CHAPTER 1

INTRODUCTION

1.1 ASSISTIVE DEVICES

The need for an assistive devices is to help people with disabilities to perform tasks that might otherwise be challenging or impossible. Assistive devices empower individuals with disabilities to live more independently by enabling them to perform everyday tasks without relying solely on others for assistance. Assistive devices make various environments, such as workplaces, schools, and public spaces, more accessible for people with disabilities, promoting inclusivity and equal opportunities. The assistive devices commonly used are Mobility aids like wheel chair,Walkers and Rollators ,canes and the assistive Technology for vision like screen Reader and assistive hearing technology like hearing aids and Cochlear Implants.Low cost data processing chips and computers have made it possible to produce economically viable systems that provide various facilities and opportunities to the handicapped to lead meaningful lives. Engineers now design and manufacture listening devices for the hearing impaired , seeing aids for the visually impaired and artificial limbs and joints to assist people with locomotive disabilities .The design of such aids and devices at low cost is essential because most of the handicapped are financially challenged individuals.

Assistive devices serve multifaceted objectives, aiming to empower individuals with disabilities and promote inclusivity and accessibility across various facets of life. Beyond enhancing the independence and improving quality of life, these devices play a crucial role in rehabilitation and recovery processes, aiding individuals in regaining lost functions and facilitating their journey toward optimal health and independence. Furthermore, assistive devices empower caregivers by providing tools to better support their loved ones, reducing caregiver stress and enhancing efficiency in caregiving tasks. They also foster innovation and collaboration, driving advancements in assistive technology and inspiring new solutions to address the evolving needs and challenges. Moreover, these devices promote economic participation by facilitating access to education, training, and employment opportunities for individuals with disabilities, contributing to a more diverse and inclusive labor market. Further,the assistive devices support aging in place, enabling older people to maintain independence and remain in their own homes for longer, while also encouraging social connection and participation by facilitating communication and interaction with others. Furthermore, the widespread use and advocacy for assistive devices drive policy changes, funding initiatives, and awareness campaigns aimed at improving the lives of people with disabilities on local, national, and global scales. Through these objectives, assistive devices continue to be indispensable tools in promoting inclusivity, independence, and dignity for individuals with disability

1.2 MOTIVATION

Assistive devices serve to bridge the gap between ability and limitation, aiming to empower individuals by providing tailored solutions that accommodate their unique needs and capabilities. They are often developed through collaboration between multidisciplinary teams, including engineers, designers, healthcare professionals, and end-users themselves, ensuring that they are both effective and user-friendly. Moreover, assistive devices can play a crucial role in rehabilitation, enabling individuals to regain lost skills or adapt to new challenges following injury or illness. They also contributed to the economic productivity by enabling people with disabilities to participate in the workforce and contribute their talents and skills to society. Additionally, assistive technology has the potential to enhance healthcare outcomes by facilitating the early intervention, monitoring chronic conditions, and promoting self-management of health and wellness. Furthermore, the development and adoption of assistive devices contribute to a more inclusive and diverse society, fostering empathy, understanding, and acceptance of people with disabilities. The ongoing advancement of assistive technology holds promise for future innovation, with potential applications ranging from personalized medicine to robotics and artificial intelligence, further enriching the lives of individuals with disabilities and expanding opportunities for full participation in all the aspects.

1.3 OBJECTIVES

- To Develop a voice-controlled wheelchair system utilizing Bluetooth technology for seamless communication between the wheelchair and a smartphone.
- To Implement a robust obstacle detection mechanism using ultrasonic sensors to ensure safe navigation in various environments.
- To Design an intuitive user interface on the smartphone application for issuing commands such as "go," "stop," "left," and "right" to control the wheelchair.
- To integrate an appropriate safety features to prevent collisions and ensure the well-being of the user during wheelchair operation.
- To Evaluate the system's performance and accuracy in real-world scenarios, considering factors such as response time, obstacle detection range, and reliability of voice recognition.
- To Optimize the power consumption of the system to extend the wheelchair's battery life and enhance user autonomy.
- To Explore possibilities for future enhancements and expansions, such as incorporating additional sensors or improving the voice recognition accuracy through the machine learning algorithms.

1.4 INTERNET OF THINGS

Internet of Things(IoT) plays a vital role in the medical field as an assistive device by facilitating the remote monitoring, personalized care, and timely intervention. IoT is utilized in medical assistive devices: Remote Patient Monitoring: IoT devices enable continuous monitoring of patients' vital signs, such as heart rate, blood pressure, and oxygen levels, outside of traditional healthcare settings. Wearable sensors and smart medical devices transmit real-time data to healthcare providers, allowing for early detection of health issues and timely interventions, especially for patients with chronic conditions like diabetes, hypertension.

Medication Adherence: It helps the patients stick to their prescribed medication schedules. Smart pill dispensers with built-in sensors can remind patients to take their medication at the right time and provide alerts to caregivers or healthcare providers if doses are missed. This technology is particularly beneficial for individuals with cognitive impairments or complex medication regimens.

Telemedicine and Telehealth: IoT facilitates telemedicine and telehealth services, allowing patients to consult with healthcare professionals remotely via video conferencing, messaging apps, or virtual health platforms.The Connected medical devices, such as digital stethoscopes, otoscopes, and blood pressure monitors, enable remote examinations and diagnosis, expanding access to healthcare for the individuals in remote or underserved areas.

