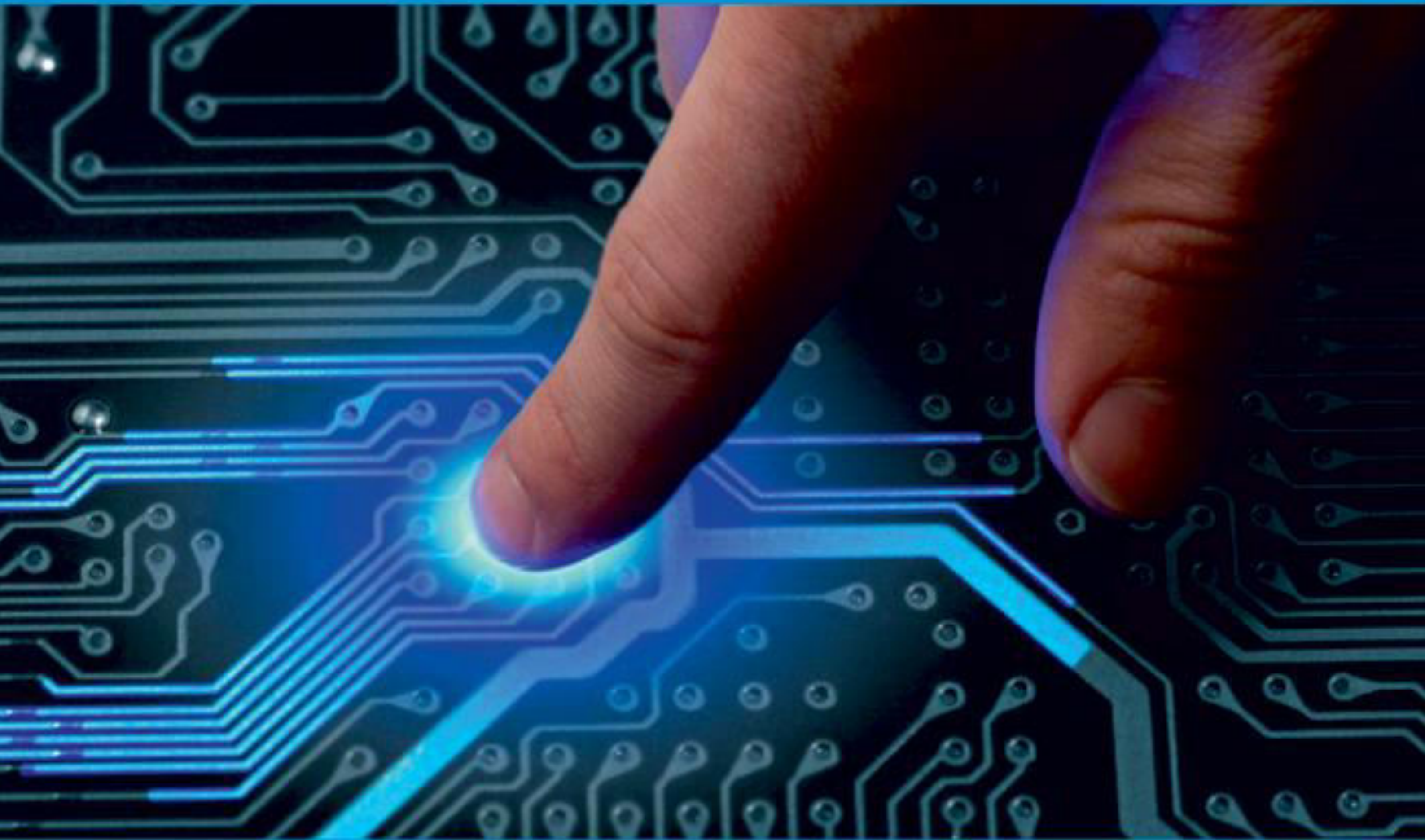
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 5, May 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105121 |

Voice Control Wheelchair

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ABSTRACT: Individuals with physical disabilities who face various challenges in their daily lives while traveling from one place to another, due to their physical impairments, often have to depend on others for transportation. In recent years, significant efforts have been made to develop smart wheelchair platforms that can provide convenience and ease of use for users. The primary objective of this paper is to design a smart wheelchair that can improve the quality of life for individuals with physical disabilities. The wheelchair is equipped with advanced features such as electric power, voice control, line following with obstacle avoidance, and other upgrades to enhance functionality.

