# Voice-Controlled Wheelchair for Physically Disabled Person

## MINI PROJECT REPORT

**Submitted to**

## Visvesvaraya Technological University

**BELAGAVI - 590 018**

**by**



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**Under the guidance of**

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**in partial fulfilment of the requirements for the award of the degree of**

## Bachelor of Engineering


**Department of Electronics & Communication Engineering**

## SDM INSTITUTE OF TECHNOLOGY

## UJIRE - 574 240


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# SDM INSTITUTE OF TECHNOLOGY

(Affiliated to Visvesvaraya Technological University, Belagavi)

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***CERTIFICATE***

Certified that the Project Work titled **Voice Controlled Wheelchair for Physically Disabled Person'** is carried out by **Mr. Pratham H P**, USN:4SU21EC061, **Mr. Rohan Kumar M S**, USN:4SU21EC069, **Mr. Sachin Alabal**, USN:4SU21EC072, **Mr. Sharath Krishna Naik**, USN:4SU21EC076 are bona-fide students of SDM Institute of Technology, Ujire, in partial fulfilment for the requirement for VI semester Mini-Project in Electronics and Communication Engineering of Visvesvaraya Technological University, Belagavi during the year 2023-2024 It is certified that all the corrections/ suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said Degree.

| | |
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# Abstract

This project focuses on designing and implementing a wheel chair, which is a mechanically operated device that allows the user to move about independently. This minimizes the user's personal effort and the force required to move the wheelchair wheels. Furthermore, it allows visually or physically handicapped people to go from one location to another. Voice commands and button controls can be used to operate wheelchairs. In recent years, there has been a lot of interest in smart wheelchairs. These gadgets are very handy while traveling from one location to another. The devices can also be utilized in nursing homes where the elderly have difficulties moving about. For individuals who have lost their mobility, gadgets are a godsend. Different types of smart wheelchairs have been created in the past, but new generations of wheelchairs are being developed and utilized that incorporate the use of artificial intelligence and therefore leave the user with a little to tamper with. The project also intends to develop a comparable wheelchair that has some intelligence and assists the user in his or her mobility.

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# Acronyms and Abbreviations

| | |
|---|---|
| VCW | Voice-Controlled Wheelchair |
| HC05 | Host Controller-05 |
| USB | Universal Serial bus |
| IDE | Integrated Development Environment |
| HC-SR04 | High-Conductance Ultrasonic Sensor |

# Chapter 1

# Introduction

People with arm and hand impairments find it difficult to utilize a standard wheelchair since their hands are incapable of operating it and cannot move it in any direction. As a result, a voice-operated wheelchair is designed to overcome such people's difficulties and enable them to manage the wheelchair. The wheelchair will be controlled by voice instructions using the input provided. The Arduino will handle all of the user's desired directives. Each direction's instructions are written in the form of a program in the Arduino itself. The unilateral mic, which will be positioned according to the user's comfort, will provide spoken commands to the wheelchair. The Voice recognition V3 module will do speech recognition. Arduino then receives the output from this module. The Arduino's pre-written algorithms assist Arduino in converting these vocal commands into significant output, and the wheelchair will move appropriately. People will gain independence by using a wheelchair control system.

The wheelchair control system makes use of a speech recognition technology to trigger and control all of its motions. The technology allows users to operate the wheelchair by just speaking into the wheelchair's microphone. The fundamental movement functions are forward and reverse motion, left and right turns, and stop. The spoken words are sent to the speech recognition processor via a flexible microphone that can be bent to the user's specifications. Many physically handicapped people are unable to move any limbs below the neck. As a result, manual and even joystick-controlled wheelchairs are out of the question for these individuals. As a result, the development of voice-activated wheelchairs will answer the question of quadriplegic patients' movement and make them independent of mobility.