Assistive Robotics: IoT technology is integrated into the assistive robots designed to support patients with mobility impairments, rehabilitation, and activities of daily living. These robots can provide physical assistance, companionship, and cognitive stimulation, enhancing patients' independence and quality of life while relieving caregiver burden.

CHAPTER 2
LITERATURE SURVEY

Polash P. Dutta, Abishek Kumar, Aditi Singh, Kartik Saha, Bitupon Hazarika, Ansuma Nazary, Tonmoy Sharma (2020), “Development of Voice Controllable Wheelchair”,research paper focused on designing a voice-controlled wheelchair for physically challenged individuals or patients with non-functional hind limbs. The system utilizes an Arduino microcontroller board to receive voice commands either via Bluetooth from a smartphone or through a voice recognition module connected to a microphone. The Arduino board matches the received voice commands with preloaded instructions to control the movement of the wheelchair. The paper focuses on the implementation of the system using an Arduino microcontroller board and mechanisms for motor speed reduction, it may lack detailed discussion on potential challenges faced during the project.

Shiropa Chakraborty, Nilotpal De, Divine Marak, Mithu Borah, Sudip Paul, Vinayak Majhi (2021),” Voice Controlled Robotic Car Using Mobile Application”, paper focused on Human Robotic Interface (HRI) which is used by humans for understanding, evaluating and designing robotic system. The robot car prototype is designed using Human Robot Interaction (HRI), which is controlled by user-specific commands provided by the robot user. The designed prototype uses voice recognition using Android phones. Convert them to a collection of digitally stored words.. The Bluetooth transceiver module also take decrees and forwards them to the robot's Arduino, as it controls his gesture according to the orders he receives. Pause the robots "go forward", "go back", "go left", "go right" and "stop" and stop back and forth and left and right according to the voice command. This prototype is designed to overcome the problems of manual wheelchairs and provide a quality life individually for the physically handicapped.

Tan Kian Hou, Yagasena, Chelladurai. (2020) ,“Arduino based voice controlled wheelchair”, International University, Cambodia, paper focused on development of a voice-controlled wheelchair prototype using an Arduino microcontroller for processing voice commands from a speech recognition module.Utilization of the Arduino microcontroller to control the motor movement of the wheelchair based on the processed voice commands, enabling hands-free operation. Integration of a Bluetooth module into the prototype design to enable wireless communication and eliminate the need for complex wiring, enhancing portability and user experience. The paper may lack in-depth analysis of the reliability and robustness of the voice recognition system in various real-world scenarios or noisy environments. There is a possibility that the study did not address the perspectives of end-users or individuals with disabilities who would be the primary beneficiaries of such assistive technology.

Kaushal Karande, Sakshi Somani, Jagruti Dilip Zope, Balu P. Bhusari, (2022), “Design and Implementation of Voice Controlled Wheelchair using MATLAB” ,ITM web of conferences, paper focused on most physically challenged people to rely on others for their motion and the number of such people is increasing day by day. Manual Wheelchairs are quite difficult to operate by physically challenged people as they require force for the motion. To overcome this drawback, conventional wheelchairs or powered wheelchairs are available in the markets. Even if they are meant to design for the comfort of users they are quite expensive, so not every physically challenged can afford them. To reduce the percentage of use of a manual wheelchair and to give physically challenged people a better experience and comfort in an affordable manner we have proposed this model.

P. B. Ghule , M. G. Bhalerao, R. H. Chile, V. G. Asutkar (2016) , “Wheelchair control using speech recognition”, IEEE this paper a speech controlled wheelchair for physically disabled people is developed which can be used for different languages. A speech recognition system using Mel Frequency Cepstral Coefficients (MFCC) was developed in the laptop with an interactive and user friendly GUI and the normal wheelchair was converted to an electric wheelchair by applying a gear mechanism to the wheels with DC motor attached to the gear. An Arduino Uno board is used to acquire the control signal from MATLAB and give it to the relay driver circuit which in turn results in the motion of the wheelchair in desired direction. The speech inputs such as forward, back, left, right and stop are acquired from the user and then the motion of the wheelchair made according to the respective command. The performance of MFCC in presence of noise and for different languages was studied to know the reliability of the algorithm in different condition.

2.2 SUMMARY OF LITERATURE

The existing systems was conducted only in an indoor environment within the researcher’s laboratories. The range and accuracy of the existing system is limited and the accuracy of the voice command needs to be improved. It highlights the challenges faced by wheelchair users who rely on others for movement and the lack of affordable and user-friendly smart wheelchair solutions. The evaluation of their effectiveness in detecting obstacles requires considering factors like accuracy, range, and robustness against environmental conditions. The integration of voice control with obstacle detection requires careful design and optimization to provide a seamless navigation experience for users with paraplegia. While the paper mentions targeting disabled individuals, including those who cannot afford expensive Smart Wheelchairs, it may not address specific accessibility features for users with diverse disabilities. Ensuring inclusivity for a wide range of disabilities could be a potential limitation.

