

VOICE CONTROLLED WHEELCHAIR USING ARDUINO AND BLUETOOTH MODULE

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering Degree in
Electrical and Electronics Engineering

by

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SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

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INSTITUTE OF SCIENCE AND TECHNOLOGY

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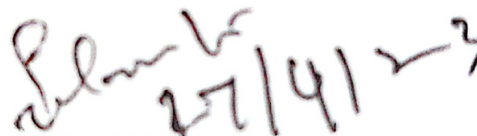
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of
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our supervision from January 2023 to April 2023.


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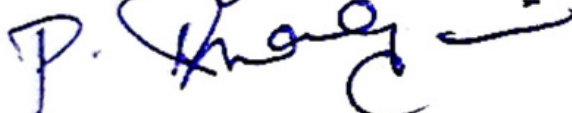
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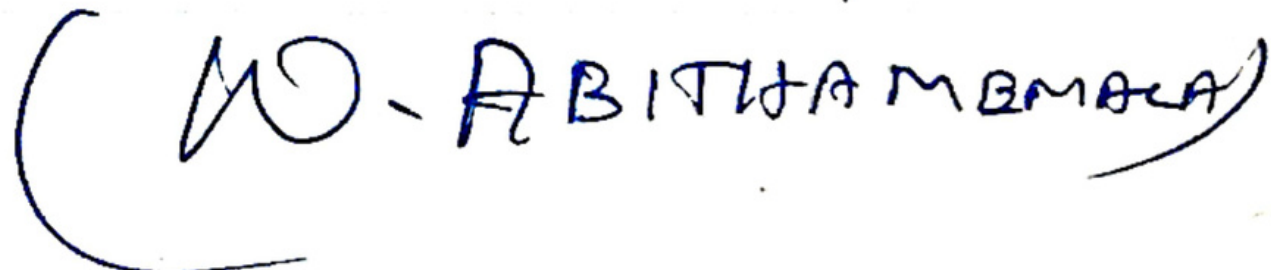
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DECLARATION

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ABSTRACT

The main objective of voice controlled wheel chair system project is recommended to control a wheel chair using the voice of person. The system is designed to control a wheel chair using the voice of person. Therefore the problems that they face can be solved by using speech recognition technology for the movement of wheel chair. The disabled people cannot move from one place to another on their own. They continuously need someone to help them in getting the wheelchair moving. The goal of this system will allow certain people to live a life with less dependence on others for their movement as a daily need. This voice controlled system make them more independent.

Powered wheelchairs with the standard joystick interface are unable to be control by many people. A voice controlled wheelchair can provide easy access for physical disabled person who cannot control their movements especially hands. Few patients such as quadraplegic, cerebral palsy and multiple sclerosis are dependent on other people to move from one place to another and due to this they don't have the freedom of mobility. This voice controlled wheelchair help them to drive the wheelchair without anyone's help. This system can be controlled by the simple voice commands given by the user. Depending upon the direction specified in the commands, the Arduino will drive the motors. The speech recognition is done by voice recognition module, connected with Arduino. The wheelchair would operate on real analogous voice signal of patient or user using the wheelchair. Therefore the problems that they face can be solved by using speech recognition technology for the movement of wheel chair.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL BACKGROUND

People with arms and hand impairment find it difficult to use a normal wheelchair as their hands are not capable of operating the normal wheelchair and cannot move it to any direction. Therefore, a voice-controlled wheelchair is built to overcome the problems faced by such people and enable them to operate the wheelchair. The wheelchair will be operated using voice commands through the given input. The Arduino will take care of all the directions the user wants. The instruction for each and every direction is written in the form of a program in the Arduino itself. By having a wheelchair control system, people will become more independent. By using the system, the users are able to operate the wheelchair by simply speaking to the wheelchair's microphone. The basic movement functions include forward and reverse direction, left and right turns, and stop. So the development of a voice-operated wheelchair will solve the query about the mobility of paraplegic patients and make them independent of mobility.

1.2 LITERATURE SURVEY

People have disabilities with their hands, feet, and lower extremities because of which they are unable to perform regular tasks. Many technologies are available to overcome this problem. To overcome this problem, there are several applications in the market which help handicapped people to perform their tasks. The proposed design supports a voice activation system for physically disabled persons incorporating manual operation. If a person is handicapped, they are dependent upon others for their day-to-day operations such as orientation, etc. Several studies have shown that independent mobility, which includes power wheelchair, manual wheelchair, and walker, access the benefit to both children and adults. Independent mobility reduces dependence on caregivers and family members and promotes feelings of self-reliance. Impaired mobility often results in decreased opportunities to socialize, which leads to social isolation, anxiety, and depression. While the needs of many individuals with disabilities can be satisfied with traditional manual or power wheelchair, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. This population includes individuals with low vision, cognitive deficits, etc. The proposed voice-controlled wheelchair would bring more convenience for the disabled people. The technology can also enhance safety for

users who use ordinary joystick-controlled powered wheelchairs, by preventing collisions with walls, fixed objects, furniture and other people.

There are many advantages to such a system like:

- It reduces human efforts.

- This is helpful to physically handicapped people who could not able to operate home appliances with their hand.

- This will help to save energy to some extent, since some people feels lazy to go and switch off the appliances manually.

- It is easy to operate for the people who are tried and does not need to operate the home appliance manually by hands.

- It reduces risk.

The proposed system has certain limitations too such as:

- It requires extra supply to operate the model.

- Only the installed voice is recognized by the module.

- The cost of the module is quite higher.

This kind of system reduces the manual effort for acquiring and distinguishing the command for controlling the motion of a wheelchair. The speed and direction of the wheelchair can be selected using the specified commands. Thus the only thing needed to ride the wheelchair is to have a trained voice. Besides that, the development of this project can be done with less cost and affordable.

However this system requires some improvements to make it more reliable. This design could be improved by implementing wireless communication in the wheelchair. By developing this system, we can directly enhance the life style of the disabled people in the community. Lastly, we hope that this kind of system could contribute to the evolution of the wheelchair technology. The motor drive and control system of the intelligent wheelchair has been presented.

The proposed microcontroller based voice operated intelligent wheelchair would bring more convenience for the disabled people. The technology can also enhance safety for users who use ordinary joystick-controlled powered wheelchairs, by preventing collisions with walls, fixed objects, furniture and other people.

1.3 SCOPE OF THE PROJECT

This system will be a Real-Time Voice controlled Wheelchair for the physically disabled person. This system will be designed to operate the wheelchair based on the voice of the user and control the movement according to the command given by the operating person. Thus this binary format would be checked with the binary code fed to the microcontroller, if true the command will be performed. These command would be performed within seconds. On the whole it's basic operation would be left, right, stop, go, back.

1.4 COMPONENTS REQUIRED

➤ Hardware requirement

- ✓ DC Geared Motor.
- ✓ Arduino Uno.
- ✓ Motor Driver Shield.
- ✓ HC-05 Bluetooth Module.
- ✓ Motor Wheels.
- ✓ Centre Wheel.
- ✓ Jumper Wires.
- ✓ 18650 Holder.
- ✓ 18650 Batteries.

➤ Software requirement

- Arduino IDE.
- Android Application.
- Programming Language
 - ✓ C Language.

CHAPTER 2

TECHNICAL ANALYSIS

2.1 FLOW CHART

We have two parts in our project,

- i) Wheel chair using user's voice
- ii) Wheel chair using android app.

The first flowchart shows the functioning of the wheel chair using voice commands. Firstly the user voice application is connected with the wheelchair Bluetooth device. Then user is supposed to speak specific commands through the application. Then using the Google voice service the word is checked and converted to text. The text format it processed further to controller, it checks for the valid input and then gives specific instruction to the motor drivers for its movement towards left, right, straight, backward otherwise stop.