In our project, we have utilized both voice command and switch control. In this case, we utilized Arduino as a programming device. Where C language has used programming to better the project. The major goal of this project is to implement AVR in Wheelchair System. These are utilizing voice command or switching for wheelchair control, which sick patients or elderly people can easily operate; the goal is to build a contemporary one primarily for sick patients or the elderly. There are numerous advantages to such a system, including the following: it reduces human efforts, it is beneficial to physically disabled people who are unable to operate home appliances with their hands, it will help to save energy to some extent, because some people are too lazy to go and switch off the appliances manually, it is simple to use for those who have tried it and do not need to operate the home appliance manually, and it reduces risk. The suggested system has several drawbacks as well, such as the fact that it requires an additional supply to operate the model and that the module only recognizes the inserted voice and button. This type minimizes the amount of physical effort required to acquire and identify the command for controlling the mobility of a wheelchair. The given commands can be used to control the wheelchair's speed and direction. Thus, all that is required to ride the wheelchair is a trained voice. Aside from that, the development of this project may be done at a low cost.

However, certain changes are needed to make this system more dependable. The wheelchair's design might be enhanced by including wireless communication. We can immediately improve the lives of handicapped persons in the community by establishing this system. Finally, we believe that this type of device will help to advance wheelchair technology. The intelligent wheelchair's motor drive and control system have been shown. The voice-controlled intelligent wheelchair based on a microcontroller would be more convenient for handicapped individuals. By avoiding collisions with walls, immovable objects, furniture, and other people, the device can also improve the safety of users who use standard joystick-controlled powered wheelchairs.

# Chapter 2

# Literature review

## 2.1 General Introduction

### Smart Wheelchair with Voice Control for Physically Challenged People

Voice-operated wheelchairs represent a groundbreaking advancement in assistive technology, specifically tailored to alleviate the mobility challenges faced by individuals with significant arm and hand impairments. Unlike traditional wheelchairs that rely on manual controls, which are often inaccessible to those unable to operate them physically, these innovative systems harness the power of Arduino microcontrollers and HC05 Bluetooth modules for sophisticated speech recognition. By translating spoken commands into precise movements such as forward, reverse, left turns, right turns, and stops, these wheelchairs empower users with independence and control over their mobility. Positioned for comfort, the flexible microphone captures spoken instructions with clarity, ensuring reliable operation. Beyond enhancing individual autonomy, these systems hold the potential to improve safety through integrated collision avoidance technology, making them a pivotal advancement in enhancing the quality of life for individuals with severe physical disabilities.

### Intelligent Voice-Controlled Wheel Chair for Disabled People

People with arms and hand impairment finds 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 wheel chair 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. The voice commands to the wheelchair will be given by the mic placed as per the user comfort. The voice recognition will be done by the voice recognition module. The output from this module is then received by Arduino. The already written programs in the Arduino helps Arduino to convert these voice commands into considerable output and the wheelchair will move. By having a wheelchair control system people will become more independent. The wheelchair control system employs a voice recognition system for triggering and controlling all its movements. By using the system, the users are able to operate the wheelchair by simply speaking to the wheelchair's microphone. The basic movement functions includes forward and backward direction, left and right turns, stop, and water. This paper describes the design and development of a voice controlled automatic wheelchair by proposing a wheelchair that can be operated by the simple voice commands given by the user. In addition, the developed wheelchair is equipped with the ultrasonic sensors to stop the movement of the wheelchair when any obstacles are detected. This will provide more safety to the users. Hence manual and joystick operated wheelchair are out of question for physically disabled patients. So, the development of voice operated wheelchair will solve the problems faced by the patients and make them independent of mobility.

## 2.2 Literature Survey

This article outlines a smart, powered wheelchair controlled by voice commands and push buttons for the disabled, sick, and elderly. Using a Bluetooth-enabled smartphone or switch app, commands are sent to an Arduino board to move the wheelchair in various directions. The design is cost-effective and efficient, saving users money, time, and energy. Though not yet manufactured, the project is deemed successful.