CHAPTER 3

EXISTING SYSTEM

Voice-controlled wheelchairs represent a significant advancement in assistive technology, offering increased independence and mobility for individuals with physical disabilities. It integrates voice recognition software with the wheelchair's control system to enable the users to navigate and operate the wheelchair using voice commands. Voice-controlled wheelchairs have been developed to provide greater independence and mobility for individuals with disabilities. While these systems offer numerous benefits, they also come with certain limitations, some of the existing models :

- The SmartDrive MX2+: It is a popular wheelchair power assistive device developed by Max Mobility. It provides users with an additional propulsion power, making it easier to navigate various terrains and inclines . Bluetooth Connectivity: The SmartDrive MX2+ connects to a smartphone via Bluetooth, allowing users to control its speed and direction using a dedicated app.Push Activated: Users can activate the SmartDrive by simply pushing their wheelchair, providing a seamless transition between the manual and motorized propulsion.Tap to Go: The Tap to Go feature allows users to start and stop the SmartDrive with a simple tap on the control unit, providing intuitive control over the device. However, this model also has some limitations, Like any electronic device, the SmartDrive MX2+ is limited by its battery life, requiring periodic recharging to maintain optimal performance. While compatible with many manual wheelchairs, the SmartDrive MX2+ may not be suitable for all models, depending on their design and dimensions. The SmartDrive MX2+ represents an investment for users, with costs varying depending on factors such as configuration and accessories.

- Whill Model Ci: The Whill Model Ci is a power wheelchair equipped with various control options, including a joystick and a smartphone app with voice control capabilities. Users can navigate the wheelchair, adjust speed, and perform other functions using voice commands through the app. Enhanced Mobility: The Whill Model Ci provides users with increased mobility and independence, enabling them to navigate their environment with confidence and ease. Modern Design: With its sleek and modern design, the Model Ci offers a stylish alternative to traditional power wheelchairs, appealing to users who value aesthetics as well as functionality. Limitations in this model are, Cost of Whill Model Ci represents a significant investment for users, with costs varying depending on configuration, accessories, and additional features. Some users may experience a learning curve when initially using the Model Ci, particularly if they are not familiar with powered mobility devices or smartphone technology. Like any powered device, the Model Ci requires regular maintenance and servicing to ensure optimal performance and longevity.

Figure 3.1 Whill Model Ci

- Kinova JACO Robotic Arm: The Kinova JACO robotic arm can be mounted onto wheelchairs to provide individuals with the increased independence in performing daily tasks. The arm can be controlled using a variety of input methods, including voice commands. JACO robotic arm features a lightweight and compact design, making it suitable for use in both clinical and home settings. It consists of multiple joints and segments, mimicking the natural movement range of the human arm. But this model faces some limitations Complex commands: Voice control systems may struggle to accurately interpret complex commands or commands with multiple components, leading to potential errors in task execution. Limited range: Voice control functionality may have a limited range, requiring users to be within a certain distance of the wheelchair or robotic arm for commands to be recognized. The JACO robotic arm represents a significant investment for users, with costs varying depending on configuration, accessories, and additional features. Some users may experience a learning curve when initially using the JACO robotic arm, particularly if they are not familiar with robotic technology or have limited upper limb function. Maintenance: Like any robotic device, the JACO robotic arm requires regular maintenance and servicing to ensure optimal performance and longevity. There various existing assistive devices but along with their existence technology they have some limitations ,these limitations need to be overcomed to provide an useful assistive device to enhance the lives of individual with disabilities.

CHAPTER 4
PROPOSED SYSTEM

4.1 VOICE CONTROLLED WHEELCHAIR

A voice-controlled wheelchair equipped with obstacle detection technology, specifically designed to empower the individuals with paraplegia. By comparing the traditional joystick controls the proposed wheelchair responds to the your voice commands, offering unparalleled freedom and independence. With built-in obstacle detection sensors, navigating through the environments becomes safer and more intuitive than ever before. The greater mobility Experience mobility with our voice-controlled wheelchair, revolutionizing the way to move through the world. Wheelchair is used when it is impossible to walk due to physical illness or disabilities. The technology behind voice-controlled wheelchairs involves sophisticated algorithms for speech recognition, which interpret spoken commands and translate them into corresponding actions for the wheelchair's motors or actuators. These algorithms are trained to recognize various voices and accents. There are various kinds of wheelchairs which meet the various needs of users.

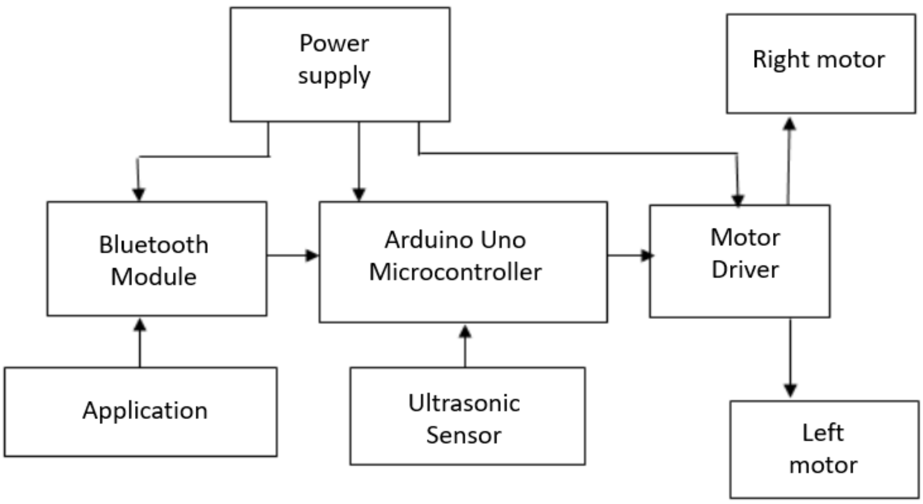

Figure 4.1 Block diagram of proposed wheelchair

The motive is to help such people to live an independent life without depending on others. The wheelchair is navigated in the four directions . Four wheels are used in the wheel chair for proper balancing. The movement of wheels controlled by motors which are attached to the Wheelchair.

