WHEELCHAIR OPERATED BY MOTION OF TONGUE

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Certificate

*This is to certify that the Project titled "**WHEELCHAIR OPERATED BY MOTION OF TONGUE**" is a bonafide work carried out in the Department of Electronics and Communication Engineering by Mr. VEDAANT DUTT (17ETEC004127) in partial fulfilment of requirements for the award of B. Tech. Degree in Electronic and*

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Declaration

WHEELCHAIR OPERATED BY MOTION OF TONGUE

The project work is submitted in partial fulfilment of academic requirements for the award of B. Tech. Degree in the Electronics and Communication Engineering of the Faculty of Engineering and Technology of M. S. Ramaiah University of Applied Sciences. The project report submitted herewith is a result of our own work and in conformance to the guidelines on plagiarism as laid out in the University Student Handbook. All sections of the text and results which have been obtained from other sources are fully referenced. We understand that cheating and plagiarism constitute a breach of University regulations, hence this project report has been passed through plagiarism check and the report has been submitted to the supervisor.

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SUMMARY

Most serious accidents and injuries often end with various disabilities, resulting in a limited control of the muscles of various body parts or even the whole body. The condition in which all the 4 limbs become dysfunctional is known as tetraplegia.

Tongue driven system is a new wireless assistive technology which is specially designed for paralyzed person.

Tongue driven system consists of an array of Hall Effect magnetic sensors and permanent magnet which is held on tongue using tissues adhesive. As a result of tongue movement magnetic field generated by magnet that will vary around the mouth. These variations are sensed by an array of magnetic sensor which is mounted on the headset outside the mouth.

The sensors' output is wirelessly transmitted to the microcontroller and microprocessor will process the signal to control the movement of power wheelchair.

This technology provides faster, smoother and more convenient control.

The wheelchair is implemented using Arduino kit. Hardware modules and software programs were designed, developed and integrated to form a prototype of the tongue-controlled wheelchair, meeting all the objectives.

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Abbreviation and Acronyms

DC	-	Direct Current
TDS	-	Tongue Driven System
LED	-	Light Emitting Diode
Rx	-	Receiver
Tx	-	Transmitter
IDE	-	Integrated Development Environment
PWM	-	Pulse Width Modulation
TTL	-	Transistor Transistor Logic
SDA	-	Serial Data
SCL	-	Serial Clock
ICSP	-	In Circuit Serial Programming
MOSI	-	Master Out Slave In
MISO	-	Master In Slave Out
USB	-	Universal Serial Bus
TWI	-	Two Wire Interface

Chapter 1. Introduction

Preamble

This chapter explains the motivation to the project, terminologies, gives an introduction to the project, and explains the basic working principles.

1.1 Introduction

Tongue Drive system is a tongue-operated unobtrusive wireless assistive technology, which can potentially provide people with severe disabilities with effective computer access and environment control. It translates users' intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue and an array of magnetic sensors.

The main aim of this project is to design and construct a tongue controlled wheel chair and device switching wirelessly using RF technology. This device is portable and this system operation is entirely driven by wireless technology.

The control system consists of Hall Effect sensor and microcontroller. Microcontroller (Arduino Uno) collects data from the sensor and transmits the encoded data through the RF transmitter. At receiver end, RF receiver receives the data through the decoder and feeds as input to the Arduino. The controller(at the Arduino) performs the corresponding actions i.e. Wheelchair movement.

This Project consists of two Arduino Uno units (each at transmitter and receiver side), wheelchair model, relay, motor driver, Hall effect sensors and wireless communication through RF-Trasciever module.

Wheelchair is made up of high torque Geared DC Motors accompanied by a motor driver. The motors directions can be changed through the set of instructions given from the Hall effect sensor and the action of these instructions is already loaded into the Arduino Uno.

1.2 Motivation

Paralysis is the loss of muscle function in a part of the body. It happens when something goes wrong with the way messages pass between the brain and muscles.

Persons with severe disabilities from Traumatic Brain and Spinal Cord Injuries (TBI/SCI), Amyotrophic Lateral Sclerosis (ALS) and stroke find it extremely difficult to carry out daily tasks without receiving continuous help. Tetraplegia is another form of paralysis in which all the limbs become dysfunctional. These individuals are completely dependent on wheeled mobility for transportation.

Powered Wheel Chairs (PWCs) allows such individuals to complete daily tasks with greater independence. Unfortunately, a PWC is operated using a joystick, which requires a certain level of physical movement ability, which may not exist in people with severe disabilities. Thus, the use of tongue is preferred in such cases.

One of the major advantages of the tongue is that it is directly connected to the brain through the spinal cord. A patient having the highest level of spinal cord injury can still move his tongue.

Moreover, paralysis is dramatically more widespread now a days. Approximately 3.7 percent of the Indian population reported are living with some form of paralysis.

Thus, our project acts as a solution to all such problems.

1.3 Scope

The aim of this project is to design a tongue controlled wheelchair which can be used by handicapped people for their easy movement.

New technologies have found a very useful way to help individuals with serious disabilities to overcome such issues and enable their movement with the help of tongues.

Scientists chose the tongue to control the system because unlike the feet and the hands, (which are connected by brain through spinal cord) the tongue and the brain have a direct connection through cranial nerve.

This new assistive technology could help individuals with severe disabilities achieve more independent lives. The novel system allows individuals with disabilities to operate a computer control PWC and interact with their environments simply by moving their tongue.

Chapter 2. Literature Review and Background Theory

2.1. Literature Review

Tongue Drive Wheelchair is a non-invasive development that explores how technology can be assistive for individuals with severe disabilities to communicate with their environment. This tongue control system leads to a more self-supportive independent life for such unfortunate people.

A few other Assistive Technologies(ATs) have also been developed to provide alternative means for PWC control:

- **Sip-n-puff** is a simple AT, which allows its user to control a PWC by blowing or sucking through a straw. However, it is slower.
- **Eye(pupil) controlled** are also commonly used AT as they are a sensory part of human body. However, eye-tracking affects the users' normal sense of vision by requiring extra eye movements that sometimes interfere with the users visual tasks.
- **Head controlled** is also one of the most suitable sources for PWC control. However, they are relatively error-prone.
- **Facial muscle** twitches based is also a widely used AT but, it is relatively slow and offer limited degrees of freedom

As conveyed by various research papers, a TDS circuit is triggered by the hall effect sensors to control the wheelchair's motors. Results occurring from the contact between the magnet and the sensor due to the tongue movement, apply order to the motors to work allowing the person to move right, left, forward and even to stop according to his needs.

Some papers also convey the need or an alarm button which can send a message to the smartphone of one of the handicap's kin. Thus, an android app can also be developed for the same. GPS module can also help in locating the handicapped.

This development was accomplished to make patients feel more satisfied because it is a safe and easy technology that doesn't need any complicated programs to realize and perform the movements.

2.2. Background theory

2.2.1 Arduino board

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output pins that may be interfaced to various breadboards and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from PCs.