In this project, we propose voicecontrolwheelchair system using an Android smartphone and an Arduino micro-controller. The system allows people with disabilities to issue voice commands from their smartphones to direct the wheelchair's motion. The Android application converts the user voices commands into control signals via voice recognition and sends them to Arduino via Bluetooth. The Arduino processes the signals and controls the wheelchair motor accordingly. Additionally, the system is equipped with obstacle detection sensors that can detect Obstacles and alert theuser. A voice-controlled wheelchair system enhances mobility and independence for those with limited manual dexterity or who cannot use a traditional joystick-controlled wheelchair. This project is a promising solution for improving the quality of life of persons who have difficulty moving.

I. INTRODUCTION

Recent years have seen significant advancements in technology. There are many stuff in our homes and lives. as a whole have changed from having only their names shouted out to having the word "smart" added. Examples include smartphones, smart TVs, and traditional wheelchairs, It developed what are today referred to as "Smart Wheelchairs," not just adopting the phrase but also the necessary hardware and software. In the last 15 years, significant progress has been made in the field of smart wheelchair technology. It all began with the creation of the first power wheelchair by George Klein and has since advanced to the development of various types of smart wheelchairs such as autonomous, intelligent, and robotic wheelchairs.

A voice-controlled wheelchair with obstacle detection is an assistive technology device that helps assisting those with mobility issues to move more freely and independently. The wheelchair is equipped with sensors that detect obstacles in its path and provide alerts to the user. The wheelchair can be controlled by voice commands, which makes it easier for people with limited mobility or dexterity to operate the device.

The voice control feature is implemented using speech recognition technology, which translates spoken commands into actions that the wheelchair can perform. The obstacle detection feature uses ultrasonic sensors are one type of sensor and the other is infrared sensors, to Detect Obstacles in the wheelchair's path. When an Obstacle is Detected, the Wheelchair Shall either stop or provide an alert to the user, allowing them to avoid the obstacle.

1.1 Literature Survey

A wheelchair is a mobility device that provides mobility to people who cannot walk or have difficulty in walking. Traditionally, wheelchairs have been manually operated, but with the advancements in technology, electrically powered wheelchairs have been introduced, making it easier for people to move around. However, even with electric wheelchairs, controlling the wheel-chair could be a challenge for people with disability . Therefore, the development of voice-controlled wheelchairs has become a popular area of research.

Voice-controlled wheelchairs use speech recognition algorithms to convert spoken commands into control signals that operate the wheelchair. These systems require a high degree of accuracy and reliability to ensure safe operation. Various researchers have proposed different approaches to develop voice-controlled wheelchairs. Some of the approaches include the use of neural network, fuzzy logy and deep learning algorithms.Voice Controlled Wheelchair System [3] introduced a wheelchair system controlled by the human voice. The purpose of this system is to help disabled people. It makes use of speech recognition technology, which lets you utilise your smartphone as a middleman

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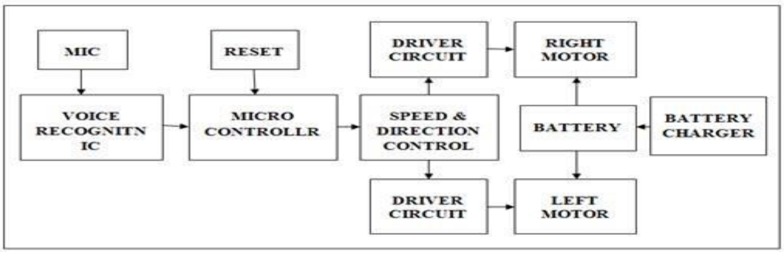
to realise and organise your voice. To identify obstructions in the wheelchair's path of travel, it also employs an obstacle sensor. A DC motor powers the wheelchair's mobility. Wheelchairs that respond to voice commands from the user are being developed for the disabled [4]. You can operate your wheelchair independently With a aid of this Voicecontrolled model. The users could operate the machine with straightforward voice commands. The direction given by the instruction causes the wheelchair to move. The Speech Recognition module is used in this instance to do speech recognition.