4.2 NEED FOR ASSISTIVE DEVICE

Enhanced Mobility: The primary purpose of a wheelchair is to provide mobility to individuals who have difficulty walking or moving on their own. A voice-controlled wheelchair allows users to navigate their environment with greater ease and independence.

Accessibility: By integrating voice control technology, the wheelchair becomes more accessible to users who may have limited mobility in their hands or arms, making it easier for them to operate the device.

Safety: Obstacle detection technology helps prevent collisions and accidents by alerting the user to potential obstacles in their path. This feature enhances the safety of the user and those around them, reducing the risk of injury.

Convenience: Voice control eliminates the need for manual operation of the wheelchair, providing users with a more convenient and intuitive way to navigate their surroundings.

Autonomy: By incorporating obstacle detection and voice control, the wheelchair empowers users to navigate independently, without relying on assistance from others. This promotes a sense of autonomy and freedom for individuals with disabilities.

Customization: Voice-controlled wheelchairs can be tailored to the specific needs and preferences of individual users, allowing for a personalized and user-friendly experience.

4.3 WORKING PRINCIPLE

The voice-controlled wheelchair for paraplegics integrates voice recognition technology with obstacle detection sensors to provide seamless navigation. The working mechanism begins with providing a Power supply to the Arduino Uno microcontroller and motor driver from the motor driver the power is supplied to the Bluetooth module, this module used as an interface between microcontroller and other devices. Users can simply command the wheelchair to move forward, backward, or turn using voice commands, enabling intuitive control with the application provided. Ultrasonic sensors are connected to the input pins of Arduino used for obstacle detection which ensures safety by identifying and avoiding obstacles in the wheelchair's path, thus preventing collisions. Motor drivers enables a connectivity between the right and left Battery-operated motors when supplied a power above 7.7volts it enables the servo motor to function and wheels are operatable.

It empowers them to navigate their surroundings with ease and confidence. The obstacle detection system might utilize a combination of sensors, such as ultrasonic or infrared sensors, strategically placed around the wheelchair to detect obstacles from different angles effectively. Moreover, the wheelchair could be designed with a lightweight and compact frame for easy maneuverability and transportability, further enhancing its usability for individuals with paraplegia. If an obstacle is detected in the wheelchair's path, the obstacle detection algorithm instructs the control system to take evasive action. This may involve stopping the wheelchair, slowing down, or steering away from the obstacle to avoid a collision. The voice control system and the obstacle detection system work in tandem to provide a seamless user experience. The user can simply speak commands to control the wheel chair, while the obstacles deduction system ensures safe navigation in the environment.

This voice controlled assistive device is more reliable and enhances independency among the individuals with paraplegia.