Types

There are various types of Arduino boards depending on their specifications, namely:

- Arduino UNO (R3)
- LilyPad Arduino
- Red Board
- Arduino Mega (R3)
- Arduino Leonardo

Components

The main components of an Arduino board are:

- ATmega Microcontroller
- USB or barrel Jack
- Reset button
- Power indicator LED
- TX RX LED’s
- Main IC
- Voltage regulator
- Pins like analog, digital, PWM (pulse width modulation), AREF, 5V, 3.3V

Arduino IDE

Arduino programs are written in the Arduino Integrated Development Environment (IDE). Arduino IDE is a special software that allows to write sketches/programs for different Arduino boards.

The Arduino programming language is based on a very simple hardware programming language called processing, which is similar to the C language. After the sketch is written in the Arduino IDE, it should be uploaded on the Arduino board for execution.

Why Arduino Uno is used?

Arduino Uno is the most standard board used. Some of its better features are:

1. Its biggest advantage is that we connect the board to the computer via a USB cable which does a dual purpose of supplying power and acting as a Serial port to interface the Arduino and the computer.
2. It can also be powered by a 9V-12V AC to DC adapter.
3. The ATmega328 chip can be newly bought, removed and replaced if damaged which is not possible with other versions.
4. The board operates at 5V throughout, i.e. Digital pins output or read 5V and Analog pins read in the range 0-5V.
5. Lot of extra Add-on hardware is built for Uno. Special hardware is available for Internet, Bluetooth, Motor control etc.
6. It is the cheapest board with all these features.

Arduino Uno

Arduino Uno is the microcontroller board based on the 8-bit ATmega328 microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, a Power barrel jack, an ICSP header and a reset button.

Pin Specifications

The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50K Ohms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analogWrite() function.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.

There also exists 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values.

1. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog Reference() function.

- **Analog pin 4 (SDA) and pin 5 (SCA)** also used for TWI communication.

Figure 2.1 Arduino Uno

Applications:

- Prototyping of Electronics Products and Systems
- Multiple DIY Projects.
- Easy to use for beginner level DIYers and makers.
- Projects requiring Multiple I/O interfaces and communications.

2.2.2 L298N motor driver module

The L298N is a dual-channel H-Bridge motor driver capable of driving two DC motors and one stepper motor. This means it can individually drive up to two DC motor for any applications like 2WD robots, Small drill machine, solenoid valve, DC lock etc.

An L298N motor driver module consists of an L298N motor driver chip(IC). which is an integrated monolithic circuit in a 15-lead Multiwatt package. It is a high voltage, a high current dual full-bridge driver designed to accept standard TTL logic levels

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 together and the corresponding external terminal can be used for the connection of an external sensing resistor.

It consists of 2 components, for controlling a DC motor:

- PWM – For controlling speed
- H-Bridge – For controlling rotation direction

Specifications:

- Driver: L298N
- Driver power supply: +5V~+46V
- Driver Io: 2A
- Logic power output Vss: +5~+7V (internal supply +5V)
- Logic current: 0~36mA
- Controlling level: Low -0.3V~1.5V, high: 2.3V~Vss
- Enable signal level: Low -0.3V~1.5V, high: 2.3V~Vss
- Max power: 25W (Temperature 75 Celsius)
- Working temperature: -25C~+130C
- Dimension: 60mm*54mm
- Driver weight: ~48g
- Other extensions: current probe, controlling direction indicator, pull-up resistor switch, logic part power supply.

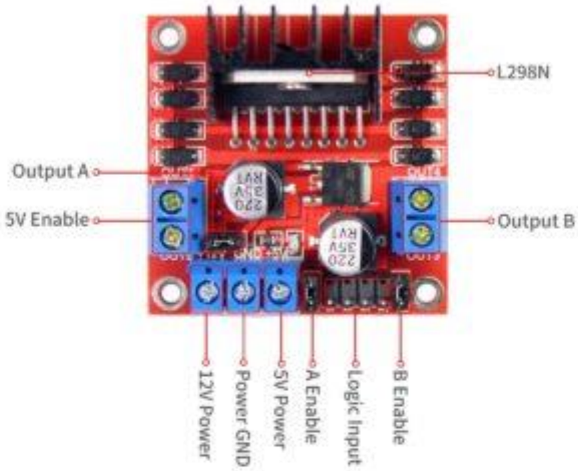

Figure 2.2 LN298 motor driver

2.2.3 NRF24L01 transmitter and receiver module

In this project, the two Arduino boards are able to communicate with each other wirelessly with the help of this module.

The multi-receiver capacity of nRF24L01 is having up to 6 channels (pipes) of radio communication open in a receiving or read mode simultaneously. This takes the form of a hub receiver (PRX - primary receiver) and up to six transmitter nodes (PTX1 - PTX6 primary transmitters).

Specifications:

- NRF24L01 is a wireless transceiver module which operates in the 2.4GHz ISM frequency band.
- It is used to communicate data wirelessly which is specially designed for ultra-low power applications.
- It can be configured and operated through SPI Protocol.
- It can transmit data at a rate up to 2 Mbps.
- This module can use 125 different channels which makes possible to have network of 125 independently working modems in one place.

- Each channel has up to 6 addresses that means it can communicate with 6 other devices simultaneously.
- The communication range is up to 100 meters and it specially designed for ultra-low power applications.

- It operates on 1.9V to 3.6V power supply range.

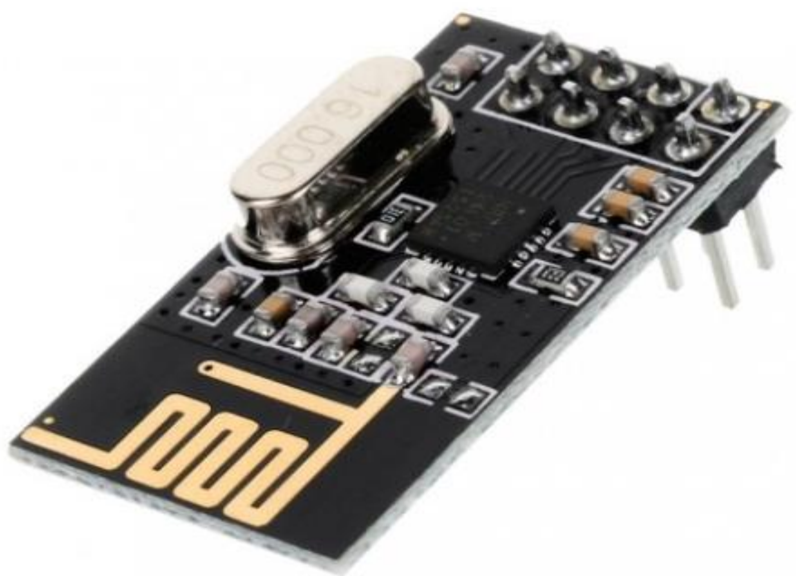

Figure 2.3 NRF24L01 transceiver module

2.2.4 Hall effect sensor

Understanding Hall Effect

The **Hall effect** is the production of a voltage difference (**Hall voltage**) across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current. It was discovered by Edwin Hall in 1879.

The Hall effect causes a measurable voltage differential across the conductor such that one side is positively charged and the other negatively.

Electrons normally travel in a straight line. The Hall effect occurs with the production of a transverse force (Lorentz force) on the charge carriers moving through a conductor, such that they actively conduct a current in the presence of a perpendicular magnetic field. The magnet's north pole pulls the negative charge carriers (typically electrons) to the side of the conductor nearest the magnet. With all the flowing electrons of the carried current on one side of the conductor, that side is negatively charged and the other side is positively charged.