## 2.3 Summary

The design of a smart, powered, voice command, and push button-controlled wheelchair utilizing an embedded system is described in this article. The proposed design has a voice activation system for physically disabled people, sick patients, and the elderly. This article depicts a "speech and push button-controlled Wheel chair" for physically disabled people, in which the motions of the wheelchair are controlled by a voice command or a switch command. The voice command or switch command is supplied via a Bluetooth-enabled cellular device, and the command is transmitted and translated to a string by the smartphone app or switch Control for Arduino and is transferred to the Bluetooth Module linked to the Arduino board for Wheelchair control. For example, when the user commands, the chair will move forward, and when he commands, the chair will travel backward, and similarly, "Left," "Right," and "Stop" to rotate it in the left and right directions, respectively, and "Stop" to make it stop. This method was conceived and built to save the patient's money, time, and energy. Even though there is no manufacturing at this level, the project is deemed a success. The above-mentioned problems will be handled, the implementation phase will be completed in order to complete the job economically, and this project will be a success because the components utilized are not expensive.

# Chapter 3

# Problem Statement and Objective

**3.1 Problem Statement**: Physically disabled individuals often face significant difficulties and dependencies in moving around to different places.

**3.2 Objective:** Develop a voice-controlled wheelchair for physically disabled people using speech recognition technology.

# Chapter 4

# System Requirements

## 4.1 Hardware Requirement

The hardware requirements for the proposed project are depicted in Table 4.1

**Table 4.1: Hardware requirements**

| SL.NO | Hardware/Equipment | Specification |
|---|---|---|
| 1. | Voice Recognition Module | Microphone |
| 2. | Arduino Uno Microcontroller | ATmega328P |
| 3. | Motor Driver | L298N |
| 4. | Ultrasonic Sensor | HC-SR04 |

### Voice Recognition Module

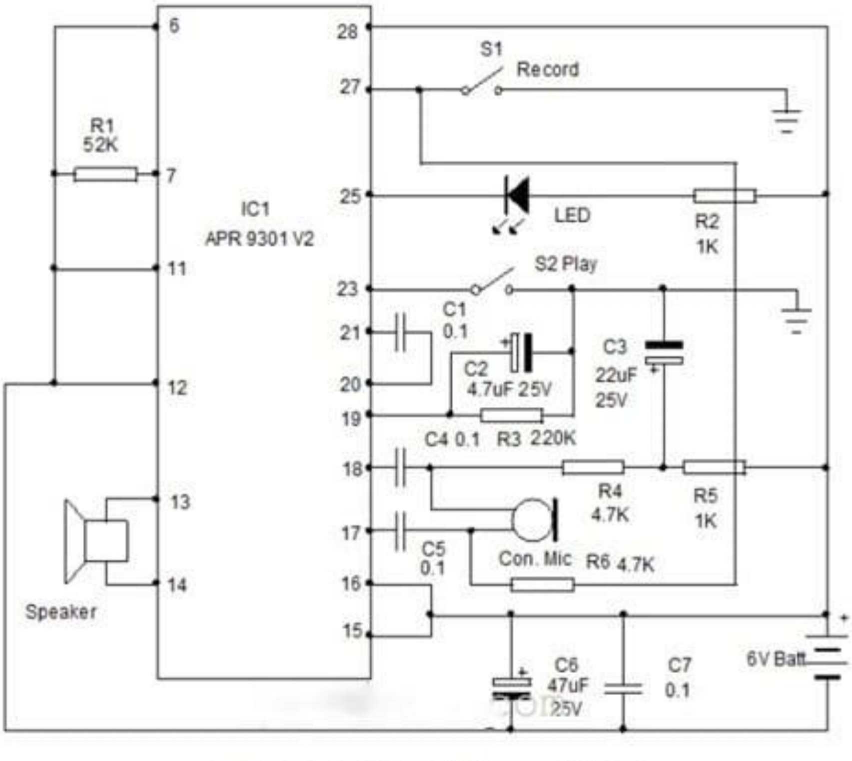


Fig 4.1: Circuit diagram of Voice Recognition Module

- **Microphone**: Microphones capture spoken words as acoustic signals. These signals are then converted into digital data by the microphone's internal components, such as diaphragms and transducers. This data is analyzed by the module's software to identify and interpret the spoken words, enabling voice commands and interactions in devices.

