eSense meter calculates Attention and meditation. It also identifies eye blinks. There are three major components of Mindwave EEG device: a sensor arm, ear clip and adjustable headset. Ear clip consist of electrode that is used as ground electrode. EEG electrode is placed on the sensor arm. A single AAA battery having 8-hour battery time is used to power the headset.

2) Arduino Microcontroller

Arduino is an open source microcontroller constructed onto a printed circuit board (PCB) to give the essential electronic communications. The Arduino capacities as an intelligent gadget by accepting contribution from sensors to control gadgets that are associated with it. With a microcontroller implanted onto the PCB, information and yield port signs are given that empowers advanced data to be conveyed between the Arduino and physical connected devices. The Serial port on the controller, permitting handled data to be passed in a bidirectional way sends one piece at any given moment in the request that they are started in a surge of support. Ports can be chosen with the goal that they are associated with a coveted comparing outer gadget, for example, PCs, screens and so on through universal serial buffer (USB). I/O operations can be utilized for perused and compose or to kill and on materials and gadgets by having the pins being set to high or low.

The microcontroller is prearranged with Arduino programming condition and employments draws which are directions to advise what the Arduino to do. Once an outline program is finished it is confirmed and aggregated which investigate the code and make an interpretation of it into an application that is good with the Arduino equipment to transfer the composed programming onto the Arduino board. The board must be reset either done physically (squeezing a

dark catch on the board) or naturally relying upon the sort of Arduino utilized as a part of request to transfer another draw onto the microcontroller. Arduino is exceptionally mainstream due to how it is open source and usability of equipment and programming.

There are a wide range of sorts of Arduino sheets and there are additionally numerous instructional exercises that could be discovered online for beginners in the underlying set up handle, instructional exercises on the most proficient method to program onto the Arduino for those wishing to make, outline and find better approaches to connect with many articles. Arduino is exceptionally availability and accessible for procurement with the product accessible to download for nothing on the web. So much inventiveness has started so much that one might have the capacity to choose to construct a custom Arduino PCB with straightforward instructional exercises promptly accessible on the web.

Programming with the Arduino improvement condition is finished by transferring draws onto the microcontroller written in Arduino Programming Language. This projects the Arduino microcontroller with the guidelines to take after by confirming/incorporating and transferring the representations. The motivation behind utilizing the Arduino programming dialect is to program the smaller scale processor chip that is situated on our PCB board on the auto. The Atmel ATmega328 microchip chip with the Arduino UNO boot loader preloaded onto it is implanted onto the Arduino UNO microcontroller PCB advancement board. It is an elite Atmel 8-bit AVR Reduced Instruction Set PC (RISC). This microcontroller is presented beneath with the remarkable engineering plan of the AtMega328 microchip and utilizing the microchip to store our information to be sent and having Arduino outline dialect code composed into the microcontroller empowers guidelines to be taken after considering the information gotten.

Fig. 12: Arduino

3) Motor Driver

L298N model of motor driver is used to control the dc motor of tires of the robotic car. Double H driver module uses ST L298N dual full-bridge driver, an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

4) Bluetooth Module

The Bluetooth module is used for communication of Robotic car with Mindwave headset. This Bluetooth module is placed on robotic car. HC-05 model of Bluetooth module is used. It provides a serial communication with 10m of range.it acts as master during the communication. Baud rate can be adjusted manually.it also has an integrated antenna. This module is configured using AT commands.

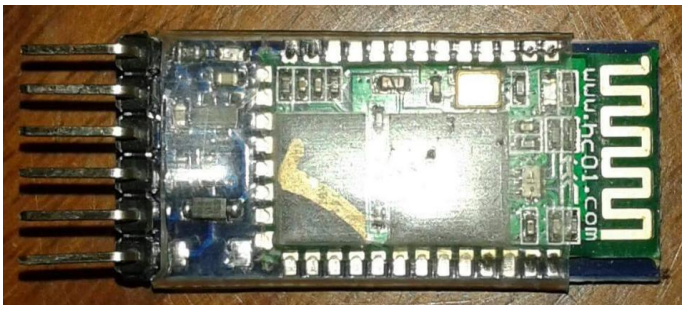

Fig. 13: Bluetooth HC05 module

5) Led's

The small Led's are used to show the attention level of the individual at run time.

Fig. 14: Led

6) Chassis and tyres

Chassis refer to platform of a robot on which all other equipment's are placed. Tyres containing DC motor are also attached to the platform.