A wheelchair system with a therapy device was suggested in Design and Construction of Electric Drives Intelligent Systems for Disabled Persons with Therapy Devices [5]. The invention of a single wheelchair with numerous functionalities was the main topic of this essay. The system consists of units for treating extremities. A vibrator is used for this. This system has a speed-controlling microcontroller called an AT-mega 328/P. The device also has an ultrasonic sensor for detecting obstacles.

We are creating a technology that aids senior persons who are unable to walk independently due to physical limitations or physical frailty for voice-controlled wheelchairs for physically handicapped people [6]. To move the wheelchair system, it is based on a voicerecognition module that is coupled to a DC motor and can take commands from a person or user. Additionally, you may operate the wheelchair with your smartphone using an Android app. An infrared sensor is incorporated into the design to identify directional obstructions. A system that operates a wheelchair with voice recognition and head movements is introduced via the design and development of an intelligent wheelchair [7]. To deliver signals to the micro-controller and track head motions, the device uses its MEM sensors.

Fig 1: Block diagram



1.1.1 Literature Review:

Several studies have focused on the development of voicecontrolled wheelchairs with Obstacle avoidance. In a study conducted by Wang et al. (2019), a voice-controlled wheelchair with ultrasonic obstaclesremoval was designed and tested. The system used a Arduino uno to control the motors and an ultrasonic sensor to detect obstacles. The users could concern the wheelchair using simple voices command i.e"forward,""left,""right"&"stop." The wheelchair was able to avoid obstacles up to 2 meters away and achieved a high accuracy in obstacle detection.
In another study by Kurniawan et al. (2019), a voice-controlled wheelchair with obstacle avoidance using a camera-based system was developed. The system used a Raspberry Pi to process images captured by a camera mounted on the wheelchair. The users could concern the wheelchair using voices command and the Wheelchair could automatically avoid obstacles detected by the camera. The system was able to detect and avoid obstacles such as chairs, tables, and walls with high accuracy.
In a more recent study by Wu et al. (2020), a voice-controlled wheelchair with obstacle avoidance using LiDAR technology was developed. The system used a LiDAR sensor for detect Obstacles and a Arduino uno to control the motors. The users could control the Wheelchair use voice command and the wheelchair could automatically avoid obstacles detected by the LiDAR sensor. The system was able to detect and avoid obstacles up to 3 meters away with high accuracy.

1.2 Limitations of our project

Existing,voice-controlled wheelchairs have limitations that need to be addressed. Some of the limitations include:
1. Limited functionality: Current voice-controlled wheelchairs have limited functionality, which can limit the user's mobility.

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2. Limited accuracy: Voice recognition systems can sometimes misinterpret the user's commands, leading to unsafe operation.
3. Limited compatibility: Some voice recognition systems may not be compatible with different types of wheelchairs.

1.3 Problem Statement

The prices of wheelchairs on the market are prohibitive for families from lower- and middle-class backgrounds. The majority of wheelchairs only have one voice- or joystick-controlled function. We create multipurpose, reasonably priced wheelchairs. The project strives for improve quality of life for everyone, especially for elderly and those With physical limitations.