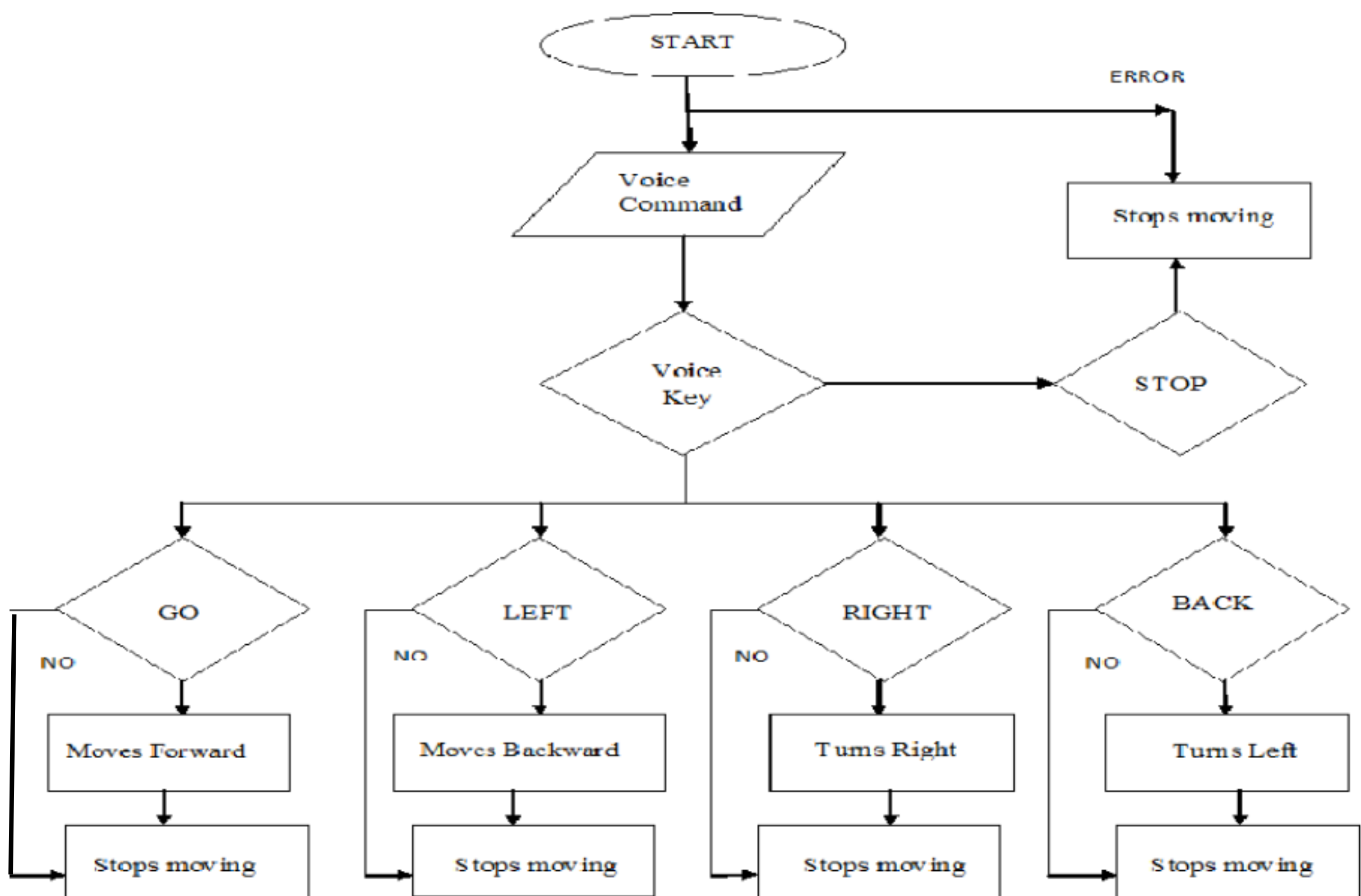


Figure 2.1 Flow Chart

2.2 PROGRAM

```
#include <Servo.h>
#include <AFMotor.h>

#define Echo A0
#define Trig A1
#define motor 10
#define Speed 170
#define spoint 103

char value;
int distance;
int Left;
int Right;
int L = 0;
int R = 0;
int L1 = 0;
int R1 = 0;

Servo servo;
AF_DCMotor M1(1);
AF_DCMotor M2(2);
AF_DCMotor M3(3);
AF_DCMotor M4(4);

void setup() {
  Serial.begin(9600);
  pinMode(Trig, OUTPUT);
  pinMode(Echo, INPUT);
  servo.attach(motor);
  M1.setSpeed(Speed);
  M2.setSpeed(Speed);
  M3.setSpeed(Speed);
  M4.setSpeed(Speed);
}

void loop() {
```

```

//Obstacle();
//Bluetoothcontrol();
//voicecontrol();
}
void Bluetoothcontrol() {
  if (Serial.available() > 0) {
    value = Serial.read();
    Serial.println(value);
  }
  if (value == 'F') {
    forward();
  } else if (value == 'B') {
    backward();
  } else if (value == 'L') {
    left();
  } else if (value == 'R') {
    right();
  } else if (value == 'S') {
    Stop();
  }
}
void Obstacle() {
  distance = ultrasonic();
  if (distance <= 12) {
    Stop();
    backward();
    delay(100);
    Stop();
    L = leftsee();
    servo.write(spoint);
    delay(800);
    R = rightsee();
    servo.write(spoint);
    if (L < R) {

right();

    delay(500);
    Stop();

```

```

delay(200);
} else if (L > R) {
    left()
delay(500);
    Stop();
    delay(200);
}
} else {
    forward();
}
}

void voicecontrol() {
    if (Serial.available() > 0) {
        value = Serial.read();
        Serial.println(value);
        if (value == '^') {
            forward();
        } else if (value == '-') {
            backward();
        } else if (value == '<') {
            L = leftsee();
            servo.write(spoint);
            if (L >= 10 ) {
                left();
                delay(500);
                Stop();
            } else if (L < 10) {
                Stop();
            }
        } else if (value == '>') {

```

```

R = rightsee();
  servo.write(spoint);
  if (R >= 10 ) {
    right();
  }
  delay(500);
  Stop();
  } else if (R < 10) {
    Stop();
  }
} else if (value == '*') {
  Stop();
}
}
}

// Ultrasonic sensor distance reading function
int ultrasonic() {
  digitalWrite(Trig, LOW);
  delayMicroseconds(4);
  digitalWrite(Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(Trig, LOW);
  long t = pulseIn(Echo, HIGH);
  long cm = t / 29 / 2; //time convert distance
  return cm;
}

void forward() {
  M1.run(FORWARD);
  M2.run(FORWARD);
  M3.run(FORWARD);
  M4.run(FORWARD);
}

```

```

void backward() {
    M1.run(BACKWARD);
    M2.run(BACKWARD);
    M3.run(BACKWARD);
    M4.run(BACKWARD);
}

void right() {
    M1.run(BACKWARD);
    M2.run(BACKWARD);
    M3.run(FORWARD);
    M4.run(FORWARD);
}

void left() {
    M1.run(FORWARD);
    M2.run(FORWARD);
    M3.run(BACKWARD);
    M4.run(BACKWARD);
}

void Stop() {
    M1.run(RELEASE);
    M2.run(RELEASE);
    M3.run(RELEASE);
    M4.run(RELEASE);
}

int rightsee() {
    servo.write(20);
    delay(800);
    Left = ultrasonic();
    return Left;
}

```

```
int leftsee() {  
    servo.write(180);  
    delay(800);  
    Right = ultrasonic();  
    return Right;}  

```

2.3 ADVANTAGES

- Reduce manpower.
- User friendly.
- Very easy to use.
- Input can be changed rapidly.
- Automated operation.
- More reliable.
- Less wiring because of Bluetooth.
- Economical.

2.4 DISADVANTAGES

- It causes problem during noisy environment.
- Even the best speech recognition system sometimes make errors.
- Bluetooth module technology often expensive.
- It has an operating range of 10-100meters.
- It only operates on commands like Back, Left, Right and stop.

2.5 PROBLEMS

- Dirty Hands with Blisters.
- Irritating horns of restless drivers.
- Inaccessible ramps.
- Getting Stuck into Narrow Doors.
- We Become Invisible.
- The Race for Getting into the Lift (Elevator)
- The Struggle for Parking the Vehicle.

2.6 APPLICATIONS

- Obstacles in the way of wheelchair are detected and avoided using IR sensor.
- Patients in the Hospitals
 - ✓ People suffering from certain paralysis can use either voice or head movement as per requirement.
- Old Age Homes
 - ✓ People at old age homes can use this chair as per their requirement.