Fig. 15: Tyres of car

7) *Batteries*

Two batteries are required to power up the robotic car. A 9V battery is required to power the Arduino. A 12 V battery is required to drive the motors of the car.

B) Microcontroller Code

Below is the portion of code of microcontroller code that is responsible to read data from serial Uart. As serial connection is established between headset and Bluetooth module. Continuous data is coming over Bluetooth module. To process on such data a function named as ReadOneByte is created. As soon as this function is called it provides the latest reading coming out of headset. By processing the current reading different actions can be performed.

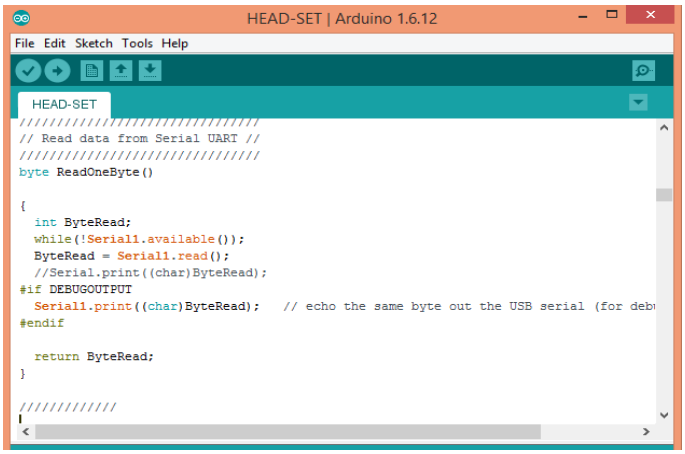

Fig. 16: Snapshot of microcontroller code

C) Implementation

The product is a EEG Headset based control system (Fig. 17). In our case, we use 1 channel Neurosky Mindwave Headset. The purpose of headset is to collect raw EEG data. Based on collected data we must take certain decisions. EEG headset transferred data serially via Bluetooth. It was received with HC05 Bluetooth module. The reason we receive data directly on Robotic car and not using any computer software to process data is to reduce the response time. Response time is one of the key parameters on which BCI systems are evaluated. If we use any computer an extra time is required which directly increases our response time. As data is received on Arduino controller, Code already written on Arduino microcontroller calculates the attention level. Based on attention level different motions of Robotic car are controlled.

V. CONCLUSION

Brain Computer Interface (BCI) is an emerging field of study. The goal of our team is familiar with this field of study and make a prototype project at the basic level. We want to deal with the electroencephalography (EEG) as controlling parameter not as medical purposes. With the help of this project we become able to access raw egg data, extract useful information out of it as controlling parameters of RC car. It was an exciting process of researching, designing and implementation. During the project, every member of group become able to get certain set of expertise in specific areas. Learning brain structure and properties of each part was a very interesting process. The market for BCI advancements hasn't yet developed as a standard thing. It is saved for the individuals who need to investigate and find out about the developing field. In this way, there is no intended interest group or market that this venture is coordinated towards, the objective of this venture is to instruct ourselves as well as other people about the utilized for mind PC interface and perhaps pass on our insight to the individuals who one day may have the capacity to bring BCI into regular daily existence.

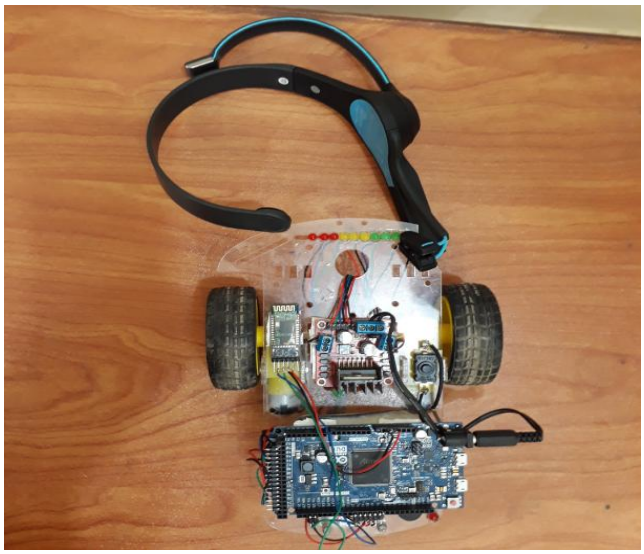

Fig. 17: Product picture

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