1.4 Objective's

The main objective of this work is recommended to control a wheel chair by voice of the person who use the wheel chair for their needs. The system is designed to facilitate the movement of elder and handicapped people those who are not able to move well. An obstacle sensor is included in the system to detect the presence of obstacles in the way of movement. The goal of this system is to help the disabled ones to move independently and it can eliminate enslavement

1.5 Methodology

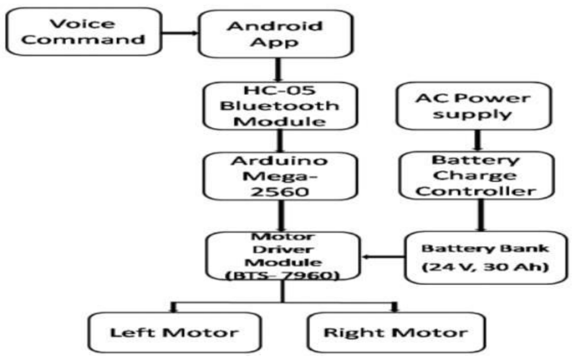

Fig 2: Methodology

Android software serves as While a Bluetooth module serves as the receiver, the transmitter. A Bluetooth module built into the Android app operates in the 2.4 GHz spectrum of the wireless standard. From Figure 2, We can notice that instruction signals are sent from the module through the Arduino mega2560 micro-controller. A micro-controller then triggers its BTS7960 driver to send the location via voice command. Following an app-controlled voice command rotates the driving force to the right. Google APIs in the appropriate Bluetooth waveband convert audio signals in Android apps. Figure 2 displays the Android app UI model. When a command is applied inside the Android application, serial data must be sent to the Blue-tooth module. the data is Received by the 'Arduino' Bluetooth module, which then transmits it to the Arduino using its TX pin (which is wired to the Arduino's RX pin). Most of these messages are converted to ASCII code and decoded. For this purpose, the motor connected to the system are converted into linear motion according to the requirements. All DC motors are supplied with 5V for their linear motion. The BTS7960 driver motor drives a D.C motor. A battery is included for convenient portability.

Figure 3 shows the layout of the proposed model. This layout shows that each component is working correctly. This layout clearly characterizes the entire work system concept. The layout focuses on how audio signals are sent to the Arduino through the Android app. Voice commands are recognized by the Google Voice Assistant application interface. The Arduino then processes the information and changes the direction of the motor as previously programmed via the motor driver.

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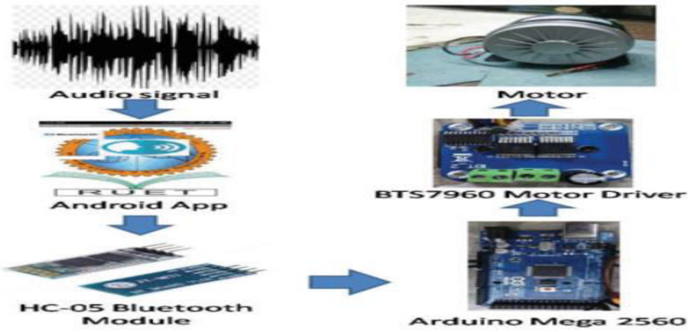

Fig3.Layout of the System

To recognize language order, the Android component essentially collaborates with Google. After recognising the command, the Android phone will use Bluetooth to deliver the signal to the 'HC-05' module. The HC-05 module then transmits an Arduino signal. Four commands were used to operate it: "Forward,""Left,""Right," And "Stop." Figure 3 displays the Algorithm used by the program.