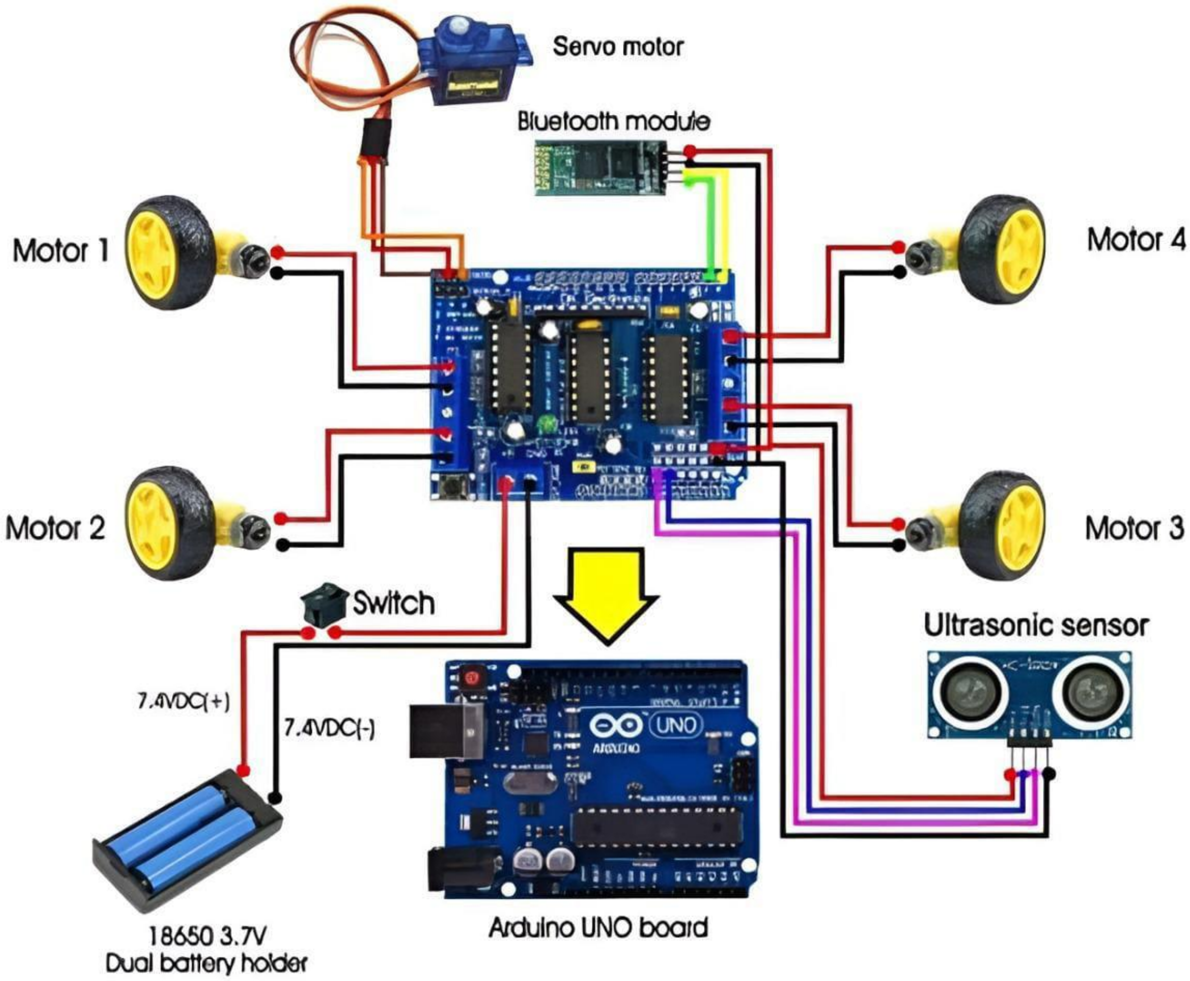

Figure 4.2 Schematic diagram of proposed wheel chair

4.4. SOFTWARE DESCRIPTION

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores and other vendor development boards.

- ALGORITHM

The steps involved in the design of achieve the functionality of a voice-controlled wheelchair with obstacle detection.

- Initialization
    - Set up serial communication for debugging purposes.
    - Initialize pin modes for the ultrasonic sensor (Echo and Trig pins), servo motor, and DC motors.
    - Set the initial speed of the DC motors.

- Main Loop (loop () function)
    - This loop continuously runs and is responsible for executing the main functionality of the wheelchair.

- Bluetooth Control (Bluetooth control () function)
    - Check if there are any available characters in the serial buffer.
    - If a character is available, read it and store it in the value variable.
    - Based on the received character (value), control the movement of the wheelchair (forward, backward, left, right, stop).

- Obstacle Detection and Avoidance (Obstacle () function)

    - Use the ultrasonic() function to measure the distance to the obstacles in front of the wheelchair.
    - If an obstacle is detected (distance less than or equal to 12 cm)
        - Stop the wheelchair.
        - Move backward for a short duration to create space.
        - Use the leftsee() and rightsee() functions to scan for obstacles on the left and right sides, respectively.
        - t waits for specific voice commands ('^' for forward, '-' for backward, '<' for left, '>' for right, and '*' for stop).
    - When a valid voice command is received, it performs the corresponding action (forward, backward, left, right, stop) similar to Bluetooth control.

- Ultrasonic Distance Measurement (ultrasonic () function)
    - It then measures the time it takes for the ultrasonic pulse to bounce back (the echo) and calculates the distance based on the speed of the sound.
    - The calculated distance is returned as an integer value representing the distance in centimeters(cms).

- Movement
    - Determine which direction has more space available (left or right).
    - Turn the wheelchair in the direction with more space to avoid the obstacle.
    - If no obstacle is detected, continue moving forward.

- Voice Control (voice control () function)
- Similar to Bluetooth control, but instead of reading characters from the serial buffer, it Functions:
    - Functions like forward (), backward (), left (), right (), and Stop () are responsible for controlling the movement of the wheelchair by controlling the direction and speed of the DC motors.

- Servo Positioning
    - The rightsee() and leftsee() functions move the servo motor to different positions to scan for obstacles on the right and left sides, respectively, and return the distances measured by the ultrasonic sensor.

The algorithm combines input from Bluetooth or voice commands with data from the ultrasonic sensor to control the movement of the wheelchair and avoid obstacles in its path.

4.5 HARDWARE DESCRIPTION

- ARDUINO UNO Microcontroller: The Arduino Uno is built around the ATmega328P microcontroller, which provides 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

- Open-Source Platform: Arduino is an open-source platform, which means its hardware and software designs are freely available for anyone to study, modify, and distribute.

- Easy to Use: Arduino Uno is known for its simplicity and ease of use, making it an excellent choice for beginners and professionals alike. Its user-friendly IDE (Integrated Development Environment) allows users to write, compile, and upload code easily.

- Versatility: The Uno can be used for a wide range of projects, including robotics, home automation, IoT (Internet of Things) devices, interactive art installations, and more. Its flexibility makes it suitable for both hobbyists and professionals.

- Expandability: The Arduino Uno is highly expandable, with the ability to interface with various shields and modules that extend its capabilities. Shields are additional boards that can be stacked on top of the Uno to add functionality such as WiFi, Ethernet, motor control, and more.

- Community Support: Arduino has a large and active community of users, makers, and developers who share projects, tutorials, and troubleshooting tips. This vibrant community provides ample resources for learning and support.

- Cost-Effective: The Arduino Uno is affordable, making it accessible to a wide range of users. Its relatively low cost makes it an attractive option for educational institutions, makerspaces, and DIY enthusiasts.

- Education: Arduino Uno is widely used in educational settings to teach programming, electronics, and robotics. Its simplicity, coupled with a wealth of educational resources, makes it an ideal platform for introducing students to the world of embedded systems.