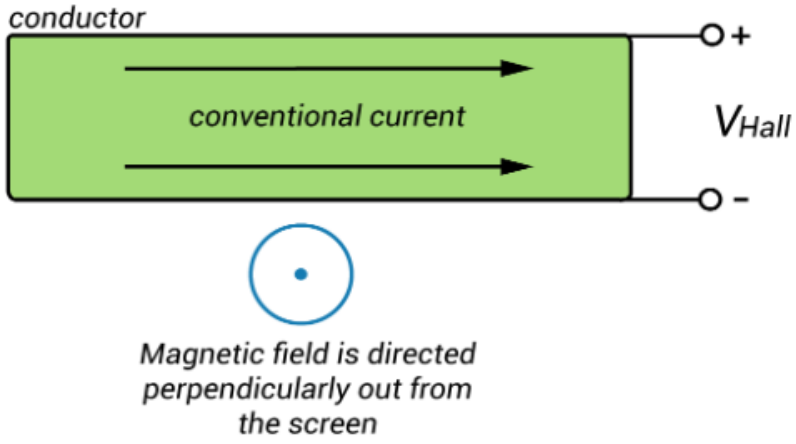

Figure 2.4 Hall Effect

Hall Effect sensor

Hall Effect Sensors are devices which are activated by an external magnetic field. A Hall effect sensor is a device that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it. Frequently, a Hall sensor is combined with threshold detection so that it acts as a switch.

There are two types of Hall Effect sensors,

- The **analog sensor** is composed of a voltage regulator, a Hall Element and an amplifier. The output of the sensor is analog and proportional to the Hall Element output or the magnetic field strength. These type of sensors are suitable and used for measuring proximity because of their continuous linear output.
- The **digital output sensors** provide just two output states, either “ON” or “OFF”. These type of sensors have an additional element, which is the Schmitt Trigger which provides hysteresis or two different thresholds levels so the output is either high or low. An example of this type of sensor is the Hall Effect switch.

Applications:

- They can be commonly seen in industrial applications such as the pictured pneumatic cylinder

- They are also used in consumer equipment, like computer printers, which use them to detect missing paper and open covers.
- They can also be used in computer keyboards
- Another use of a Hall Sensor is in the creation of MIDI organ pedal-boards
- Hall sensors are commonly used to time the speed of wheels and shafts, such as for internal combustion engine ignition timing, tachometers and anti-lock braking systems.
- They are used in brushless DC electric motors to detect the position of the permanent magnet.

Advantages of Hall effect sensor includes:

• Such a switch costs less than a mechanical switch and is much more reliable.

• It can be operated at higher frequencies than a mechanical switch.

• It does not suffer from contact bounce because a solid state switch with hysteresis is used rather than a mechanical contact.

• It will not be affected by environmental contaminants since the sensor is in a sealed package. Therefore, it can be used under severe conditions.

Figure 2.5 Hall effect sensor

2.2.5 Permanent magnet

A magnet is a material or object that produces a magnetic field.

A permanent magnet is an object made from a material that is magnetized and creates its own persistent magnetic field.

An everyday example is a refrigerator magnet used to hold notes on a refrigerator door. Materials that can be magnetized, which are also the ones that are strongly attracted to a magnet, are called ferromagnetic (or ferrimagnetic). These include the elements iron, nickel and cobalt and their alloys.

Although ferromagnetic materials are the only ones attracted to a magnet strongly enough to be commonly considered magnetic, all other substances respond weakly to a magnetic field.

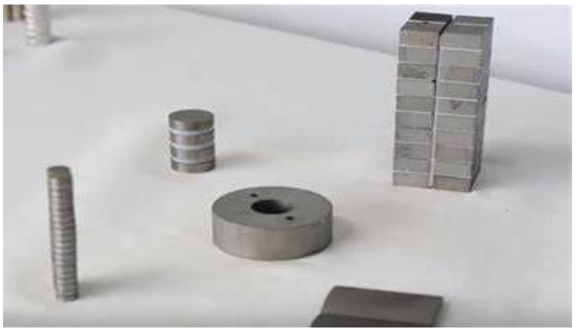

Figure 2.6 Magnet

2.2.6 LED

A light-emitting diode (LED) is a semiconductor light source that emits light
when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

The longer leg of an LED represents the positive terminal and the shorter one is negative.

Figure 2.7 LED

2.2.7 DC Motors

A Direct Current(DC) motor is a rotating electrical device that converts direct current of electrical energy into mechanical energy. An Inductor coil inside the DC motor produces a magnetic field that creates rotary motion as DC voltage is applied to its terminal. Inside the motor is an iron shaft, wrapped in a coil of wire. This shaft contains two fixed, North and South, magnets on both sides which causes both a repulsive and attractive force, in turn, producing torque.

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.

The motor used in this project is a geared type with 100 rpm speed.

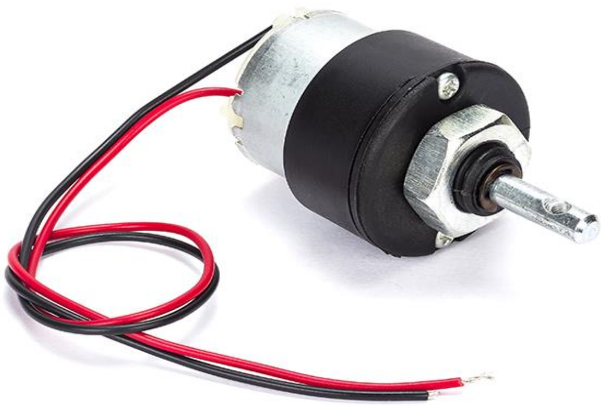

Figure 2.8 DC Motor

2.2.8 Chassis

A chassis consists of an internal framework that supports a manmade object in the construction and use. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). Here we use a metallic chassis.
It also comes with the wheels.

Figure 2.9 Chassis

2.2.9 12V and 9V Battery

To provide energy to DC motors for movement of a wheel chair, a 12V/1.3Ah battery is used. It is a rechargeable 12 V Lead Acid battery.

Specifications:

- Nominal Voltage 12V
- Rated Cap 1.3AH
- Approx. Weight 0.57kg
- operating temperature range operating between -15° C to +50 ° C
- Low self-discharge of about 2-3% per month

In addition to this, 9V batteries are used to power the Arduino modules at the transmitter and the receiver end.

Figure 2.10 12VBattery and 9 V battery

2.2.10 Snap Power Cable

It is a power cable connector connecting the 9V battery to the barrel jack connector of the Arduino for the purpose of powering it.

Figure 2.11 Power Cable

2.2.11 Jumpers

A jumper wire is an electrical wire, with a connector or pin at each end, which is normally used to interconnect the components in a breadboard.

Individual jumper wires are fitted by inserting their end connectors into the slots provided in a breadboard. The other end can be connected to the respective sensor or device. It causes minimal attenuation of signals.

Based on the type of end connectors, it can be classified as 3 types:

1. Male to male
2. Male to female
3. Female to female

Figure 2.12 Male to Male Jumper wires

2.2.12 Breadboard

A breadboard is a construction base for prototyping of electronics. Basically, it is a rectangular plastic board with a bunch of tiny holes in it. These holes let easily insert electronic components to prototype an electronic circuit, with a battery, switch, resistor, and an LED.
Because the solderless breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design.
The leads of a device can fit into the breadboard because the inside of a breadboard is made up of rows of tiny metal clips.