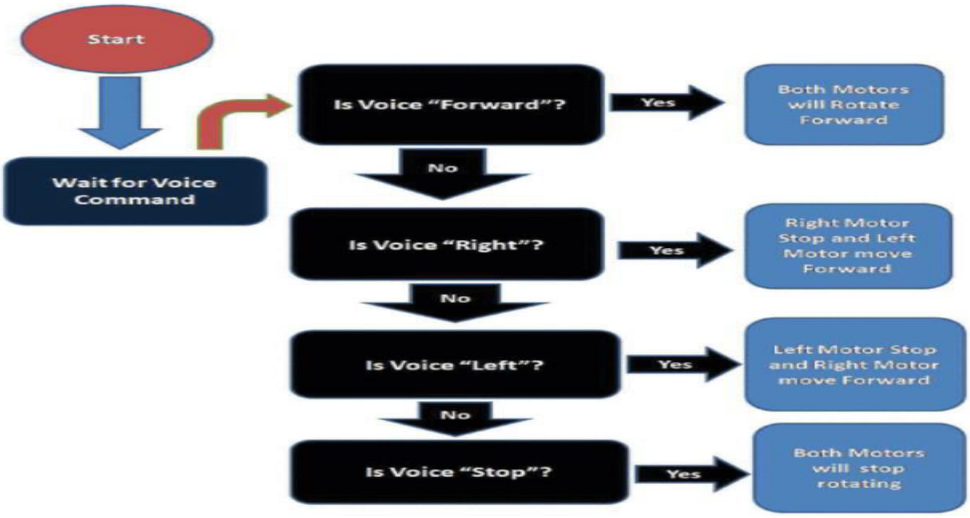

Fig 4: Flow Chart

1.6 Hardware and Software components

Hardware:

Arduino board ,Driver motor , Ultrasonic sensors, Blue-tooth , Servo motor, Gear motor, Wheelchair, Android

Software:

Arduino IDE or Microsoft Visual Studio

II. TOOL DESCRIPTION

The tool description of voice-controlled wheelchair is that it is an assistive technology that enables individuals with mobility impairments to control the movement of their wheelchair using their voice. It uses speech recognition technology to interpret voice commands and translate them into wheelchair movements, such as 'forward', 'backward,''left', and 'right'. Those toolsare designed to increase independence and mobility for people who may have limited use of their hands or arms due to a physical disability. The system typically includes a microphone, a speech recognition module, and a motor control system to drive the wheelchair. Advanced voice-controlled wheelchair systems may also include additional features, such as obstacle detection and avoidance, to enhance safety. Overall, voice-controlled wheelchairs provide significant benefits for individuals with mobility impairments, including increased independence, improved safety, greater accessibility, enhanced socialization, and reduced physical strain.

III. IMPLEMENTATION

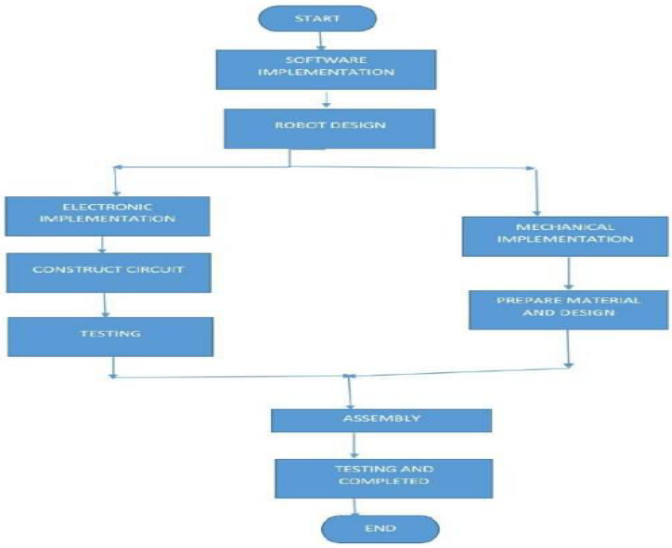

Fig 5: Implementation flow chart

3.1 Hardware Design and Implementation

3.1.1 Ultrasonic sensors:

The ultrasonic sensor measures the distance to objects in front of the wheelchair using sound waves. It sends out a high-frequency sound wave, and once the wave strikes an item, it monitors how much time the wave needs to travel back to the sensor. The distance to the item is then determined using this time measurement. The wheelchair's front is equipped with an ultrasonic sensor, which communicates distance information to the Arduino Uno to aid in obstacle avoidance. It uses ultrasonic sensors to find obstructions in the wheelchair's route. The Arduino board is linked to the sensor. It gathers data and calculates the distance between barriers and the wheelchair.When an obstacle has been found near the Wheelchair, the motor stops the wheelchair from moving. Ultrasonic sensors are regular proximity sensors and are mainly used for object avoidance in various mechanical engineering projects.