CHAPTER 3

PROJECT DESCRIPTION

3.1 CIRCUIT CONNECTIONS

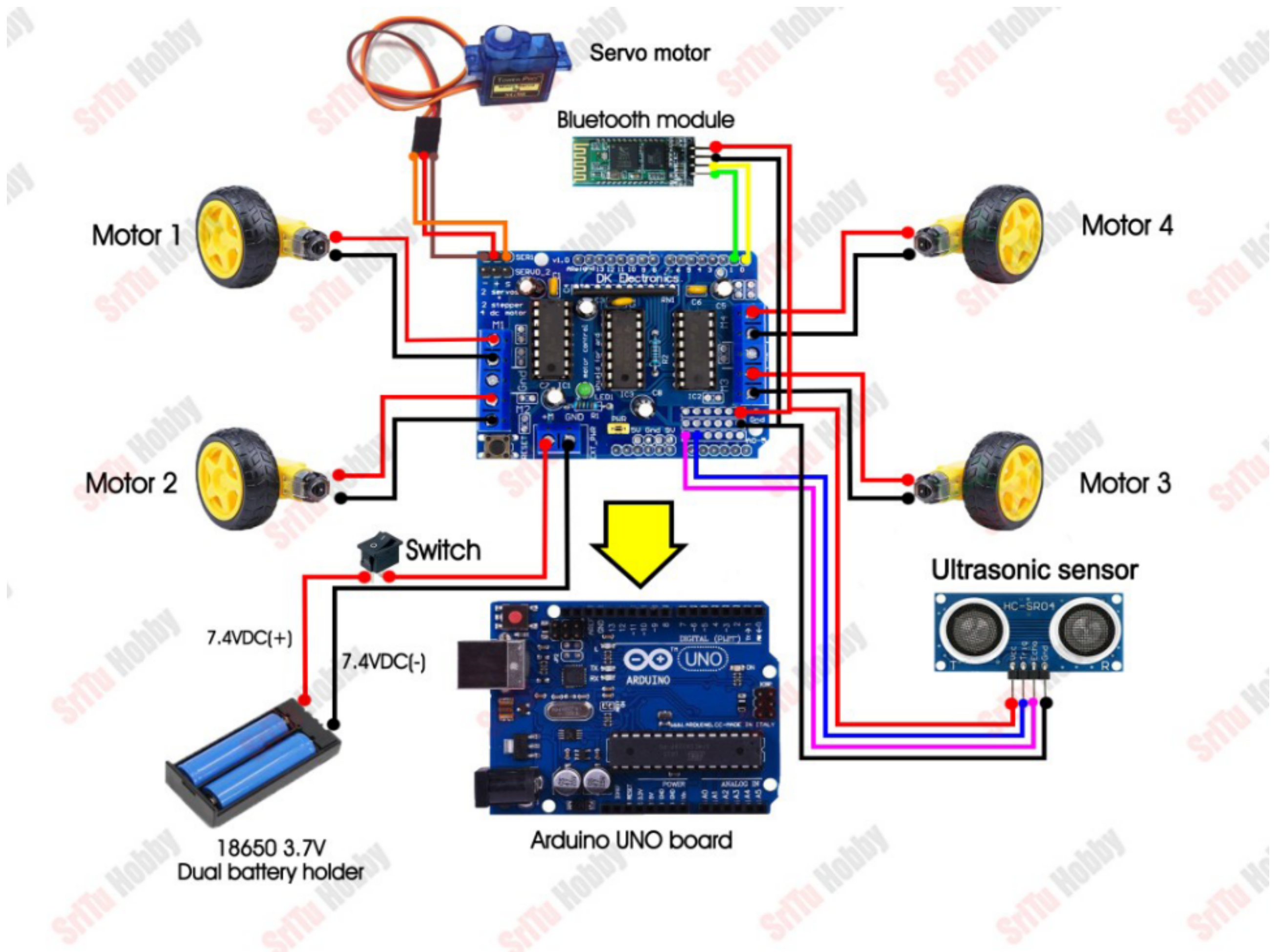


Figure 3.1 Connection Circuits

Speech recognition module receives voice commands of the user and sends binary code corresponding to the received command to the microcontroller. Similarly gesture recognition module sends analog voltages in three directions corresponding to each orientation to the microcontroller. Output of the speech recognition module and gesture recognition module are interfaced to controller.

This controller controls the wheelchair based on received gesture or voice command. To control wheelchair DC motors will be driven through the microcontroller where DC motors are connected to the wheels of wheelchair, but DC motors will not be driven directly by microcontroller as their operating voltages are not compatible. Hence to drive motor L293D motor driver is used. Motors will be fixed to front wheels of wheelchair and hence based on the rotation of motors direction of wheelchair will be controlled.

3.2 BLOCK DIAGRAM

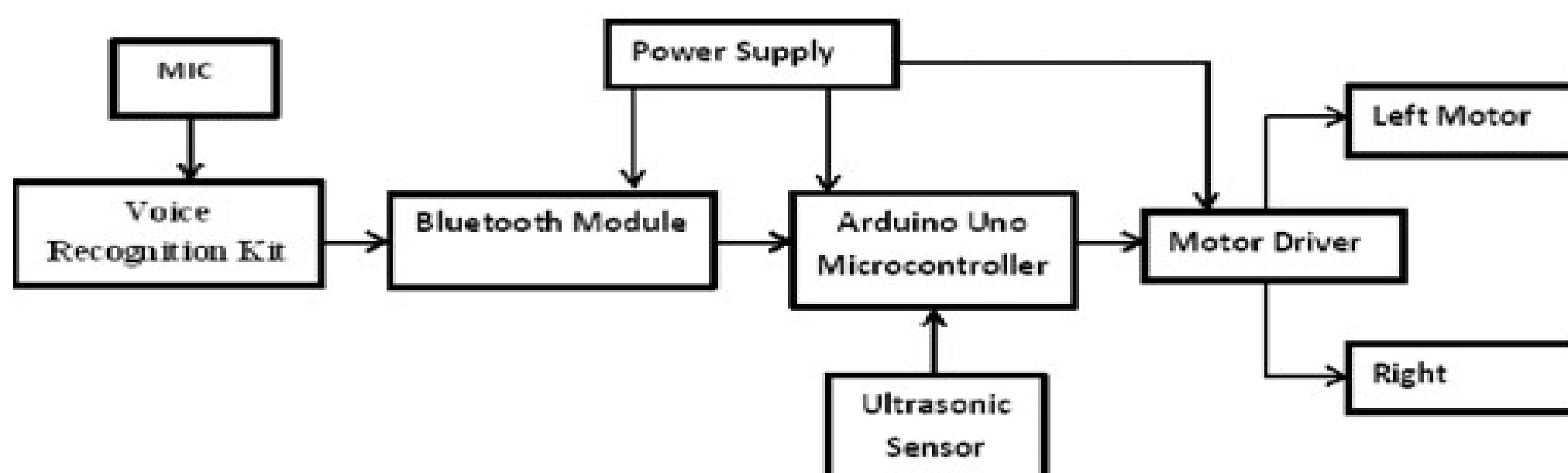


Figure 1.2 Block Diagram of proposed model

3.3 PROJECT CONCEPT EXPLANATION

The above diagram is a Block Diagram of the proposed system. There are three main components of the Voice Recognition System (VRS), Bluetooth module, and Arduino UNO as a Micro-controller. Others are Motor Driver IC, Micro-phone, Left and Right DC Motor. The first is a microphone is used to capture the voice command and is given to the Voice Recognition System as input. Voice Recognition System (VRS) is a model based on Deep Learning and Signal Processing.

The main Function of VRS is to identify the user voice command and passed it to the Controller through Bluetooth. Next is Arduino UNO as Micro-Controller has main functionality is to control all hardware-related components such as Motor Driver IC, Left Motor, and Right Motor. Arduino UNO is used as a computational-processing device. It is connected to both motors through driver IC. Last is Bluetooth Module acts as the communication medium between Microcontroller and Voice Recognition System (VRS). It is connected to Arduino as it requires the power supply and Processing Power. The workflow in the proposed system is an audio signal as the input given to the Voice Recognition System (VRS) after the identification of the voice command, a Bluetooth connection is established between the micro-controller and VRS, and the output of VRS is given to the micro-controller which has a set of instructions to control both motors through Driver IC which is based on the output of Voice Recognition System.

3.4 METHODOLOGY

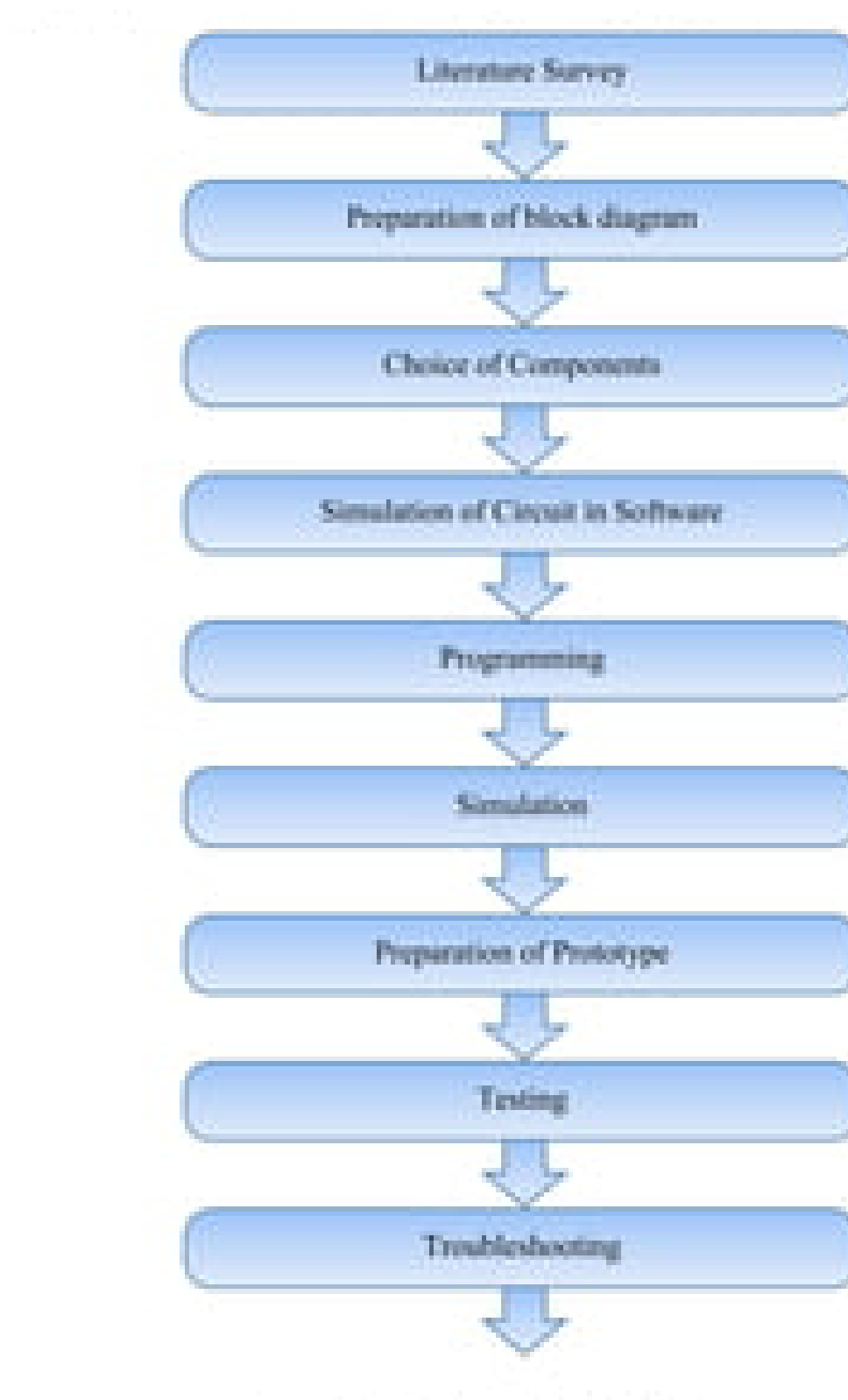


Figure 3.4 Methodology

The Voice commands are given with the help of smart phone. The android phone that is connected through Bluetooth with Bluetooth Module HC-05. The voice command is converted to an array of string and the string is passed to Arduino Uno connected to it. Once the Bluetooth Module receives the message, the command sent will be extracted and executed by the microcontroller attached to it and depending on the commands fed to the Motor Driver, the motors will function accordingly. The system will interpret the commands and control the Wheelchair accordingly via android application. Meanwhile, the ultrasonic sensor works while the circuit is on and it detects the obstacle within a range of 4 meters and makes sure the path has no obstacle. If any obstacle occurs it notifies the Arduino and stops wheelchair till further command is obtained from the user.