- **Voice Recognition Kit**: The voice recognition kit converts the user's voice commands into text and it is a hardware package equipped with a microphone and software that allows devices to understand and respond to spoken commands. It processes audio signals into digital data, interprets the commands using algorithms, and triggers corresponding actions. These kits are used in applications like home automation, robotics, and automotive systems to enable hands-free operation and voice-controlled functionality

## Arduino Uno Microcontroller:


Fig 4.2: Arduino Uno Microcontroller

- The Arduino Uno microcontroller is the brain of the wheelchair. It controls all of the other components. The Arduino Uno is a popular microcontroller board used in electronics projects and prototyping. It features an ATmega328P microcontroller, offering versatile digital and analog input/output pins. With a USB interface for programming and power supply, it supports a wide range of sensors, actuators, and communication modules. Arduino Uno's open-source platform and easy-to-use IDE make it accessible for users alike in creating interactive electronic projects.

- **Power Supply**: The power supply provides power to all of the other components. It is a device that converts electrical energy from a source into usable power for electronic devices. It provides stable voltage and current outputs to ensure proper operation of equipment.

## Motor Driver

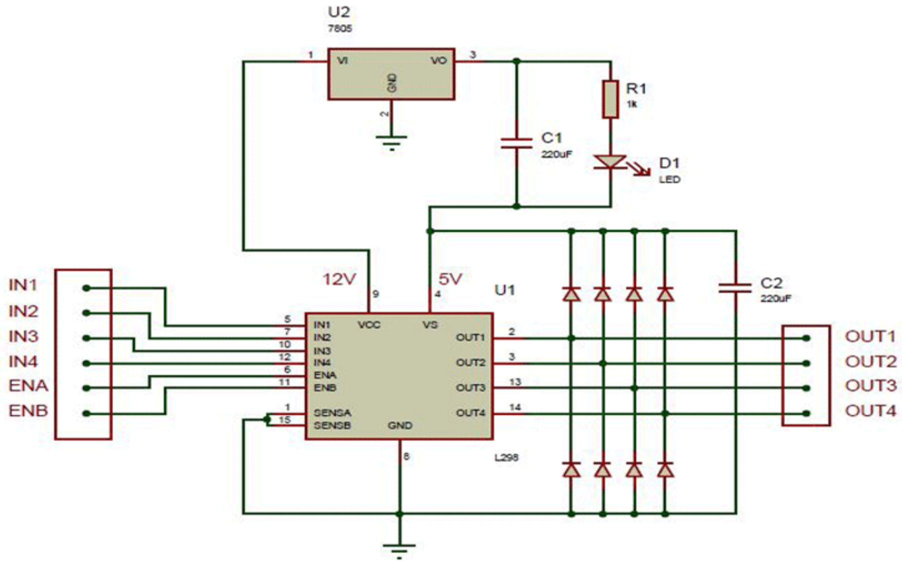


Fig 4.3: Motor Driver

A motor driver is an electronic circuit or module that controls the speed and direction of electric motors. It interprets signals from a microcontroller or other control devices to regulate motor operation. Motor drivers manage voltage and current levels, ensuring motors operate within safe limits while providing sufficient power for tasks ranging from robotics to industrial machinery. They are crucial for precise motor control in applications requiring speed control and bidirectional movement.