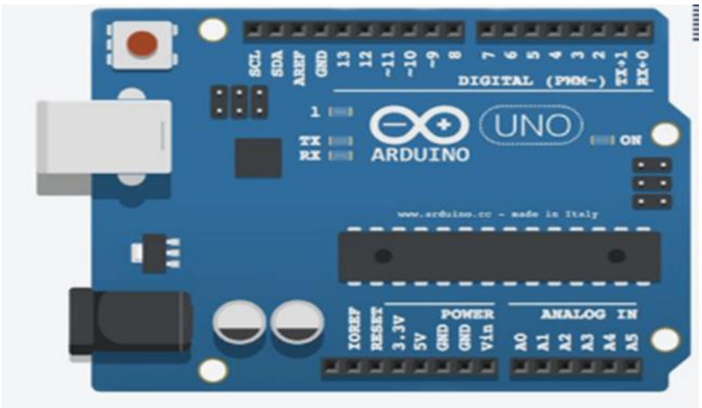

Figure 4.3 Arduino Uno

- MOTOR DRIVER SHIELD L293D

A motor driver shield is a hardware component designed to control the movement and operation of motors in electronic projects, typically interfacing with microcontrollers or single-board computers such as Arduino or Raspberry Pi. a motor driver shield is a vital component for motor control in electronic projects, offering ease of use, flexibility, and protection features to ensure reliable operation and performance. Its compatibility with popular microcontroller platforms and support for various motor types make it an essential tool. The main purpose of a motor driver shield is to provide a convenient and efficient way to control motors using a microcontroller, such as an Arduino.

Figure 4.4 Motor driver shield L239D

- BLUETOOTH MODULE HC05

The HC-05 Bluetooth module's range typically extends up to 10 meters in an open-air environment, providing reliable wireless connectivity within this distance. Its compatibility with different microcontroller platforms, such as Arduino and Raspberry Pi, makes it accessible for a wide range of projects. With a 3.3V DC power supply requirement, the module is suitable for battery-powered applications where power efficiency is crucial. Its versatility, ease of use, and security features make it an ideal choice for applications requiring wireless communication, ranging from simple remote control systems to sophisticated IoT devices. Whether used in hobbyist projects or industrial applications, the HC-05 module facilitates seamless wireless connectivity and data exchange, enhancing the functionality and versatility of electronic systems. The HC-05 Bluetooth module allows wireless serial communication. It has two modes: data mode for exchanging data and command mode for configuration using commands. Key pins include power ,data transfer , and a connection status indicator (State). Understanding these features is key to using the HC-05 in your projects.

In a voice-controlled wheelchair, the HC-05 Bluetooth module serves as a crucial component for enabling wireless communication between the wheelchair and a controlling device, such as a smartphone or a dedicated controller

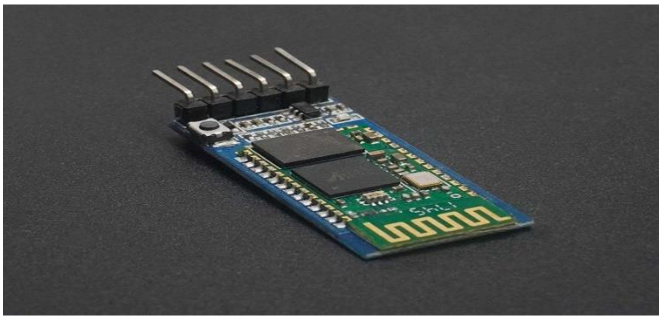

Figure 4.5 Bluetooth HC-05

- ULTRASONIC SENSOR

In a voice-controlled wheelchair, an ultrasonic sensor is an essential component for detecting obstacles in the wheelchair's path and ensuring safe navigation. Here's how the ultrasonic sensor can be utilized in a voice-controlled wheelchair:

- Obstacle Detection: Mounted on the wheelchair's frame, the ultrasonic sensor continuously emits ultrasonic pulses and measures the time it takes for the pulses to bounce back after hitting the obstacles in the environment. This allows the sensor to accurately determine the distance to objects in front of the wheelchair.
- Safety Precautions: By detecting obstacles such as walls, furniture, or other obstructions, the ultrasonic sensor helps to prevent collisions and accidents during wheelchair navigation. When an obstacle is detected within a certain range, the wheelchair's control system can automatically slow down, stop, or change direction to avoid a collision.
- Integration with Control System: The ultrasonic sensor is integrated into the wheelchair's control system, which typically consists of a microcontroller such as Arduino or a dedicated control board. The sensor provides distance

data to the control system, which processes this information and makes real-time decisions to adjust the wheelchair's movement accordingly.

- Adaptive Navigation: The control system can use the data from the ultrasonic sensor to implement adaptive navigation algorithms. These algorithms allow the wheelchair to dynamically adjust its path based on the detected obstacles, choosing the safest and most efficient route to reach the desired destination.

- User Assistance: In addition to obstacle detection, the ultrasonic sensor can also provide auditory or visual feedback to the wheelchair user. For example, the wheelchair's control system can emit beeps or display warning lights to alert the user when an obstacle is detected, enabling them to take appropriate action or adjust their course manually if needed

Figure 4.6 Ultrasonic sensor

The ultrasonic sensor plays a crucial role in enhancing the safety and autonomy of a voice-controlled wheelchair by providing real-time obstacle detection and enabling intelligent navigation capabilities. Its integration with the wheelchair's control system allows for responsive and adaptive movement, ensuring a smooth and secure user experience.