The voice recognition module is the key feature of this project that is used to setup the desired voice command and output. It consists of three phases, which is voice customization, voice capture and voice recognition. Voice customization is the process of matching the desired voice recorded to the desired output signal. Voice capture is the phase that records the desired person's voice command and saves the voice based on the customization configuration. The voice recognition phase is the final phase where when voice command has been recognized, this module will send a specific signal to the microcontroller for the necessary operation. the block diagram of the voice recognition module. The voice instructions are recorded via serial communication with the PC using Access Point communication software with baud rate of 9600. After the connection of the voice recognition module to the PC is successfully implemented, the existing voice instructions are deleted by sending hex command AA 01. The recording is started with the desired voice command in group 1 by sending the hex command AA 11. After this command has been sent, user is required to record a total of five voice commands in order to complete the group recording. On completion of the voice capturing phase, verification is required by sending the hex command AA 21 to import group 1 into the voice recognition module. The recorded voice command is verified again by repeating the five commands that has been recorded earlier. Figure 3 shows the returning result of the voice verification after each command has been verified successfully by the module.

CHAPTER 4

PROPOSED SYSTEM

4.1 PROJECT DESIGN

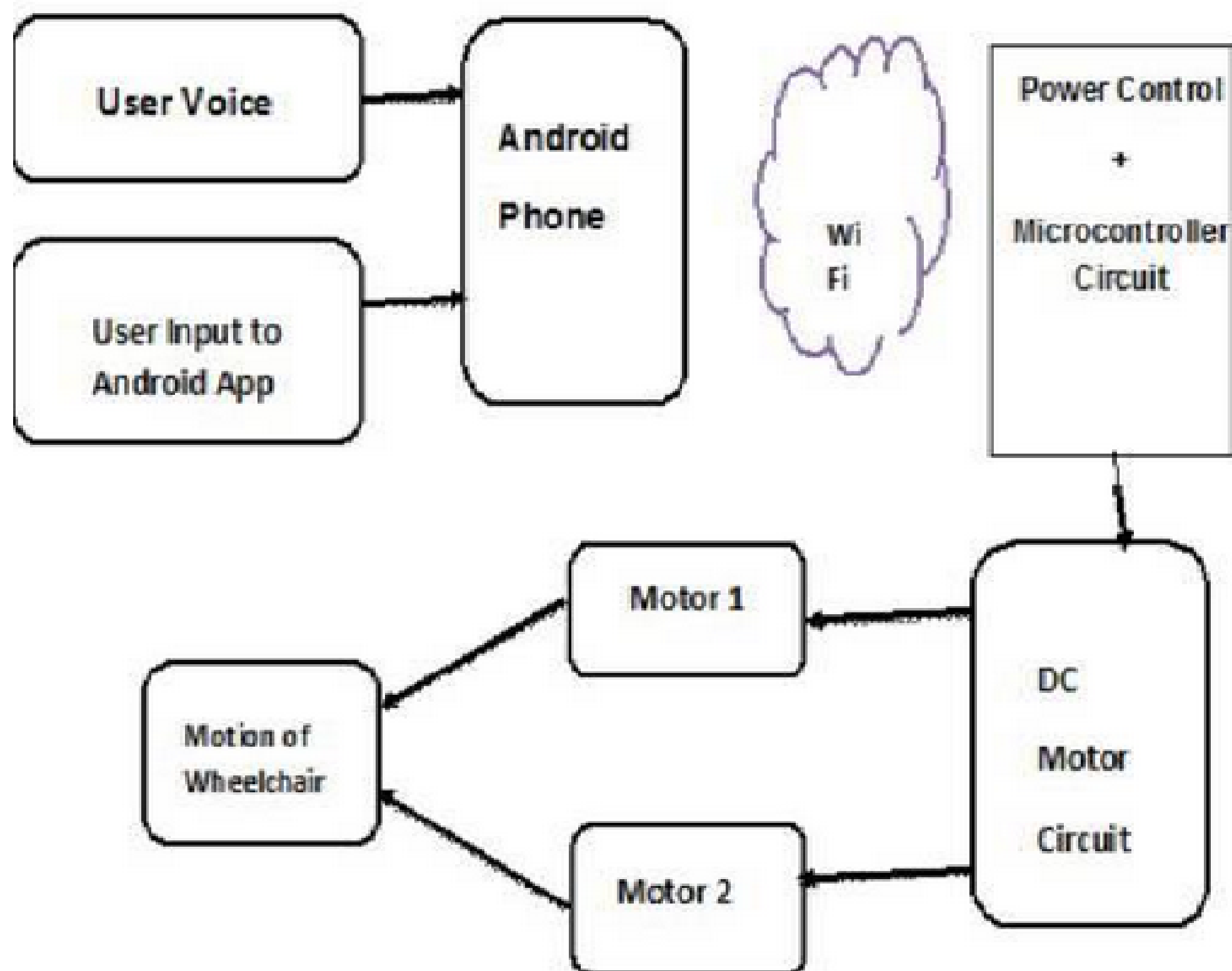


Figure 4.1 Architecture of System

The purpose of this paper is to develop a wheelchair which will move as per the user's commands. This system works on voice commands given by the wheelchair user. The system is fully independent as the user do not need any other person to help him to move the wheelchair. There are basically five commands, which command is given by the user, accordingly the wheelchair will move. The voice commands of the user is recognized in the first step. Once it is recognized, the commands are converted into its equivalent instructions which drive the system. This system consists of two major modules namely Voice recognition module and motor driving module.

The voice recognition is done through voice recognition module. The output of this module is directed to Arduino which uses a motor driver IC to drive the motors. The output is in the form of voice signals and is transferred to the voice recognition module which acts as an interface between mic and Arduino. The Arduino then receive the output from voice recognition module thus converting it into binary code. The system is unable to understand any language other than binary code.

Thus, the generated voice command is converted into machine understandable form.

This system uses the Arduino uno R3. It is connected with motors to drive the wheelchair anywhere. Motors are responsible for the movement of wheelchair. Hence, motors receives input from the Arduino and depending upon the instruction type, motors moves accordingly. This system uses two motors connected with motor driver. There are five different instructions that can be given to the motors, they are forward, backward, left, right and stop. The movement of wheelchair depends only upon these five commands The wheelchair responds to the voice command from its user to perform any movement's functions. The basic movement functions include forward direction, left and right turns and stop.

4.2 COMPONENTS

4.2.1 Hardware modules

➤ DC Geared Motor

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gearbox to a motor reduces the speed while increasing the torque output. The most important parameters in regard to gear motors are speed (rpm), torque (lb-in) and efficiency (%).



Figure 4.2.1 Picture of DC Geared Motor

Arduino Uno

- ✓ Arduino Uno is an open-source microcontroller board based on the processor ATmega328P.
- ✓ There are 14 digital I/O pins, 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button. It contains all the necessary modules needed to support the microcontroller. Just plug it into a computer with a USB cable or power it with an adapter to get started.