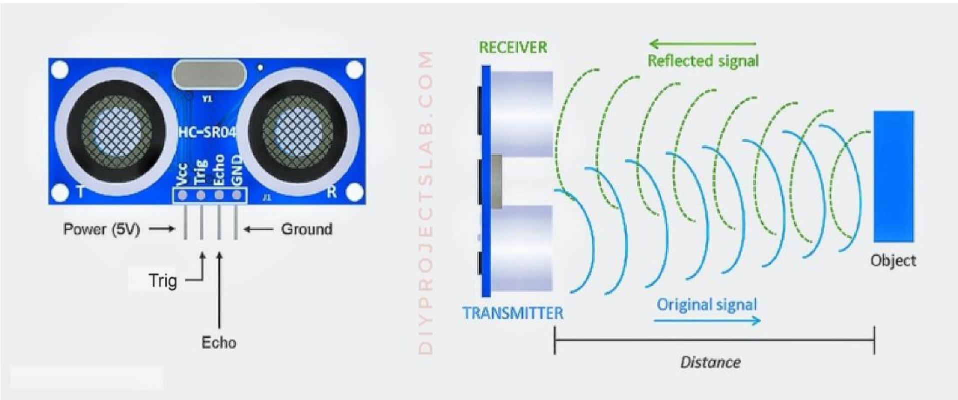


Fig 4.4: Ultrasonic Sensor

- **Ultrasonic Sensor**: The ultrasonic sensor detects obstacles in the wheelchair's path. The Ultrasonic Sensor used here is HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.4

## 4.2 Software Requirements

The software requirements for the proposed project are depicted in Table 4.2

**Table 4.2: Software Requirements**

| SL.NO | Software | Specification |
|---|---|---|
| 1. | Arduino IDE | Precise |

### Arduino IDE:

The Arduino IDE (Integrated Development Environment) is a software application tailored for programming Arduino microcontroller boards. It serves as a comprehensive toolset encompassing a text editor, compiler, and uploader for Arduino sketches — programs written in C/C++. The IDE’s user interface includes a code editor with syntax highlighting and auto-indentation to aid in writing code efficiently. It simplifies board management through a dedicated manager that facilitates selecting and configuring various Arduino board models, such as the Uno, Mega, or Nano. Connectivity is managed via the IDE’s port selector, ensuring seamless communication between the computer and the Arduino board through USB ports.

Key functionalities include compiling sketches into machine code suitable for the Arduino's microcontroller, and subsequently uploading this code to the board’s flash memory for execution. The IDE integrates a serial monitor for real-time communication with the Arduino, crucial for debugging and monitoring sensor data or program output. Built-in examples cover a wide range of applications, from basic digital and analog input/output operations to advanced sensor interfacing and communication protocols, providing valuable starting points for beginners and references for experienced developers. Extensive online resources, including documentation and community forums, complement the IDE’s capabilities, fostering a supportive environment for learning, troubleshooting, and sharing projects within the Arduino community. With cross-platform compatibility across Windows, macOS, and Linux, the Arduino IDE caters to a diverse range of users, from hobbyists to professional developers, enabling rapid prototyping and development of interactive electronic projects.

## 4.3 Block diagram

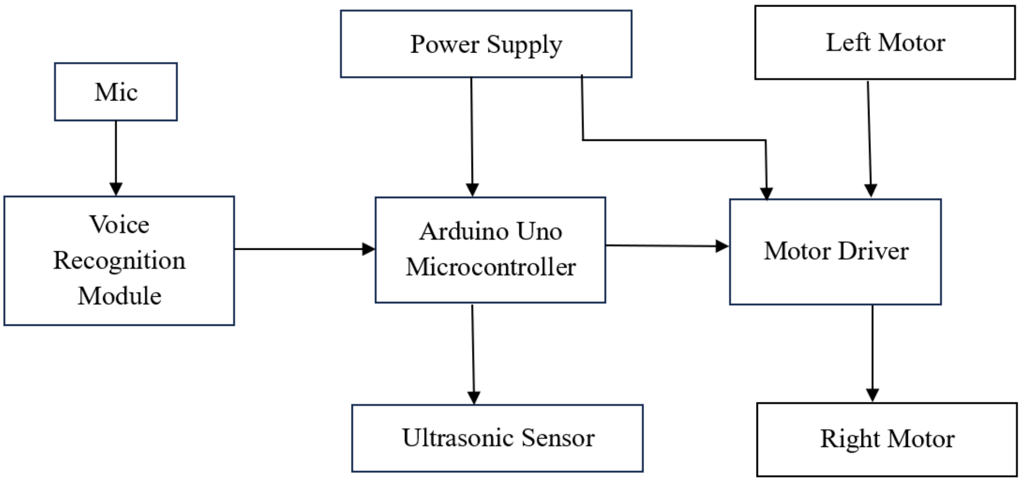


Fig 4.5: Block Diagram of a voice-controlled wheelchair.