Figure 2.13 Breadboard

Chapter 3. Aim and Objectives

3.1 – Title

Design and development of tongue operated wheelchair for paralyzed patient.

3.2 - Aim

To design and develop a tongue operated wheelchair for paralyzed patient.

Objectives

1. To study the existing tongue operated wheelchair for the paralyzed patient.
2. To arrive at the block diagram and specification for the tongue operated wheelchair for the paralyzed patient.
3. To design and develop tongue operated wheelchair and demonstrate the movement of the wheelchair using tongue.
4. To demonstrate the developed prototype with following features:
    - START and STOP functionalities of the wheelchair.
    - LCD indicating direction of wheelchair
    - A push button based horn and alarm signal.
5. To port the developed software on the hardware and test its functionality.
6. To demonstrate the project and document the work as a Project Report.

Chapter 4 Design and Implementation

4.1 Block Diagram

4.1.1 Transmitter

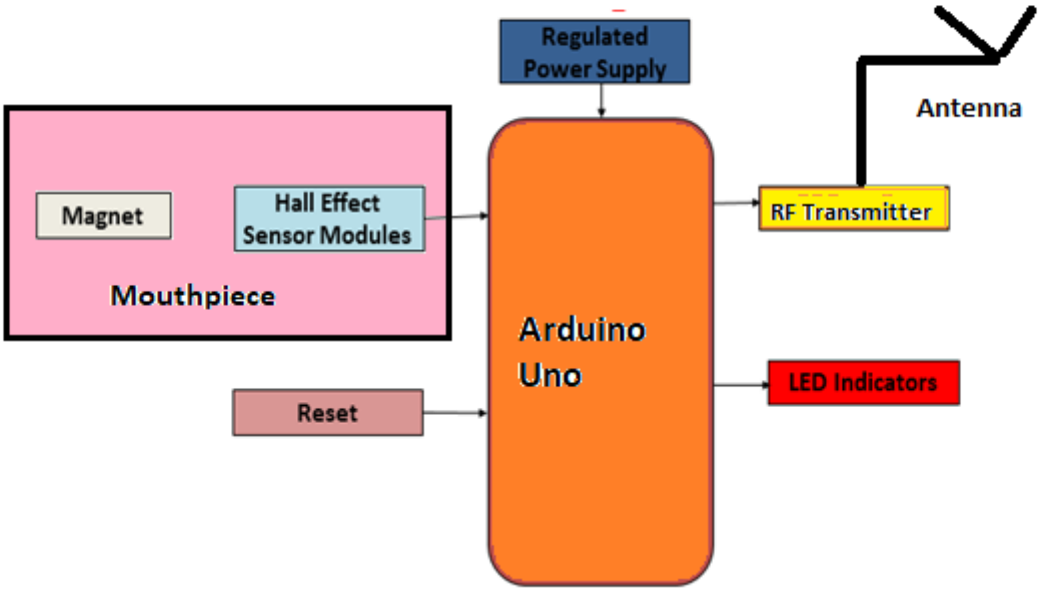

Figure 4.1 Block diagram at the transmitter side

The block diagram represents the full construction of the TDS. It has various elements:--

1. Mouthpiece: It is further subdivided as
    - Magnet
    - Hall Effect Sensor
2. Arduino Uno: acts as a brain to all the components. It controls all the functions.
3. Regulated Power supply: It is a 9V DC regulated power supply given to the Arduino.
4. LED: They act as indicators which glow when one of the sensors is activated.
5. Transmitter: It transmits signals wirelessly to its complementary receiver.

4.1.2 Receiver

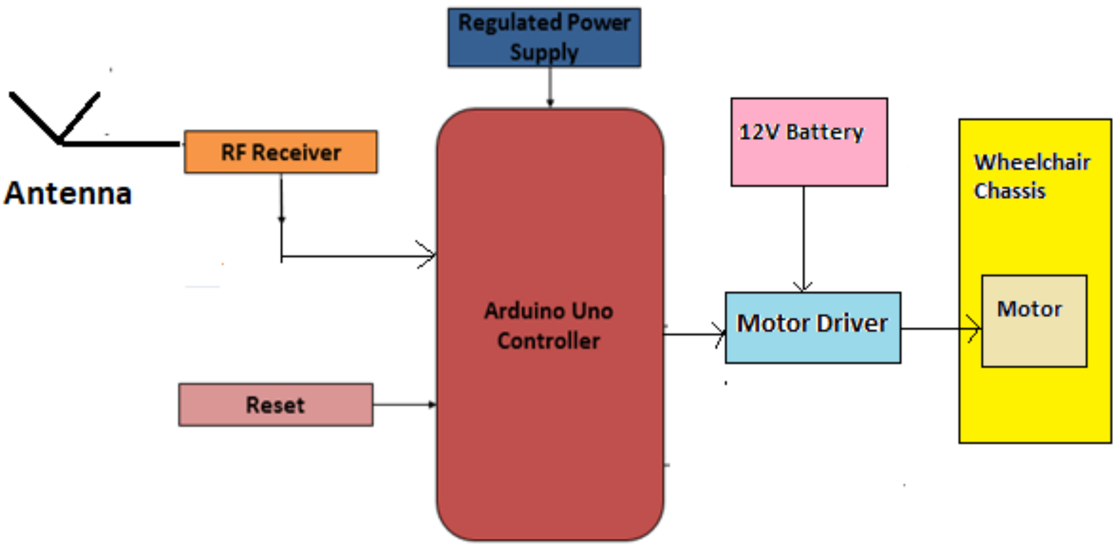

Figure 4.2 Block diagram at the receiver side

It consists of the following components:-

1. Receiver: It receives RF signals from the transmitter.
2. Arduino: It analyses the information signals received from the receiver and performs appropriate function.
3. Regulated Power Supply: It is a 9V battery for powering the Arduino.
4. Motor driver: It is a device which produces enough voltage to drive the motor and hence, acts as a medium between the Arduino and motors.
5. 12 V power supply: It is a 12 V battery for powering the motor driver.
6. Wheelchair: It can be further subdivided as
   - Chassis
   - DC motors