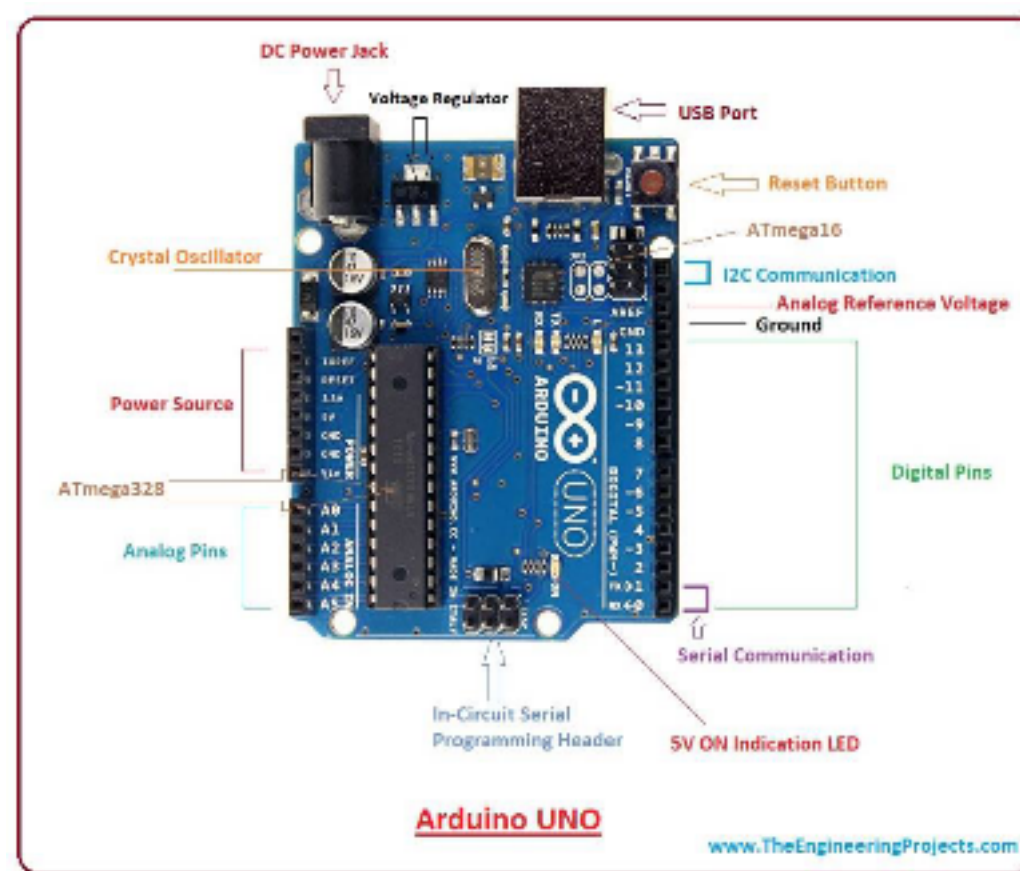


Figure 4.2.2 Picture of Arduino Uno

Motor Driver Shield

- ✓ This motor driver shield can be used to drive up to 4 DC motors. (up to 600MA and 36v).
- ✓ It can also be used to drive up to 2 Stepper Motors and Servo Motors.
- ✓ The L293D driver shield for Arduino is integrated with a 2-pin terminal block and jumper to connect external power, for separate logic/motor supplies.

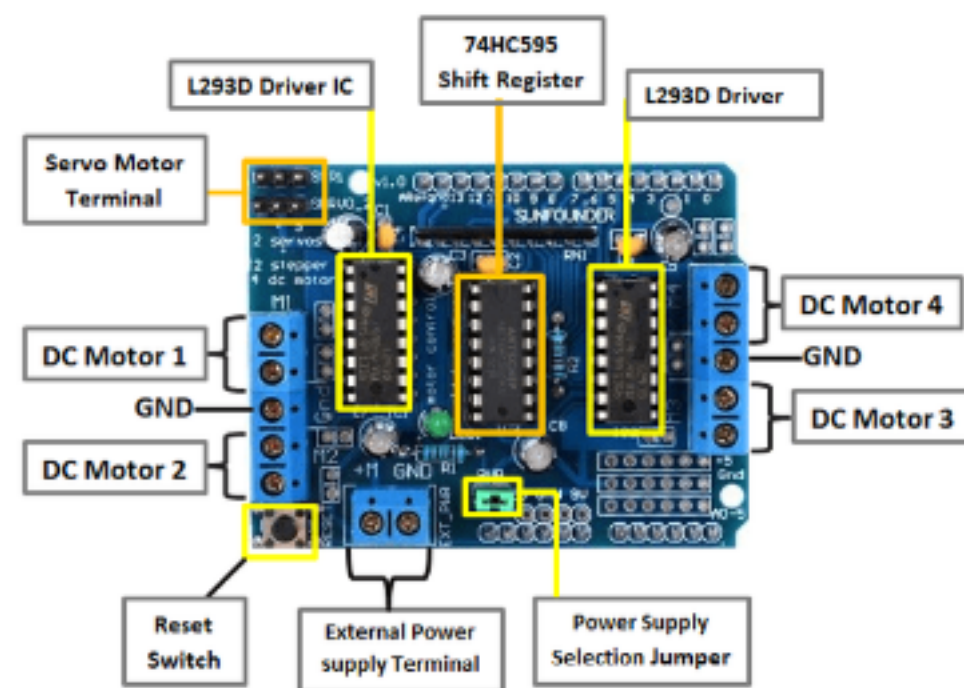


Figure 4.2.3 Picture of Motor Driver Shield

HC-05 Bluetooth Module

- ✓ The HC05 bluetooth module is used as UART serial converter module and can easily transfer the UART data through the wireless bluetooth. The Bluetooth module has a Frequency: 2.4GHz ISM band, PIO control and comes with an integrated antenna and edge connector.

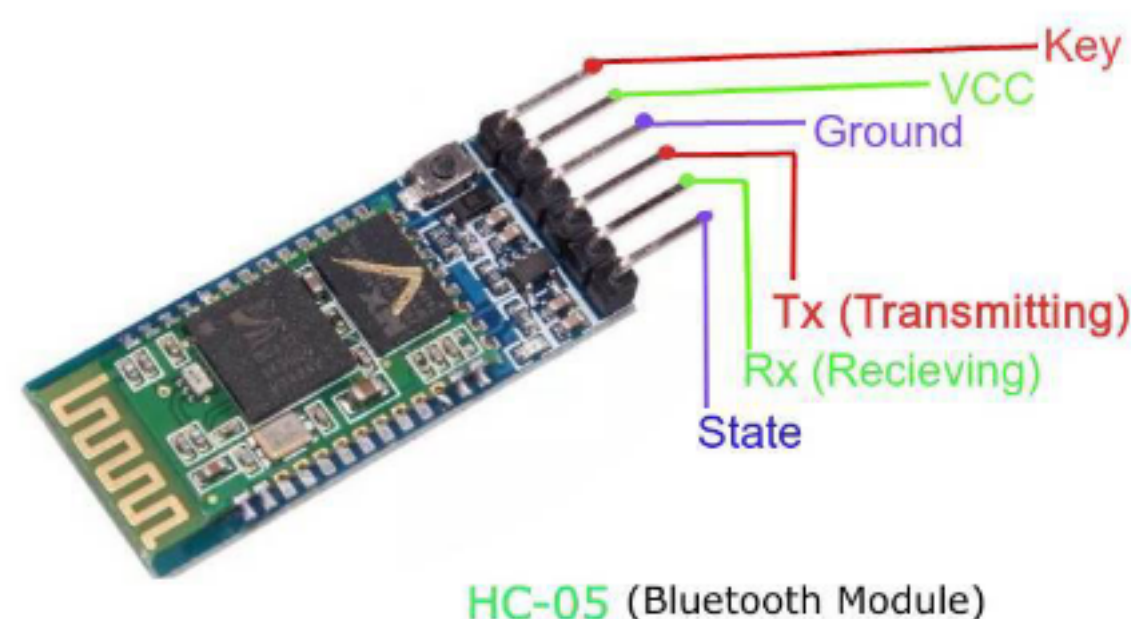


Figure 4.2.4 Picture of HC-05 Bluetooth Module

Ultra Sonic Sensor

Ultrasonic transducers and ultrasonic sensor are devices that generate or sense ultrasound energy. The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig and Echo. The VCC pins and the Ground of the module needs to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any of the Digital I/O pin on the Arduino Uno Board.



Figure 4.2.5 Picture of Ultrasonic Sensor

WHEELS

Wheelchair has two rear wheels. Universal wheel is fixated in wheelchair base in front both wheels have the same diameter. The two rear wheels are drive using two DC motor connected to each wheel. The instructions are passed through micro-controller to the motor, the wheels rotated in the specific direction.



Figure 4.2.6 Picture of Wheels

4.2.2 Software modules

Arduino Software (IDE): The Arduino IDE(Integrated Development Environment) is used for debugging and writing the program. It is open source software. Arduino is a computer hardware and software company, project, and user community that designs and manufactures single board microcontrollers and microcontroller kits for building digital devices and interactive objects that can control objects and sense in the physical and digital world.

The IDE has a text editor for writing programs, a toolbar, a message area, a text console with various buttons for common menus and functions.