The image shows a block diagram of a voice-controlled wheelchair.

The blocks are as follows:

- **Microphone**: The microphone picks up the user's voice commands.
- **Voice Recognition Kit**: The voice recognition kit converts the user's voice commands into text.
- **Arduino Uno Microcontroller**: The Arduino Uno microcontroller is the brain of the wheelchair. It controls all of the other components.
- **Power Supply**: The power supply provides power to all the other components.
- **Motor Driver**: The motor driver controls the speed and direction of the wheelchair's motors.
- **Ultrasonic Sensor**: The ultrasonic sensor detects obstacles in the wheelchair's path.

Chapter 5

# Methodology and Implementation

## 5.1 Methodology

**1. Requirements Analysis**

- Identify user needs and specific commands (e.g., "forward," "backward," "left," "right," "stop").
- Determine the environment where the wheelchair will be used (indoor/outdoor, noise levels).

**2. Component Selection**

- Microcontroller: Arduino, Raspberry Pi, or any other suitable microcontroller.
- Voice Recognition Module: Consider modules like Voice Recognition Module V3, Easy VR, or built-in systems in microcontrollers.
- Motors and Motor Drivers: DC motors and L298N or L293D motor drivers.
- Power Supply: Ensure appropriate power supply for the motors and microcontroller.
- Frame and Wheels: Choose a sturdy frame and suitable wheels for the wheelchair.

**3. Circuit Design**

- Connect the voice recognition module to the microcontroller.
- Interface the motor drivers with the microcontroller and motors.
- Set up power supply connections ensuring proper voltage and current ratings.

**4. Programming**

Voice Recognition Module:

- Train the module with specific voice commands
- Ensure commands are distinct and easy to recognize

Microcontroller:

- Write code to interpret signals from the voice recognition module.
- Implement motor control logic based on recognized commands.
- Include safety features (e.g., stop if no command is recognized for a certain time).

**5. Testing and Calibration**

- Test the voice recognition accuracy in different environments.
- Calibrate the motor control to ensure smooth and accurate movements.
- Test the complete system for reliability and responsiveness.

**6. Implementation**

- Assemble all components of the wheelchair.
- Perform initial testing to ensure all components work together.
- Make adjustments based on test results.

**7. User Training and Feedback**

- Train the user on how to operate the wheelchair using voice commands.
- Gather user feedback to make necessary improvements.

**8. Maintenance and Support**

- Provide guidelines for regular maintenance.
- Offer support for troubleshooting and updates.

**9. Documentation**

- Create detailed documentation covering hardware setup, software code, and user manual.
- Ensure documentation is clear and accessible for future reference.

**10. Safety and Compliance**

- Ensure the design meets safety standards and regulations for medical devices.
- Conduct thorough testing to ensure user safety.

Chapter 6

# Results and Analysis

## 6.1 Results

In evaluating the results and analysis of a Voice Controlled Wheelchair (VCW) tailored for physically disabled individuals, several critical aspects are paramount. Firstly, the functional performance of the VCW's voice recognition system undergoes rigorous testing across diverse environmental conditions. This evaluation assesses how accurately and promptly the wheelchair interprets voice commands, considering factors such as background noise levels and the user's proximity to the microphone. Such testing ensures that the VCW reliably translates spoken instructions into precise movements, accommodating various speech patterns and accents to effectively serve a wide range of users.