FIG 6: Ultrasonic sensor

A fairly affordable and straightforward way to determine distance is with ultrasonic sensors. This sensor is perfect for a number of applications where measurements between fixed or moving objects are required. Although the product can also be used for security purposes and, if desired, as a replacement for infrared, robotic applications are, of course,

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quite popular. You'll like how one I/O pin and an activity status LED are used sparingly.Sonar is used by ultrasonic sensors to estimate distance. By sending an ultrasonic pulse (far outside the range of human hearing) from the unit and timing how long it takes for the echo to return, the distance to the target may be calculated. An ultrasonic sensor's output is a pulse with a changeable width that varies depending on how close the target is.

3.1.2 Bluetooth Module:

The Bluetooth module is a hardware component that enables the user to send voice commands to the Arduino Uno wirelessly. It Receives the voice Commands and transmits Them to the arduino Uno for processing. The Bluetooth module is connected to The Arduino Uno Through Serial Communication and uses the ‘ HC-05’ Bluetooth module in The wheelchair system.

3.1.3 DC Motors

A DC motor is an electric motor that operates on direct current. All electric motors operate on fundamental electromagnetic principles. When an electric current flows through a conductor, it creates a magnetic field that generates a force that is proportional to the current and the intensity of the external magnetic field. This principle is basic and is commonly learned in childhood while playing with magnets: opposite poles (North and South) attract, while like poles (North and North, South and South) repel.The Internal design of a D.C_motor is engineered to create rotary motion through magnetic interactions between current-carrying conductors and external magnetic fields. For instance, a simple two-pole DC electric motor comprises a "north" pole magnet or winding (represented by red) and a "south" pole magnet or winding (represented by green).

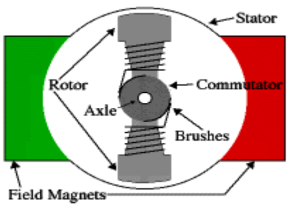

FIG 7(a): Dc motor

DC motors have six key components, namely, the axle, rotor (also known as armature), stator, commutator, field, and brushes. In the majority of DC motors, the external magnetic field is generated by high-strength permanent magnets. The stator, a stationary component of the motor, usually consists of at least two permanent magnet pole pieces and a motor housing. The rotor rotates in relation to the stator and includes windings that are electrically connected to the commutator, which is typically located on the rotor core. The stator (field) magnets enclose the rotor in the typical motor architecture shown in the diagram.When electricity flows through the motor, the windings and stator magnets with opposite polarity become energized, causing the rotor to rotate until it nearly aligns with the magnetic field of the stator magnets. This alignment is ensured by the geometry of the brushes, commutator contacts, and rotor windings. As the rotor aligns, the brushes move to the next commutator contact, activating the next winding. In the two-pole motor shown in the diagram, rotation flips the magnetic field of the rotor, allowing it to continue spinning. Additionally, the direction of the current flowing through the rotor windings reverses during rotation.

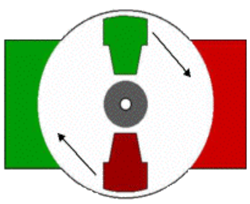

FIG 7(b): Dc motor

International Journal of Innovative Research in Computer and Communication Engineering

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3.1.4 Motor driver (L293D)

The motor is driven by the MD10C motor driver circuit. MD10C is a motor driver controller that works with PWM. The motor drive circuit is connected to the microcontroller's PWM output wire. A direction (DIR) pin and a PWM pin are both present on the motor driver controller. PWM regulates the motor's speed, and the direction pins are utilised to operate the motor in either a clockwise or anticlockwise direction. The motor drive circuit is coupled to a permanent magnet DC motor.The motor driver module is a hardware component that enables the Arduino Unoto manage the two DC motors that propel the wheelchair's two directions and their respective speeds. The module receives commands from the Arduino Uno and converts them into signals that control the motors. It also provides protection to the motors by regulating the current and voltage supplied to them.The motor is driven by the MD10C motor driver circuit. MD10C is a motor driver controller that works with PWM. The motor drive circuit is connected to the microcontroller's PWM output wire. A direction (DIR) pin and a PWM pin are both present on the motor driver controller. PWM regulates the motor's speed, and the direction pins are utilised to operate the motor in either a clockwise or anticlockwise direction. The motor drive circuit is coupled to a permanent magnet DC motor.