4.3 PROJECT PROTOTYPE

4.3.1 Prototype Fabrication

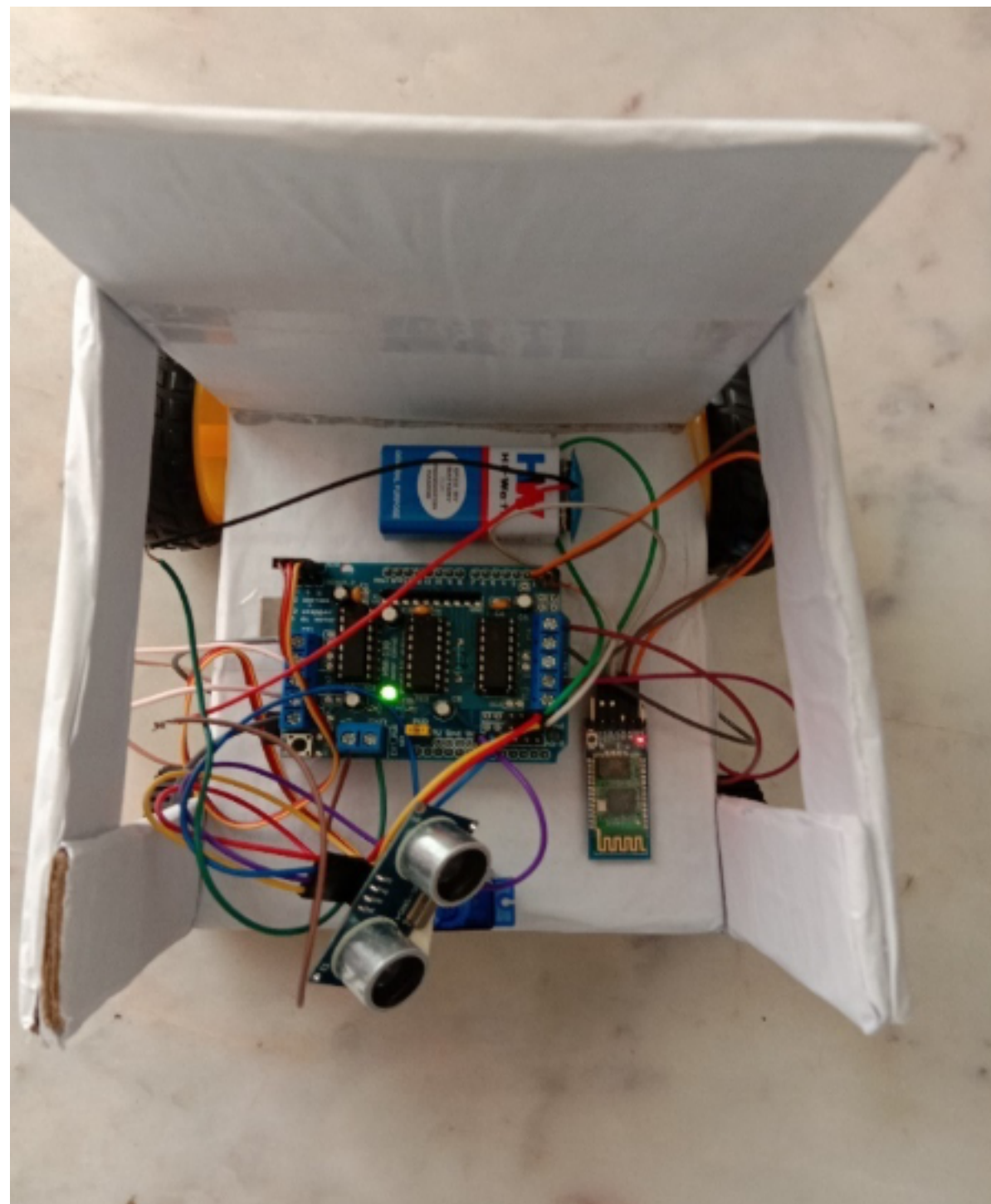


Figure 4.3.1 Front View of Prototype



Figure 4.3.2 Back View of Prototype

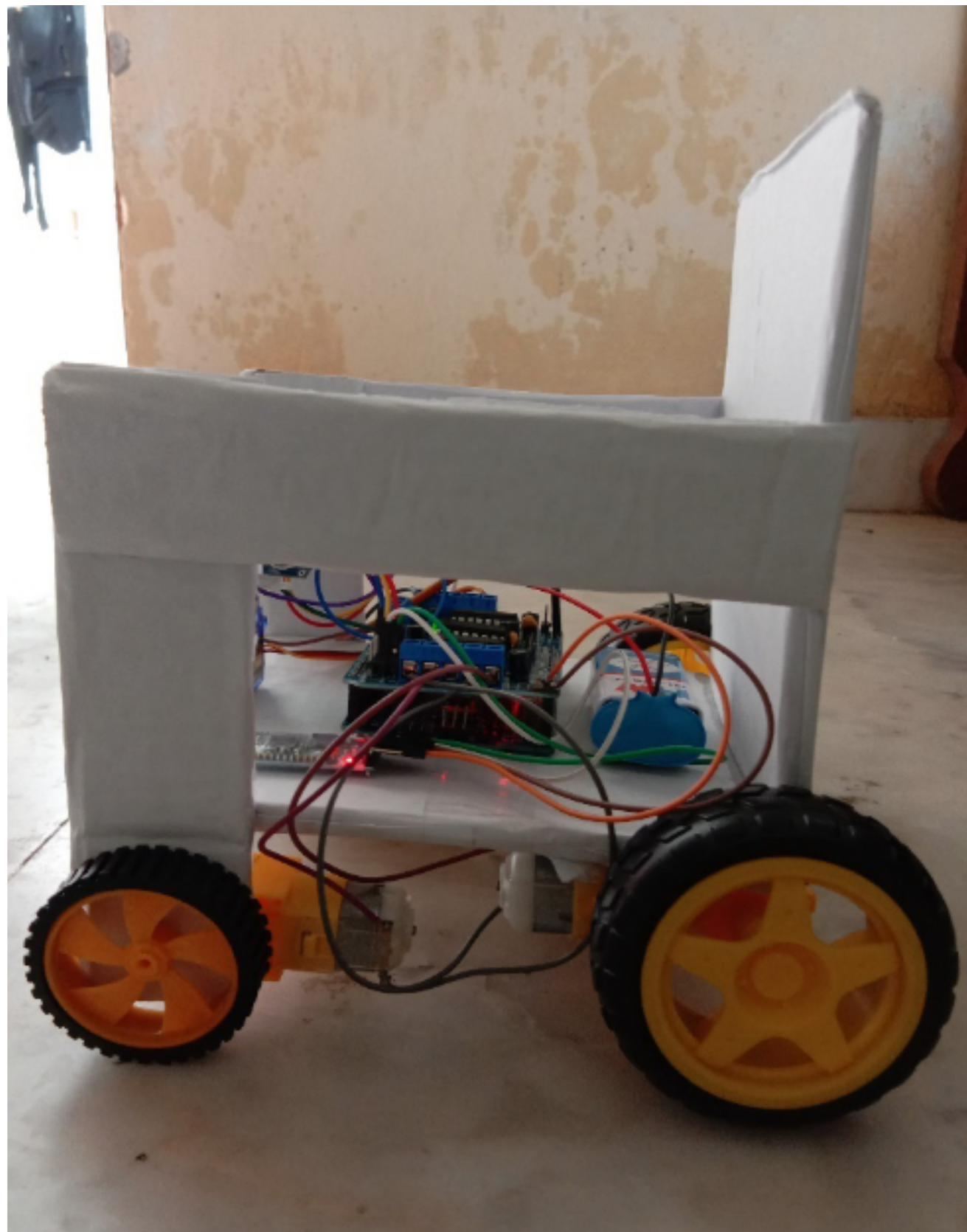
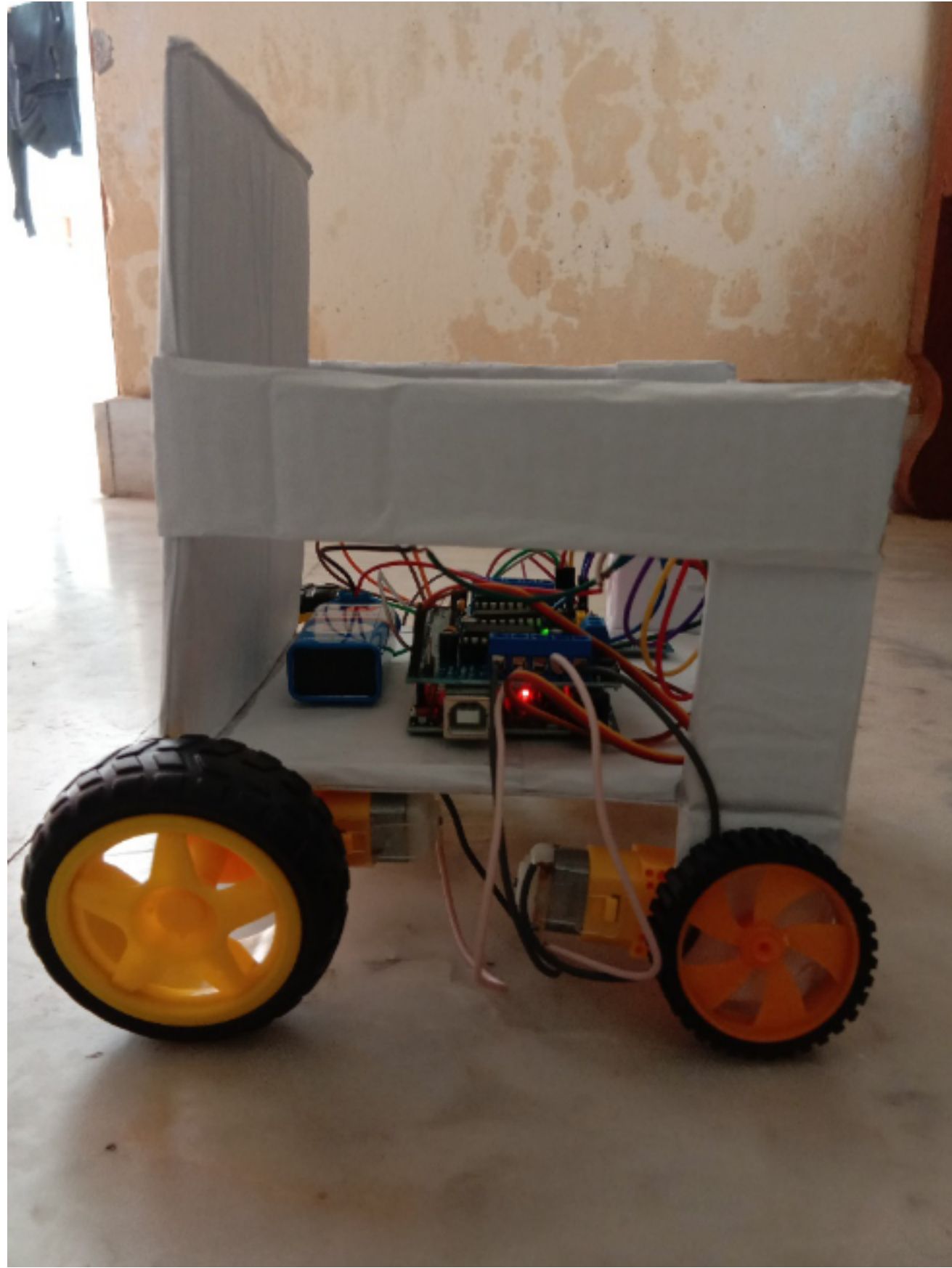