4.2 Circuit diagrams

4.2.1 Transmitter side

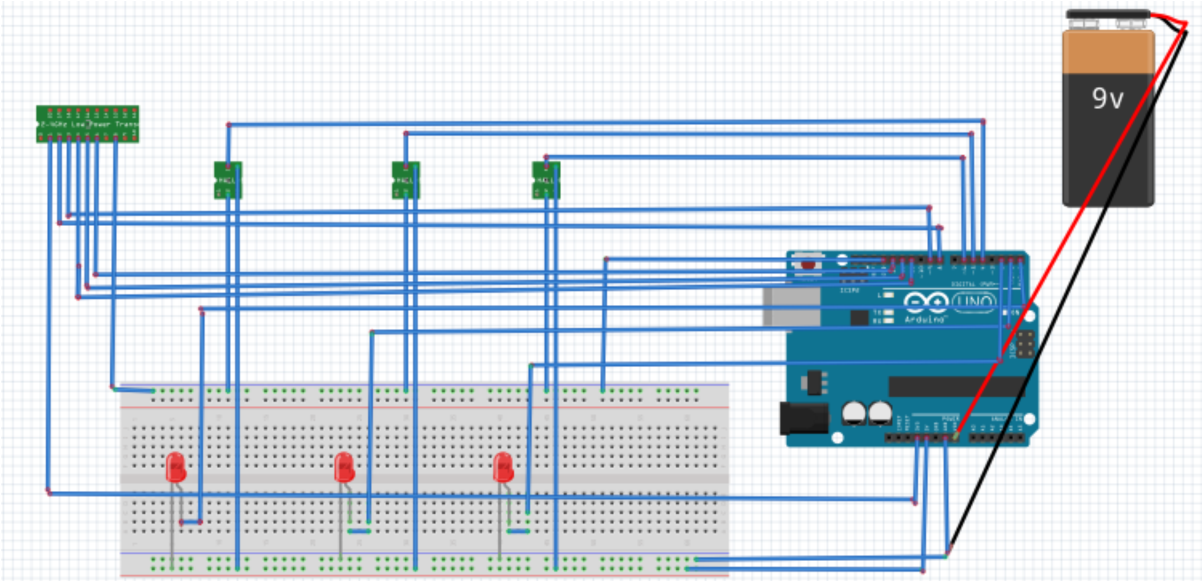

Figure 4.3 Transmitter side Circuit Diagram

4.2.2 Receiver side

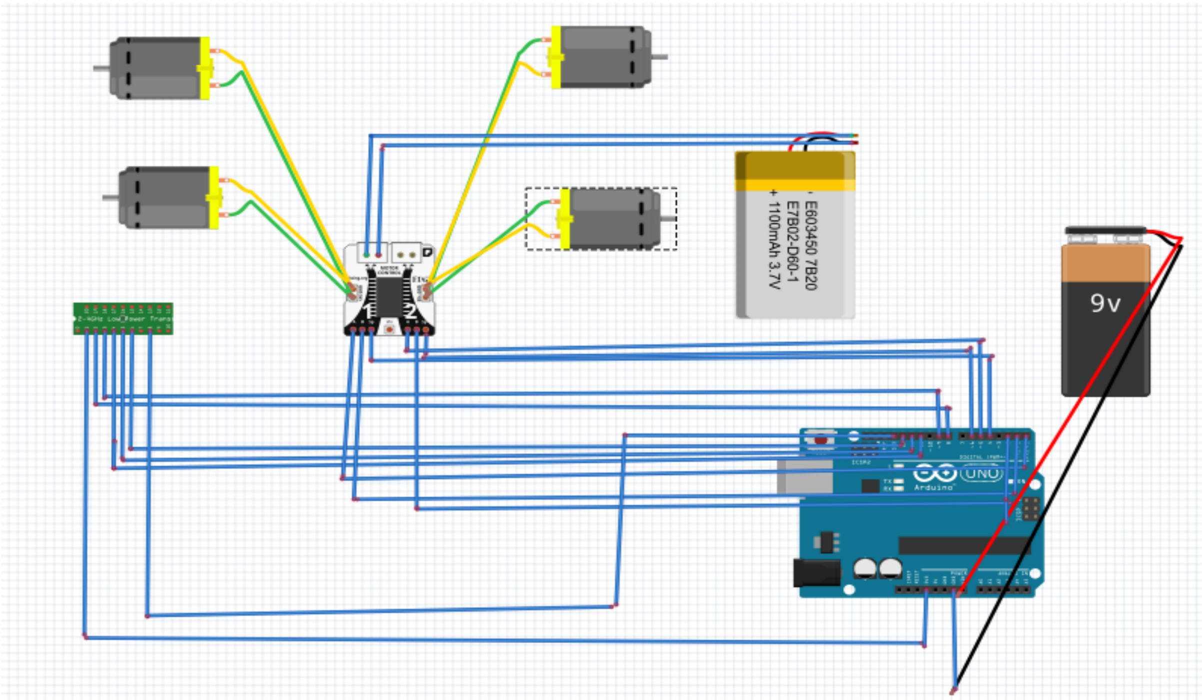

Figure 4.4 Receiver side Circuit Diagram

4.3 Construction

Transmitter side

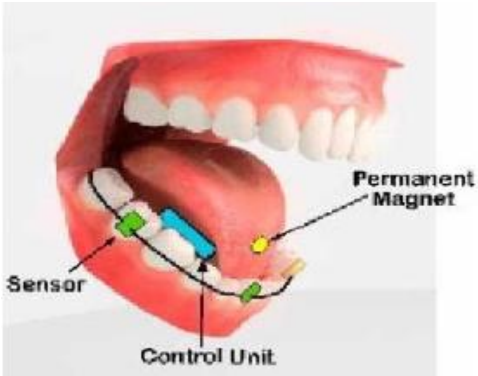

Figure 4.5 TDS mouthpiece

The Transmitter section is placed in the user's mouth and receiver section is placed at the back of the chair.

In the transmitter section, the magnet is at the center of the tongue and the three Hall Effect sensors are placed at the outer side of the teeth as shown in the figure above.

The Hall sensors can be placed in an orthodontic brace or headset, depending on the intensity of magnetisation.

The magnet can be fixed either permanently or temporarily. The permanent magnet fixing method is known as tissue piercing and temporarily magnet fixing method is known as tissue adhesive.

Receiver side

The receiver side consists of a wheelchair made up of chassis and High torque Geared DC Motors connected to castor wheels. It also consists of a system of Arduino along with receiver module, motor driver, batteries and other elements which are all placed behind the chair. They all aid in driving the wheelchair.

4.4 Working Principle:

- First of all, the Hall Effect sensors are triggered by the magnet placed on the tongue. The interaction between the magnet and sensors activates the sensor, in accordance to the Hall Effect, explained earlier. The direction of magnet depends on the direction, the tongue is moved.
- Here, three of these sensors are placed for three directions – left, right and forward. The corresponding LED to that Hall Effect sensor gets activated, as shown in the transmitter side circuit diagram.
- This controller processes all the required information and commands as per the code. Next the information is wirelessly transmitted to the receiver module via NRF24L01 transmitter.

  The transmitted signals are RF signals of the range 433Mhz.
- The NRF24L01 receiver receives these signals and sends them to the AtMega controller in the Arduino.
- The Arduino processes the received information about the direction and inputs the same to the L298N motor driver module. The action of these Instructions is already loaded into the Microcontroller using Embedded C programming.
- The L298N motor driver module controls the direction of the four geared motors as per the speed and direction information received from the Arduino.
- Thus, the wheelchair moves in a set of particular directions i.e. left, right, or forward.