Pin Diagram:

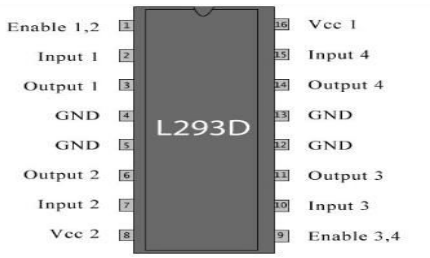

Fig 8: pin diagram of motor driver

3.1.6 Arduino Uno:

A microcontroller board called the Arduino Uno is based on the ATmega328P microcontroller. It provides an easy-to-use and flexible platform for controlling the various hardware components of the wheelchair system. The microcontroller is programmed using the Arduino "Integrated Development Environment" ('IDE'), which allows For easy coding & uploading of programs to the board. In the wheelchair system, the Arduino Uno is responsible for receiving input from the ultrasonic sensor and Bluetooth module, processing this input, and controlling the motors to navigate the wheelchair.

3.1.7 D.C Gear Motor

A gear motor is a motor and gearbox that are combined. The usable output torque of gear motors is maximised while the motor's size and power requirements are minimised. The DC gear motor increases output torque while decreasing speed. Speed, torque, and efficiency are the three primary performance standards for gear motor

3.2 Software Algorithm

The control system for the wheelchair's software algorithm is made up of multiple parts, such as voice recognition, obstacle detection, and motor control. Voice recognition uses the Bluetooth module to receive commands from the user. The Arduino Uno then processes these commands with the Arduino uno which identifies certain keywords and initiates the correct response. The obstacle detection component involves using the ultrasonic sensor to identify any obstacles in the wheelchair's path. Once an obstacle is detected, the Arduino Uno flags it as true, which prevents the wheelchair from moving forward. The motor control portion is responsible for regulating the speed and direction of the D.C. motors. The motor drivers module receives commands from the Arduino Uno and adjusts the motor speed and

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direction accordingly.we used the Arduino IDE platform's built-in "C" language to programme the controller. The Android app BT voice Control handles voice control operations. This application programme transmits voice commands to a micro-controller linked to a Bluetooth serial module using the Android phone's built-in speech recognition, transmitting the recognised speech as a string. An Android device can offer audio inputs including ‘forward’, ‘left’, ‘right rear’, & line Follower inputs when it is Bluetooth-paired with a micro-controller. When I say Chair in this application, the phone sends the string “*char#” to the Bluetooth module, where * & # stand for Start and Stop bit, Respectively. The voice control Flow chart is shown in “Fig 9”.