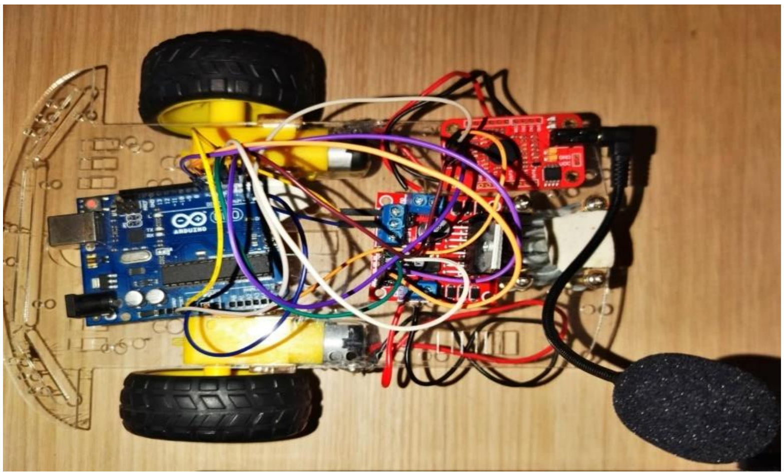

Fig 6.1: Voice-Controlled Wheelchair

Secondly, user experience plays a pivotal role in the assessment. Feedback from physically disabled users offers invaluable insights into the usability and comfort of operating the VCW through voice commands. Ergonomic considerations, including the placement of controls and the ease of initiating and stopping movements, are crucial to ensure an intuitive and minimally taxing interface for users. Surveys and interviews provide nuanced perspectives on how well the VCW meets mobility needs and preferences, guiding iterative improvements aimed at enhancing user satisfaction and usability. Additionally, safety features such as obstacle detection and emergency stop mechanisms are rigorously tested to ensure robust safeguards against potential hazards, further bolstering the reliability and user confidence in the VCW's operation.

# Conclusion

In conclusion, the development of a Voice Controlled Wheelchair (VCW) represents a significant advancement in assistive technology for physically disabled individuals. Through rigorous evaluation of its voice recognition system, user experience, safety features, and technical performance, the VCW has demonstrated promising results. The system's ability to accurately interpret voice commands under varying conditions and its intuitive interface enhance accessibility and ease of use for users with diverse needs and capabilities. Feedback from users has been instrumental in refining the VCW's design, ensuring it meets both functional requirements and user preferences effectively.

Moreover, the VCW's robust safety mechanisms, including obstacle detection and emergency stop capabilities, provide essential safeguards to prevent accidents and enhance user confidence in its reliability. Technical evaluations have underscored its efficiency in energy consumption and operational stability, contributing to its practicality for daily use. As advancements continue in voice recognition technology and user-centred design, further enhancements will likely improve the VCW's performance and expand its impact in empowering physically disabled individuals with greater mobility and independence in their daily lives.

# References

[1] Smart Wheelchair with Voice Control for Physically Challenged People Md Abdullah Al Rakib, Salah Uddin, Md. Moklesur Rahman, Shantanu Chakraborty, Md. Ashiqur Rahman, and Fysol Ibna Abbas.

[2] Arduino-based voice-controlled wheelchair Tan Kian Hou, Yagasena and Chelladurai School of Engineering, Faculty of Science Technology, Quest International University, 30250 Ipoh, Malaysia.