Figure 4.3.3 Lateral View of Prototype

CHAPTER 5

IMPLEMENTATION

5.1 EXPERIMENTS

Step 1: Uploading program to Arduino UNO board

Select Arduino UNO board and COM port to upload the code.

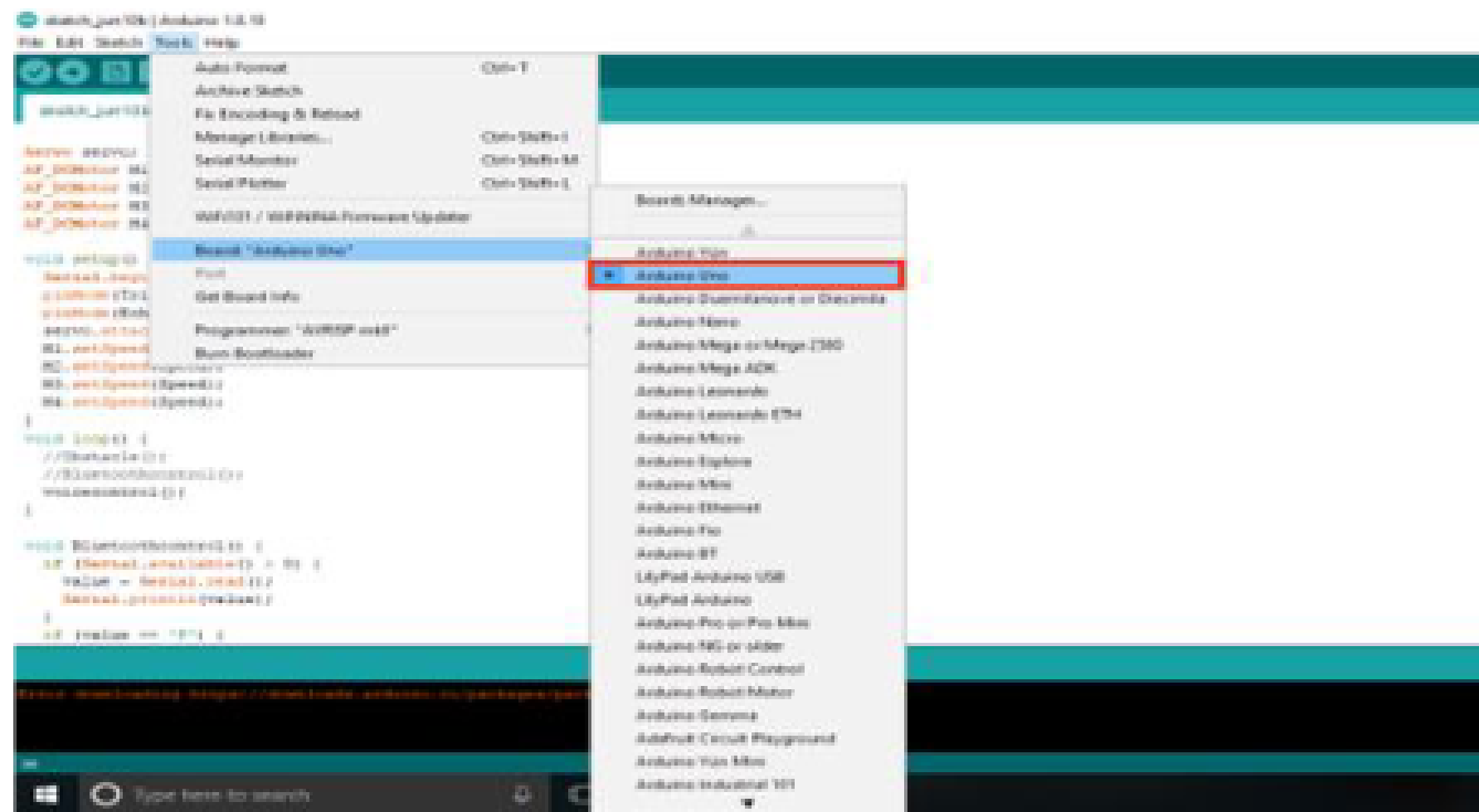


Figure 5.1 Uploading program to Arduino UNO board

Step 2: Installation of app

Download and install the Arduino Bluetooth Control app.

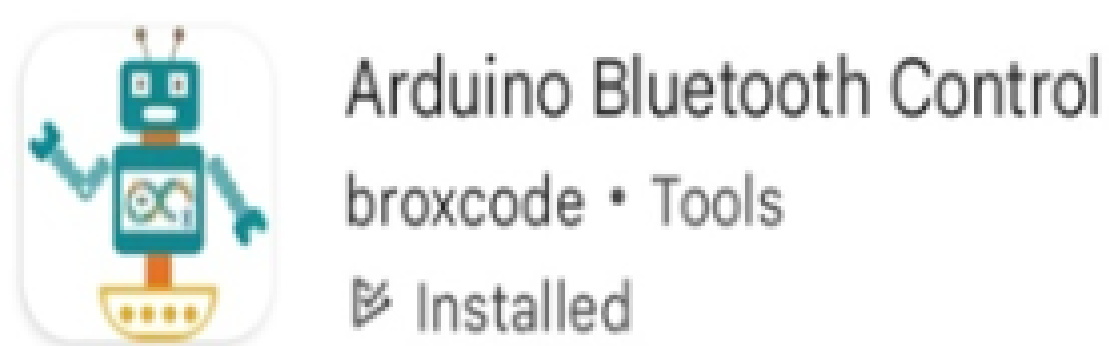


Figure 5.2 App Installation

Step 3: App interface

After, run this application and click the setting button. Then, click the “voice commands configuration” button and include the commands one by one.