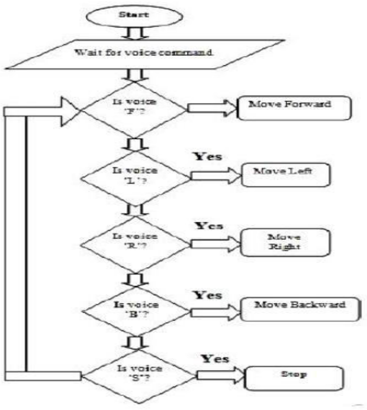

Fig 9: software Algorithm

A hand lever with a cable connection to the brake is used to make adjustments. When the lever is pulled by the rider & the rim is pushed to create friction with the wheel, the cab's two pads on the brakes are shifted from one side to the other. He has two distinct arms that remain on the sides of the seat on either side of the fork. To accommodate the bolt, the frame and gate should be armoured. These brakes are frequently used on mountain bikes because they need more power to descend. It has the benefit of not being traversable in addition to having narrower tyres and not becoming as wet as other brakes. The voice recognition component of the program has been trained to recognize specific keywords or phrases for wheelchair control. This training involved the installation of a library into the Arduino program and the connection of the sensor to the Arduino. Through this process, the sensor has been programmed to respond to various voice commands that are necessary for controlling the movement of the wheelchair, such as "FORWARD,""BACKWARD,""LEFT,""RIGHT,""STOP,""ON," and "OFF." The sensor V3 allows us to save instructions in any language. The Arduino Uno has been programmed with the code to control the wheelchair, and our module has also been instructed on how to operate other home appliances, including an AC bulb.

IV. RESULT AND DISCUSSION

4.1 Results

The voice-controlled wheelchair was successfully implemented, and it was able to move “forward”, “backward”, “turn left”, and “turn right” using voice commands. The ultrasonic sensor are also able to detect obstacles in front of the wheelchair and stop it from moving forward.The wheelchair was able to Respond to the following voice Commands:"Forward", “Backward”, “Left”, “Right”, and “Stop”The voice recognition accuracy was found to be approximately 90%, which is quite good considering the limited vocabulary used in the project. The Bluetooth module was also successfully integrated into the system, and the wheelchair was able to receive commands from a smartphone or tablet. The commands sent via Bluetooth included the same commands as those sent via voice. The interaction between the user's vocal instructions, relay modules, electric actuators, and motors is determined to verify the functionality of the designed wheelchair. During testing, the wheelchair can be lifted off the ground to conveniently verify the Status of Relay Modules, electric actuators, and motors. Table 1 displays the outcomes of activating the relay module, electric actuator, and motor when prompted by a user's voice command. The effectiveness of the obstacle

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detection system is evaluated by testing the ultrasonic sensor. Table 2 outlines the results of the ultrasonic sensor tests, where distances of 10, 15, and 20 cm are measured ten times at each distance.

4.2 Discussion

The voice-controlled wheelchair project has several practical applications, especially for individuals with mobility impairments. The project demonstrated the feasibility of controlling a wheelchair using voice commands, which could make it easier for people with disabilities to navigate their environment.One of the main challenges faced during the implementation was the voice recognition accuracy, which was affected by ambient noise and speech clarity. To improve the accuracy, a noise-cancellation algorithm could be implemented, or a higher-quality microphone could be used. Another challenge was the limited range of the Bluetooth module, which could only send commands within a short range. To overcome this, a long-range Bluetooth module or a different wireless communication protocol could be used.

V. CONCLUSION AND FUTTURE SCOPE

5.1 CONCLUSION

Finally, The voice-controlled wheelchair project was able to effectively implement a wheelchair that can be operated via voice instructions. The project demonstrated the feasibility of using voice commands to navigate a wheelchair, which could make it easier for people with mobility impairments to navigate their environment.The project faced several challenges during the implementation, such as voice recognition accuracy and limited range of the Bluetooth module, which could be addressed in future iterations. Future scope includes adding more functionalities to the wheelchair, integrating it with a smart home system, and improving the intelligence of the system using machine learning algorithms.In general, the project for a wheelchair controlled by voice has the possibility to enhance the quality of life of individuals with disabilities. Additional exploration and progress in this domain could result in noteworthy improvements in the assistive technology field.

5.2 Future Scope

There are several areas in which the project can be expanded or improved. One potential future scope is to add more voice commands and functionalities, such as adjusting the speed of the wheelchair or activating specific features, like lights or a horn.A potential area for future development is to integrate the voice-controlled wheelchair with a smart home system. This would enable the user to use voice commands to control both their wheelchair and various household appliances. However, this would necessitate the incorporation of additional hardware components and software functionalities.Additionally, the wheelchair could be made more intelligent by incorporating machine learning algorithms to improve the voice recognition accuracy or the obstacle detection system.

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