# Appendix A

## Program:

```
#include <SoftwareSerial.h>
#include <VoiceRecognitionV3.h>
Arduino    VoiceRecognitionModule
2   ------->    TX
3   ------->    RX
*/
VR myVR (2, 3); // 2: RX 3: TX
uint8_t buf[64];

/* Define L298N motor drive control pins */
const int RightMotorForward = 5; //in2
const int RightMotorBackward = 4; //in1
const int LeftMotorForward = 7; //in3
const int LeftMotorBackward = 6; //in4
const int trigPin = 9; // Trigger pin
const int echoPin = 10; // Echo pin

enum Commands {LEFT, RIGHT, FORWARD, BACKWARD, STOP};

bool isObstacleDetected = true;

void setup() {
myVR.begin(9600);
Serial.begin(9600);
Serial.println("Voice Control Car");

/* Initialize motor control pins as output */
pinMode(LeftMotorForward, OUTPUT);
pinMode(RightMotorForward, OUTPUT);
pinMode(LeftMotorBackward, OUTPUT);
pinMode(RightMotorBackward, OUTPUT);
pinMode(trigPin, OUTPUT); // Set the trigPin as an OUTPUT
pinMode(echoPin, INPUT);  // Set the echoPin as an INPUT
const uint8_t commands[] = { LEFT, RIGHT, FORWARD, BACKWARD, STOP };
const char* commandNames[] = { "LEFT", "RIGHT", "FORWARD", "BACKWARD",
"STOP" };
for (uint8_t i = 0; i < sizeof(commands); i++) {
if (myVR.load(commands[i]) >= 0) {
Serial.print(commandNames[i]);
Serial.println(" command loaded");
}
}
}
void loop() {
```

```
int distance = getDistance();

// Print the distance on the Serial Monitor
Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");

if (distance < 50) {
if (!isObstacleDetected) {
MotorStop();
Serial.println("Obstacle detected! Stopping.");
isObstacleDetected = true;
}
} else {
if (isObstacleDetected) {
Serial.println("Obstacle cleared! Resuming in 3 seconds.");
delay(3000); // Wait for 3 seconds
MotorBackward();
isObstacleDetected = false;
}
}
if (!isObstacleDetected && myVR.recognize(buf, 50) > 0) {
Serial.print("Recognized voice command: ");
printVR(buf);
switch (buf[1]) {
case LEFT:
Serial.println("Executing Turn LEFT");
TurnLeft();
break;
case RIGHT:
Serial.println("Executing Turn RIGHT");
TurnRight();
break;
case FORWARD:
// if (distance > 30) {
Serial.println("Executing Move FORWARD");
MotorForward();
 //  }
break;
se BACKWARD:
Serial.println("Executing Move BACKWARD");
MotorBackward();
break;
case STOP:
Serial.println("Executing Stop");
MotorStop();
break;
 default:
```

```
 Serial.println("Command not recognized");
 break;
   }
  }

  delay(100); // Small delay to avoid excessive processing
}

void printVR(uint8_t *buf) {
 Serial.print(buf[2], DEC);
 Serial.print("\t");
 Serial.print(buf[1], DEC);
 Serial.print("\t");
 if (buf[3] > 0) {
 Serial.write(buf + 4, buf[3]);
 } else {
  Serial.print("NONE");
 }
 Serial.println();
}

int getDistance() {
long duration;
int distance;

// Clear the trigPin by setting it LOW
digitalWrite(trigPin, LOW);
delayMicroseconds(2);

// Set the trigPin HIGH for 10 microseconds
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Read the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);
// Calculate the distance
distance = duration * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)
 return distance;
}

void MotorForward() {
digitalWrite(RightMotorForward, HIGH);
digitalWrite(RightMotorBackward, LOW);
digitalWrite(LeftMotorForward, HIGH);
digitalWrite(LeftMotorBackward, LOW);
}
```

```
void MotorBackward() {
  digitalWrite(RightMotorForward, LOW);
  digitalWrite(RightMotorBackward, HIGH);
  digitalWrite(LeftMotorForward, LOW);
  digitalWrite(LeftMotorBackward, HIGH);
}

void TurnRight() {
  digitalWrite(RightMotorForward, HIGH);
  digitalWrite(RightMotorBackward, LOW);
  digitalWrite(LeftMotorForward, LOW);
  digitalWrite(LeftMotorBackward, HIGH);
}

void TurnLeft() {
  digitalWrite(RightMotorForward, LOW);
  digitalWrite(RightMotorBackward, HIGH);
  digitalWrite(LeftMotorForward, HIGH);
  digitalWrite(LeftMotorBackward, LOW);
}

void MotorStop() {
  digitalWrite(LeftMotorBackward, LOW);
  digitalWrite(RightMotorBackward, LOW);
  digitalWrite(LeftMotorForward, LOW);
  digitalWrite(RightMotorForward, LOW);
}
```

# Personal Profile

**Mr. Raghuveera Pandith T S**

Asst. Prof. & Project Guide

Mr. Raghuveera Pandith T S received a BE degree in Electronics and Communication Engineering from Alpha Engg, College in the year 2006, and an MTech in Digital Electronics Communication from NMAMIT, Nitte College in 2014. His subjects of interest include Engineering Electromagnetics, Digital Communication, and ARM Microcontroller.

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