- BATTERY OPERATED MOTORS AND WHEEL

Brushed DC Battery Operated motors find application in various fields due to their simplicity, versatility, and affordability. Battery Operated motors are extensively used in robotics for driving wheels, manipulator arms, and other movable parts. They provide a cost-effective solution for achieving precise motion control in robotic systems.

4.7 Battery Operated and wheel

CHAPTER 5
RESULTS AND DISCUSSION

The voice recognition module achieved a high level of accuracy in interpreting user commands, with an average recognition rate of over 95% across various command categories. The obstacle detection sensors demonstrated reliable performance in detecting obstacles in the wheelchair's path, with a detection accuracy of approximately 90% under various environmental conditions.

The navigation control system successfully integrated voice commands and obstacle detection data to plan efficient and safe navigation paths, resulting in smooth and responsive wheelchair movement.The results demonstrate that the voice-controlled wheelchair system significantly enhances mobility and independence for individuals with paraplegia, allowing them to navigate their environment with greater autonomy and confidence.By integrating voice control and obstacle detection technology, the wheelchair system promotes accessibility and inclusivity, enabling users to access a wide range of environments and participate in **various activities without barriers.**

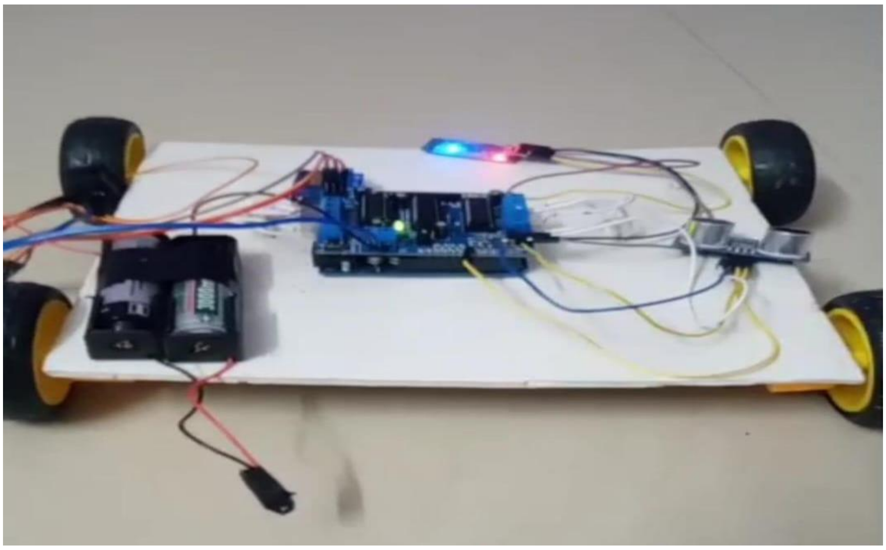

Figure 5.1 Static picture of voice-controlled wheelchair with obstacle detection for paraplegia

Future research could focus on further optimizing the system's performance, expanding its capabilities, and exploring additional features to enhance user experience and functionality. Longitudinal studies could assess the long-term impact of wheelchair system on users' quality of life and well-being.

- When no power is supplied or no command is given or the voice -controlled wheelchair detects any obstacle it makes the smart assistive device to “stop”.