The below diagram can better represent the working principle

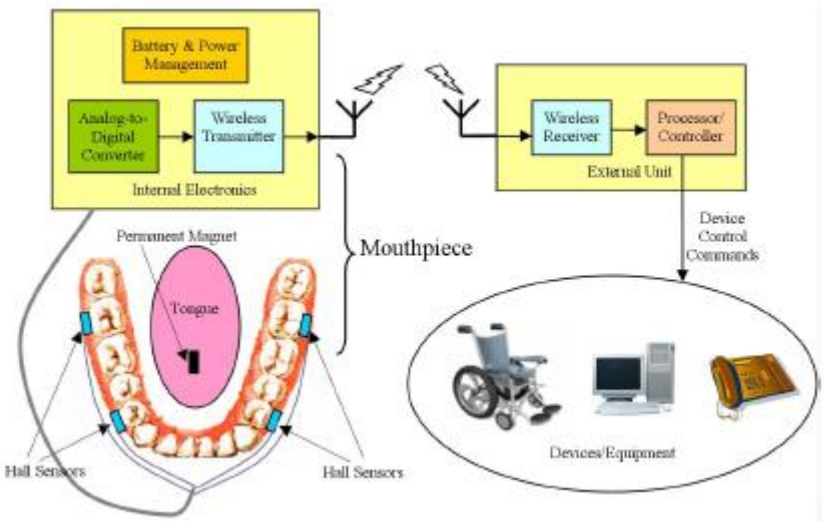

Figure 4.6 TDS working

4.5 Advantages of TDS

Advantages of TDS over other PWC control methods are:

- Tongue and mouth occupy an amount of motor cortex in the human brain. Therefore, they are inherently capable of carrying out complex manipulation tasks.
- The tongue is connected to the brain via hypoglossal cranial nerve, which escapes severe damage in accidents.
- The tongue is easily accessible and is not influenced by the position of the rest of the body, unlike other sensory organs like eyes, skin etc.
- The TDS is more robust against noise and interference due to the proximity of the magnet and Hall-effect sensors in the oral cavity,
- The hall sensor used is a small, passive and wireless component leading to user convenience and power saving.
- The TDS is mostly hidden from sight, thus it offers a degree of privacy for the user.
- Other advantages of the Tongue Drive system are being unobtrusive, low cost, minimally invasive, flexible, and easy to operate.

4.6 Disadvantage

The main disadvantage, using this type of sensor is that, due to the saliva from the tongue, a delay of time occurs while the sensor wants to go back to its steady state. This might lead to patient's injury because the sensor will not be able to detect the patient's desire to move the chair in a particular direction, until it goes back to its stable state.

4.7 Software

4.7.1 Arduino IDE: The Arduino Integrated Development Environment (IDE) is a cross-platform application that is written in functions from C and C++.

It is used to write and upload programs to Arduino compatible boards. The source code for the IDE is released under the GNU General Public License.

The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.

The IDE environment mainly contains two basic parts:

1. Editor: It is used for writing the required code
2. Compiler: It is used for compiling and uploading the code into the given Arduino Module.

Figure 4.7 Arduino Logo

4.7.2 Fritzing:

Fritzing: It is an open-source software(CAD) for the design of electronics hardware.

This can help to support designers and artists ready to move from experimenting with a prototype to building a more permanent circuit. It was developed at the University of Applied Sciences Potsdam.

The software aids in simulating Arduino microcontroller with other required sensors and allows the user to document their Arduino-based prototype and create a PCB layout for manufacturing.

4.8 Testing

‘1’ denotes active state(ON)

‘0’ denotes inactive state(OFF)

HES denotes Hall effect sensor

M denotes Motor

At the transmitter side

Table 4.1 Transmitter side Test Case

S No.	HES1	HES2	HES3	LED1	LED2	LED3	Trans. Message
1	1	0	0	1	0	0	‘left’
2	0	1	0	0	1	0	‘forward’
3	0	0	1	0	0	1	‘right’

At the receiver side

Table 4.2 Receiver side test case

S. No	Message rec.	M1	M2	M3	M4	Wheelchair direction
1	‘left’	0	1	1	0	Left
2	‘forward’	1	1	1	1	Forward
3	‘right’	1	0	0	1	Right
4	-	0	0	0	0	stop

4.9 Observation

Case 1. When magnet if brought near 1st sensor

Transmitter side:

First LED glows(from right)

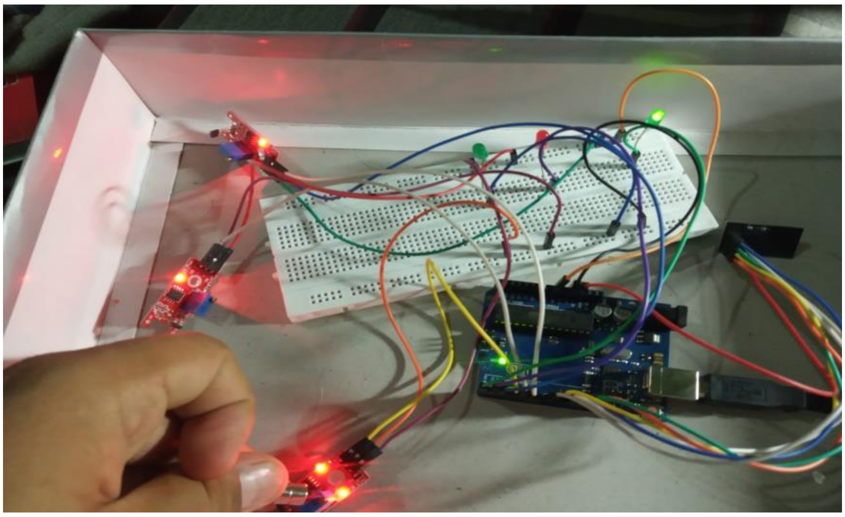

Figure 4.8 Case 1(Transmitter)

Receiver side

The below is a snap of the serial monitor, where the received signal is displayed

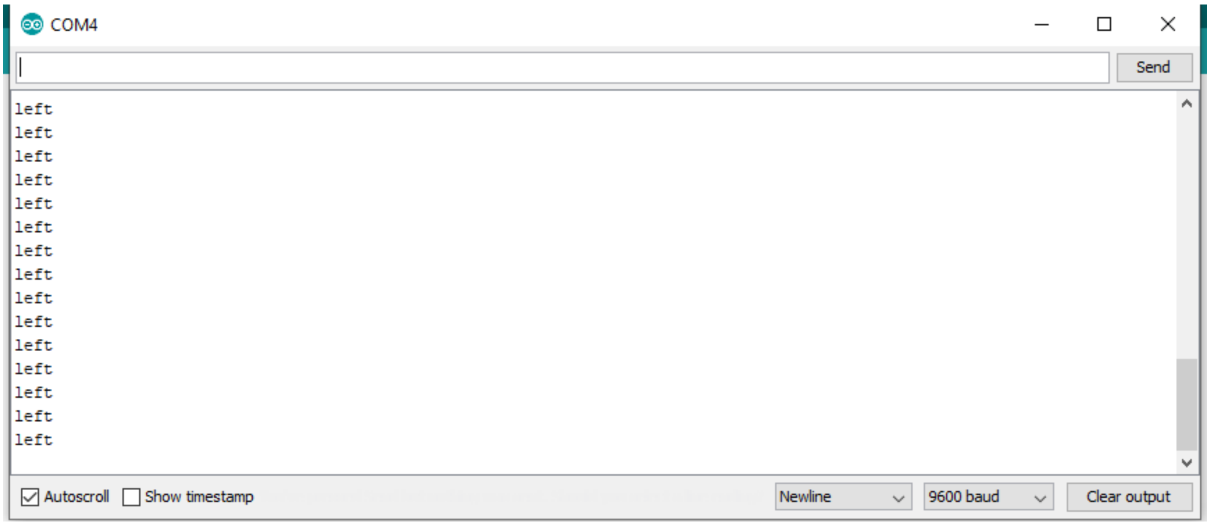

Figure 4.9 Case 1(Receiver)