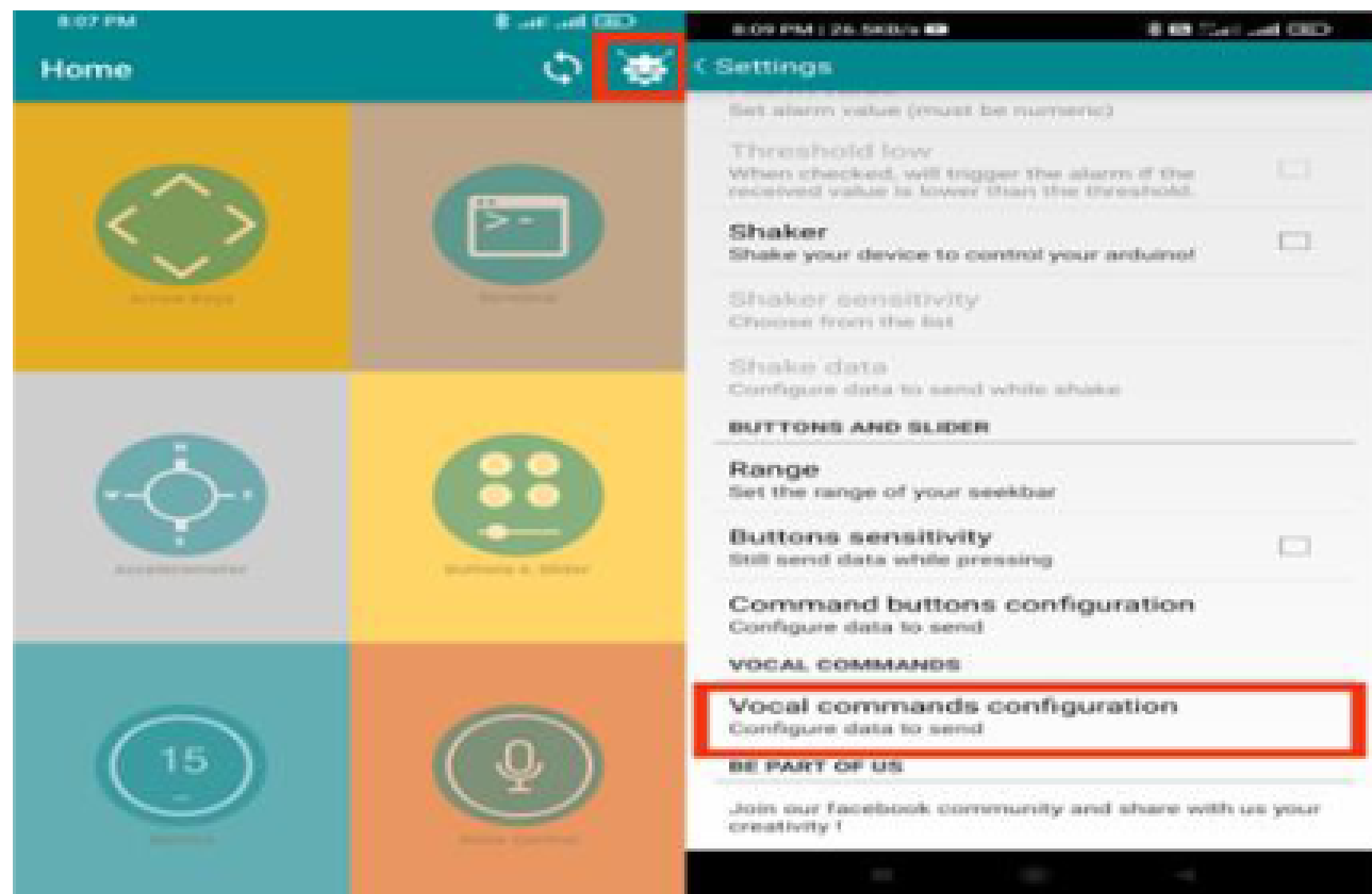


Figure 5.3 App Interface

Step 4: Voice commands to control wheel chair

The voice commands are given through the Arduino Bluetooth control and Bluetooth rc car app. Such as “GO”, “BACK”, “LEFT”, “RIGHT” and “STOP”.The wheelchair will move according to command given.

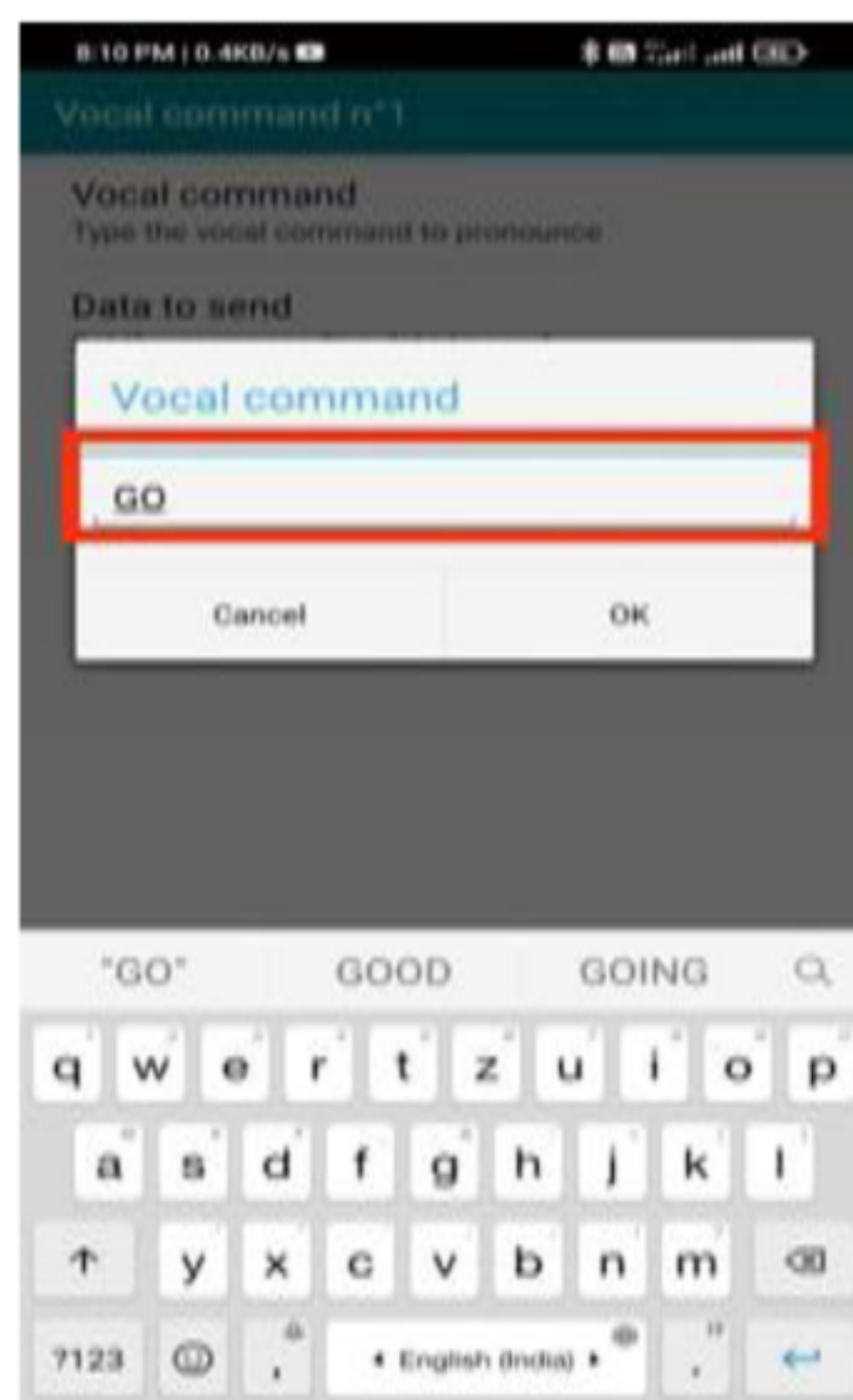


Figure 5.4 Voice commands

5.2 RESULTS

As the part of research work, we made an app as shown in which can control the motor with Arduino through Bluetooth. We made a circuit which consists of Arduino and 4 motors. Whenever the command is given using user voice to the app the signals are sent to the Arduino through Bluetooth and motors are rotated. The rotation of motors is controlled by giving the user voice commands from the application. That is each command sends different signals to the Arduino. We tested our product using different Android devices. The prototype showed a varied response time for different directions.

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 SUMMARY

This project can be summarised as a system that is used for handicapped person can able to move around using voice of that person. To design and develop an android app through which we can operate a movement of a wheel chair using android device.

6.2 CONCLUSION

This project elaborates the design and construction of Smart Electronic Wheelchair with the help of Bluetooth Module. The circuit works properly to move as the command given by the user. After designing the circuit that enables physically disabled to control their wheel using an android application in their smartphones and it has also been tested and validated. The detection of any obstacle is successfully

controlled by the microcontroller. As the person switches on the circuit and starts moving, any obstacle which is expected to lie within a range of 4 metres will be detected by the Ultrasonic sensor. This proposed system contributes to the self-dependency of differently abled and older people.

6.3 FUTURE SCOPE

- Using gear box we can produce high speed moving wheelchair.
- PWM modulation can also increase speed.
- Solar panel can also be used to charge the battery for power supply to the components required to drive the wheelchair.
- The wheelchair can also include gesture feature to operate the wheelchair.
- Finding a way to automatically charge the battery with the help of motion of the wheel chair.

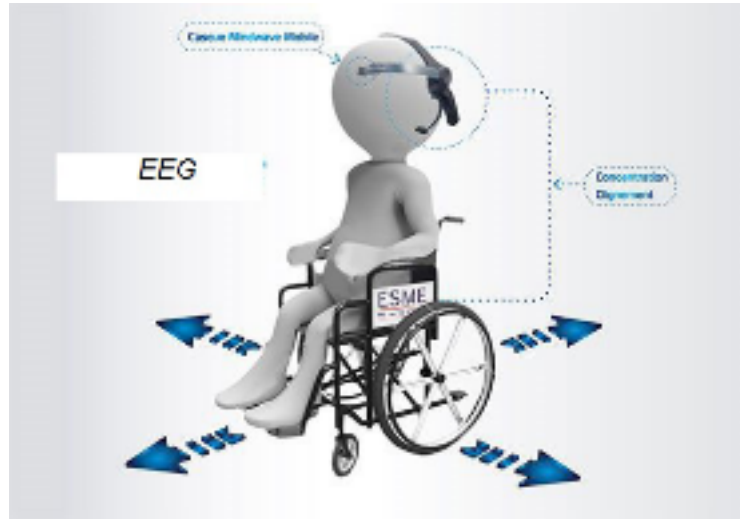


Figure 6.1: Brain Controlled(EEG)

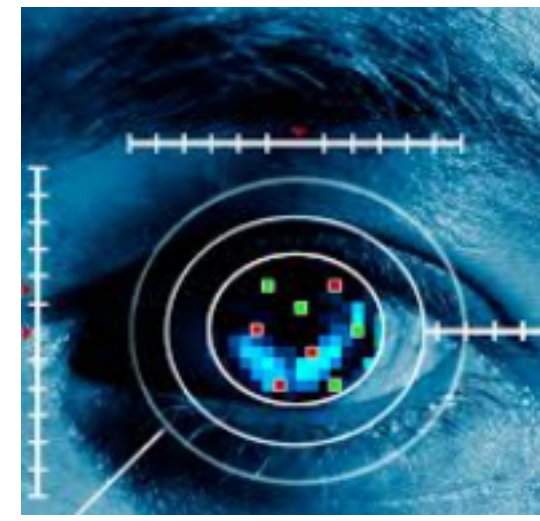


Figure 6.2: Eye Pupil controlled

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