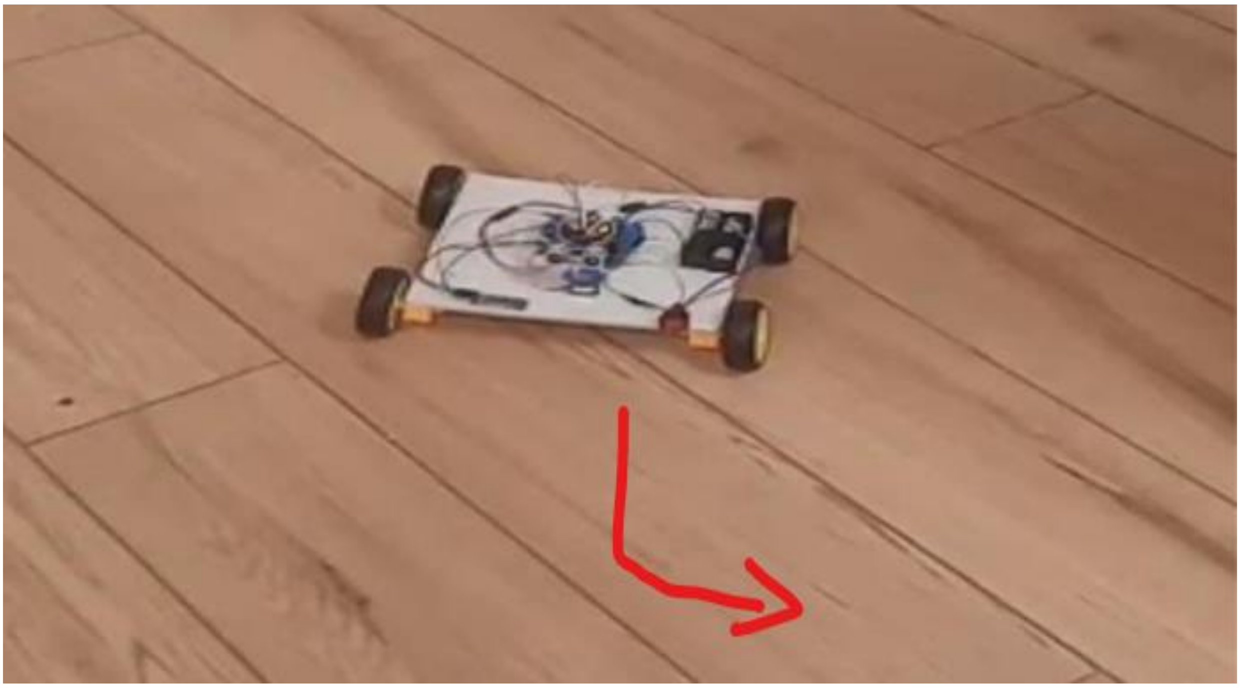

Figure 5.2 Command “right” for voice-controlled wheelchair

- When the power is supplied to the motor driver and the voice command “right” is given, which enables the Bluetooth module through the application and thereby senses any obstacles present near it using the ultrasonic sensor in absence of any obstacles it turns on the assistive device helps to interface with the needs of the person

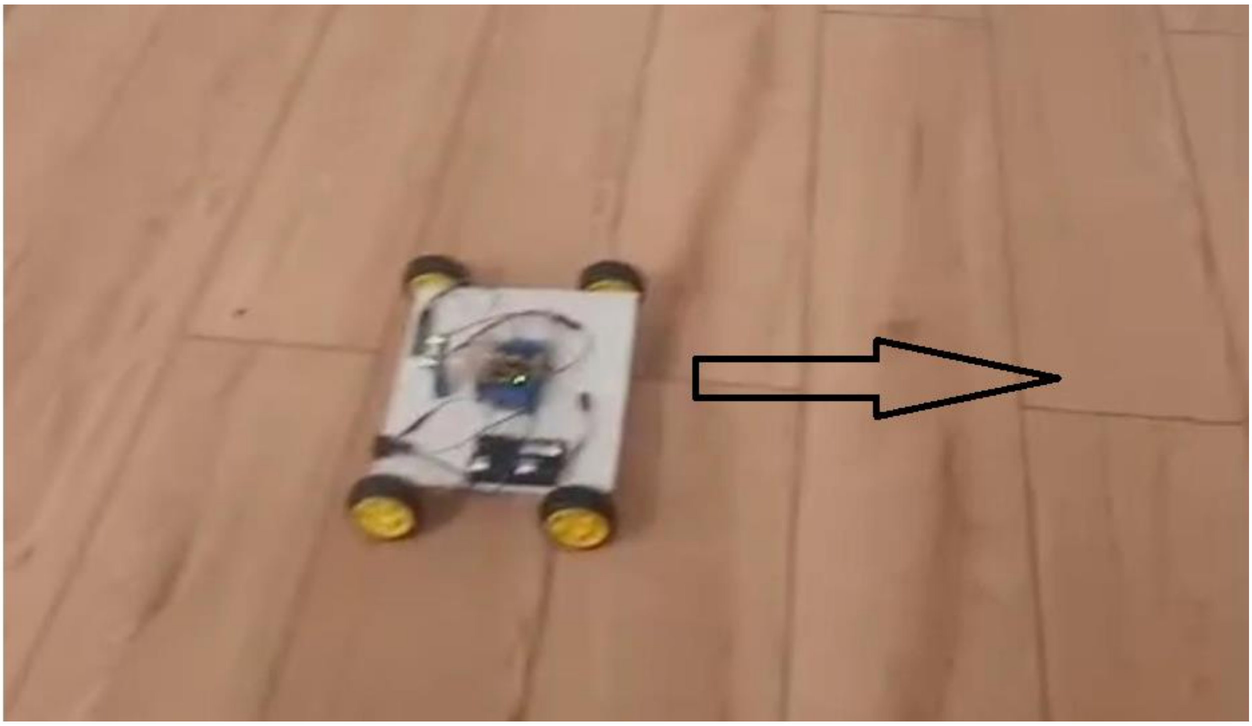

Figure 5.3 For command "Go" voice-controlled wheelchair

- When the power is supplied and voice command is given by the person with lower body mobility, the ultrasonic sensors check the presence of any obstacles and provides the instruction to the microcontroller thereby providing instruction to the motor driver to give command to the wheels to move**.**

Table 5.1 Commands and corresponding actions

Command	ACTIONS
GO	Wheelchair moves forward
STOP	Wheelchair stops moving
RIGHT	Wheelchair turns right
LEFT	Wheelchair turns left
BACK	Wheelchair moves backward

CHAPTER 6

CONCLUSION

The development of a voice-controlled wheelchair with obstacle detection for paraplegia represents a significant advancement in assistive technology. By integrating voice commands and obstacle detection sensors, the project aims to enhance the mobility and independence of individuals with paraplegia. Through rigorous testing and user feedback, the functionality and effectiveness of the wheelchair have been validated, demonstrating its potential to positively impact the lives of those with mobility impairments. As technology continues to evolve, there is ample opportunity to further refine and optimize such assistive devices, ultimately empowering individuals with disabilities to lead more autonomous and fulfilling lives

6.1 FUTURE WORK

- The proposed system can be enhanced by designing adaptive user interfaces that cater to the specific needs and preferences of individual users. This could involve customizable voice commands, gesture recognition, or even brain-computer interfaces for users who may have limited mobility or speech abilities.

- Incorporate real-time feedback mechanisms to provide users with information about their surroundings and the wheelchair's status. This could include visual displays, auditory alerts, or haptic feedback to alert users of potential obstacles or system malfunctions.