Case 2. When magnet is brought near 2nd sensor

Transmitter side: 2nd LED glows

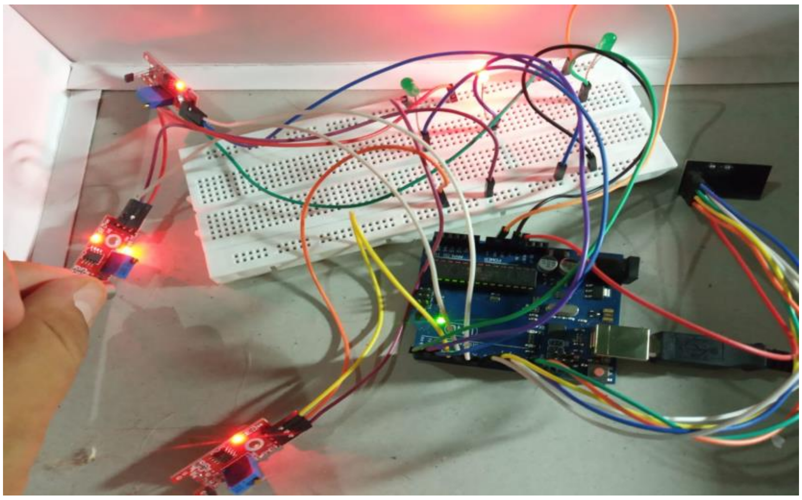

Figure 4.10 Case 2(Transmitter)

Receiver side: Information received

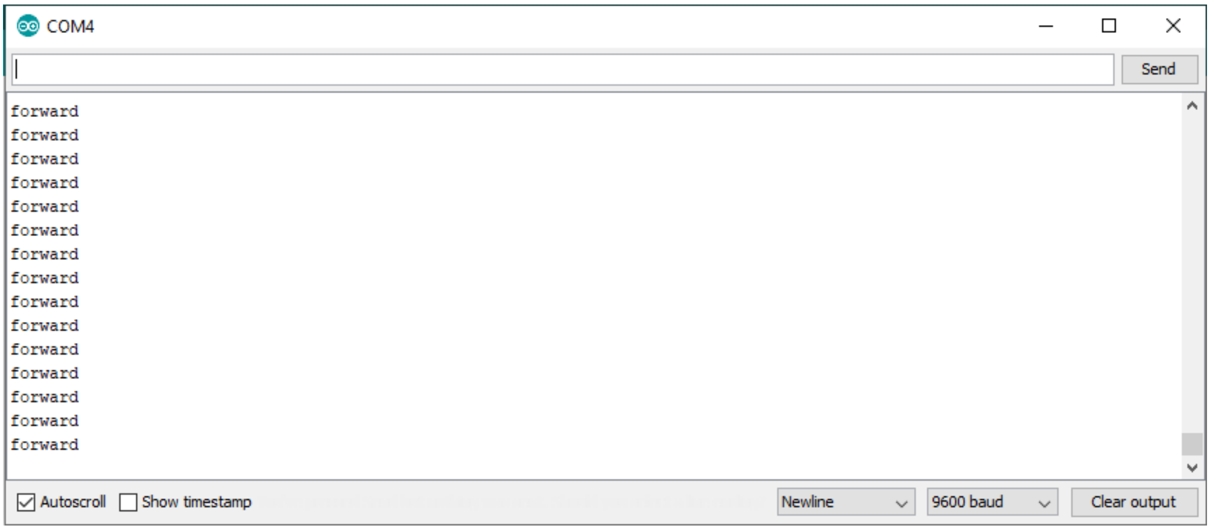

Figure 4.11 Case 2(Receiver)

Case 3. When magnet if brought near 3rd sensor

Transmitter side:

third LED glows

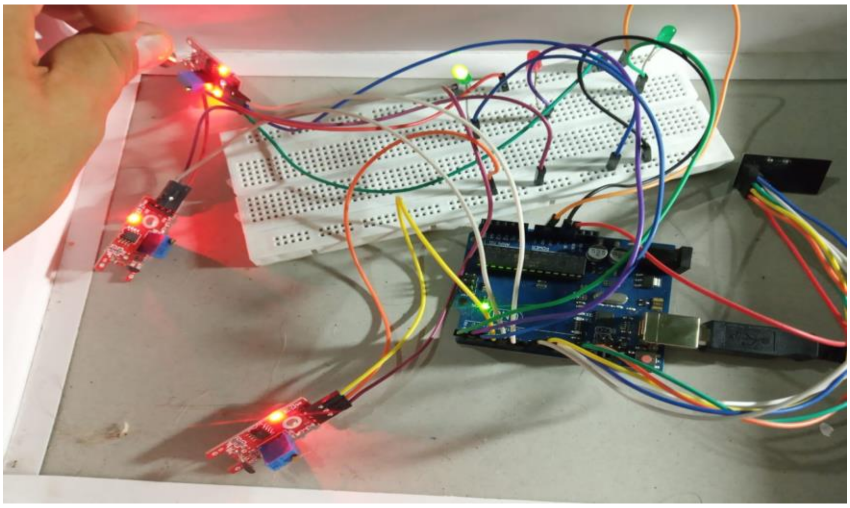

Figure 4.12 Case 3(Transmitter)

Receiver side:

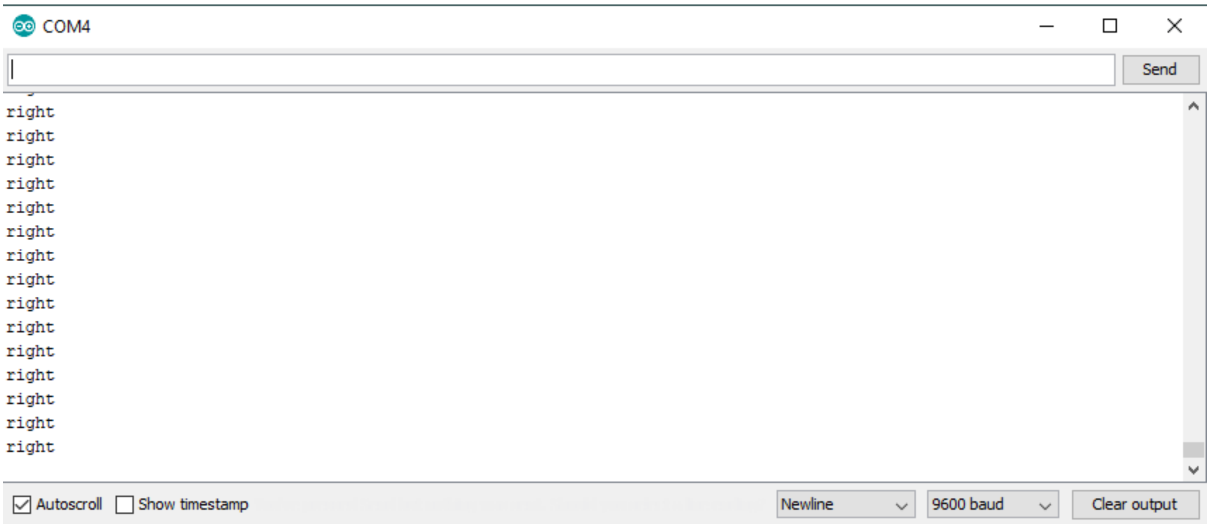

Figure 4.13 Case 3(Receiver)

Chapter 5. Project Costing

The costing of the project is shown in Table 5.1.

Table 5.1 Project Costing

S.no	**Components**	**Cost (Rs)**
1.	Arduino Uno(2)	650
2.	12V Adapter, Battery, Clamp and Charger	795
3.	9V Battery with Connectors	60
4.	Hall Effect Sensor Modules	180
5.	Miniature Permanent Magnet	20
6.	NRF24L01 Trasceiver Module	250
7.	L298N motor driver	220
8.	12V DC Geared Motor(4)	500
9.	Chassis	90
10.	Frontwheel	25
11.	Big Castor Wheel(4)	100
12.	Bread Board(2)	100
13.	Jumper Wires	120
14.	LED(3)	30
15.	Miscalleneous	500
	Total	**3640**

6. Conclusion and Suggestions for Future Work

Conclusion

There are people who willing to mingle with the common people and likes to do at least their basic work but, their body wouldn't support them in that way may because of several reasons which is mentioned earlier.

Our project is mainly concerned about those people who need some additional support which will bring them their actual common life. The wheel chair is basically operated on tongue and our definitive objective in building up the TDS is to help individuals who are handicapped understanding and enable them to live a free and self dependent life. The framework utilizes a cluster of attractive sensors to remotely follow tongue developments by recognizing the position and direction of a perpetual attractive tracer made sure about on the tongue.

The framework comprises of Hall Effect sensors and a chair which is interfaced to the controller. Microcontroller gathers information from the sensor and transmits the encoded information through the RF transmitter.

At recipient end, RF collector gets the information. The controller enables in moving the wheelchair in a specified direction with the help of several other components.

Future Improvements/alterations

- An alarm button can be put on the wheelchair, which can send alert messages to the android app present on the smartphone on concerned person.
- Audio direction control and announcement functionality can be introduced by making use of a suitable voice module.(ARP-9600)
- An ON/OFF button should be present on the chair's handle.
- There should be some control which can enable stopping or back movement of the wheelchair.
- There should be speed control option on the wheelchair. This can be enabled by using an accelerometer.
- An ultrasonic sensor can be used to prevent unwanted collision of the wheelchair with some obstacle.

- A smoke detecting sensor can also be used to detect fire in the wheelchair.
- A PCB board design can be implemented for the circuit made on the breadboard. This will lead to the circuit becoming more compact.
- An Android App can be developed which will serve as the platform where the handicap’s kin can receive a message in case of an emergency. The emergency will occur only when the person sitting on the wheelchair presses the alarm button.

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- Youtube links: - https://www.youtube.com/watch?v=WNCn062YzXc&t=865s
- https://www.youtube.com/watch?v=M-oulY8Mujo

Team Experience

When this idea was initiated under the guidance of our mentor, Dr. Ugra Mohan Roy, we were in a challenging situation. This was because there were very few sources available which could guide us through this project.

We had to think a lot about the process of transmission of messages from the transmitter end to the receptor. We tried a lot of times and failed while wirelessly transmitting messages because this was the first time, we all were working with Arduino. Finally, we were able to complete this task. There were several other issues which we faced and overcame in duration of completing this project.

This was a good concept which our team worked on and we were able to learn a lot of things from it. So, all in all this was a pretty good experience.

Dr Roy gave us the freedom to work on, in our own way and we are thankful for their support and confidence which they bestowed upon us.

Appendix

Appendix-A

Transmitter side code:

```
int hallSensorPin1 = 4;
int hallSensorPin2 = 5;
int hallSensorPin3 = 6;
int ledPin1 = 0;
int ledPin2 = 1;
int ledPin3 = 2;
int state1 = 0;
int state2 = 0;
int state3 = 0;

//Include Libraries
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>

//create an RF24 object
RF24 radio(9, 8);  // CE, CSN

//address through which two modules communicate.
const byte address[6] = "00001";

void setup()
{
pinMode(ledPin1, OUTPUT);
pinMode(ledPin2, OUTPUT);
pinMode(ledPin3, OUTPUT);
pinMode(hallSensorPin1, INPUT);
pinMode(hallSensorPin2, INPUT);
```

```
pinMode(hallSensorPin3, INPUT);

radio.begin();

//set the address
radio.openWritingPipe(address);

//Set module as transmitter
radio.stopListening();

}
void loop(){

state1 = digitalRead(hallSensorPin1);
if (state1 == HIGH) {
digitalWrite(ledPin1, HIGH);
//Send message to receiver
const char text[] = "left";
radio.write(&text, sizeof(text));
delay(100);
}
else {
digitalWrite(ledPin1, LOW);
}
state2 = digitalRead(hallSensorPin2);
if (state2 == HIGH) {
digitalWrite(ledPin2, HIGH);
//Send message to receiver
const char text[] = "forward";
radio.write(&text, sizeof(text));
delay(100);
}
```

```
else {
digitalWrite(ledPin2, LOW);
}

state3 = digitalRead(hallSensorPin3);
if (state3 == HIGH) {
digitalWrite(ledPin3, HIGH);
//Send message to receiver
const char text[] = "right";
radio.write(&text, sizeof(text));
delay(100);
}
else {
digitalWrite(ledPin3, LOW);
}
}
```

Appendix-B

Receiver side code

```
const int in1 = 7;
const int in2 = 6;
const int in3 = 5;
const int in4 = 4;
const int enA = 3;
const int enB = 10;

//Include Libraries
#include <SPI.h>
#include <nRF24L01.h>
```

```
#include <RF24.h>

//create an RF24 object
RF24 radio(9, 8);  // CE, CSN

//address through which two modules communicate.
const byte address[6] = "00001";

void setup()
{
// Set all the motor control pins to outputs
pinMode(enA, OUTPUT);
pinMode(enB, OUTPUT);
pinMode(in1, OUTPUT);
pinMode(in2, OUTPUT);
pinMode(in3, OUTPUT);
pinMode(in4, OUTPUT);

// Turn off motors - Initial state
digitalWrite(in1, LOW);
digitalWrite(in2, LOW);
digitalWrite(in3, LOW);
digitalWrite(in4, LOW);

while (!Serial);
Serial.begin(9600);

radio.begin();

//set the address
radio.openReadingPipe(0, address);
```

```
//Set module as receiver
radio.startListening();
}

void loop()
{
analogWrite(enA, 255);
analogWrite(enB, 255);

//Read the data if available in buffer
if (radio.available())
{
char text[32] = {0};
radio.read(&text, sizeof(text));
Serial.println(text);
if(text=="forward")
{
//forward
digitalWrite(in1, HIGH);
digitalWrite(in2, LOW);
digitalWrite(in3, HIGH);
digitalWrite(in4, LOW);
}
else if(text=="left")
{
//left
digitalWrite(in1, LOW);
digitalWrite(in2, LOW);
digitalWrite(in3, HIGH);
digitalWrite(in4, LOW);

}
```

```
else
(
//right
digitalWrite(in1, HIGH);
digitalWrite(in2, LOW);
digitalWrite(in3, LOW);
digitalWrite(in4, LOW);
}
}
}
```