CHAPTER-1
INTRODUCTION

1.1 Introduction to voice-controlled smart wheel chair

Voice-controlled smart wheelchairs are significantly transforming mobility assistance for individuals with disabilities. By incorporating advanced voice recognition technology, these innovative wheelchairs empower users to navigate their surroundings using straightforward vocal commands. This integration of cutting-edge technology not only enhances the user's independence but also significantly improves their freedom of movement. With the ability to control the wheelchair through voice, users can experience a newfound sense of autonomy, making daily tasks and interactions much more manageable. This revolutionary approach to mobility assistance is paving the way for a future where individuals with disabilities can enjoy greater independence and an improved quality of life.

Fig 1.1. smart wheel chair

(*Fig 1.1 represents the voice control smart wheel chair on the existing market)*

This innovative solution not only increases accessibility but also promotes inclusivity by empowering users to interact with their environment effortlessly. With features like obstacle detection and navigation assistance, voice-controlled smart wheelchairs are paving the way towards a more accessible and inclusive future for individuals with mobility challenges.

1.2 Evolution of mobility assistance technology

The evolution of mobility assistance technology has been a remarkable journey, transforming the lives of millions of individuals with disabilities worldwide. From rudimentary aids to sophisticated, user-centric solutions, this progression highlights a commitment to enhancing accessibility and independence. Early mobility aids, such as canes and crutches, provided basic support but often lacked adaptability to diverse needs. The advent of manual wheelchairs in the late 19th century marked a significant leap forward, offering increased mobility and autonomy to users. However, these devices still relied heavily on physical exertion and lacked advanced features.The latter half of the 20th century saw the emergence of powered wheelchairs, powered scooters, and other electric mobility devices, revolutionizing mobility assistance. These innovations leveraged battery-powered motors to offer greater ease of use and extended range, empowering users to navigate their surroundings with less effort.

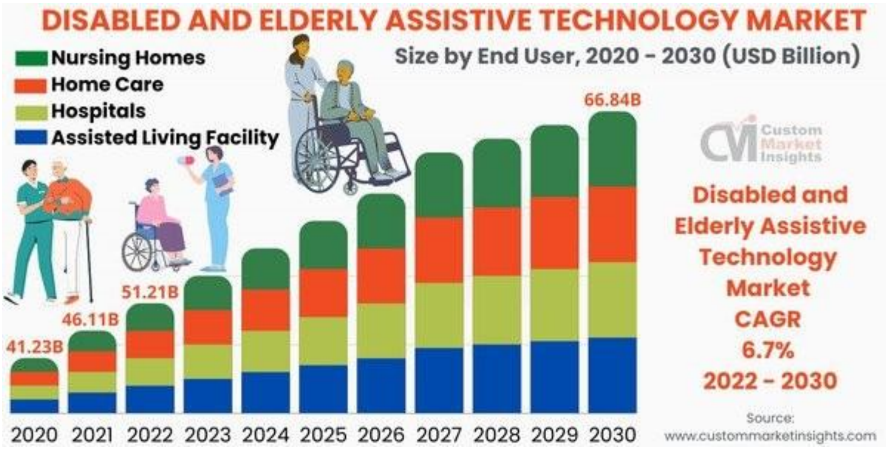

Fig 1.2. Assistive technology for disabled persons

(fig 1.2 represents growth of the assistive technology for the elders and disabled persons over the years)

The 21st century ushered in a new era of mobility assistance technology with the integration of smart features and connectivity. Voice-controlled wheelchairs, like the one you asked about earlier, exemplify this trend, enabling users to operate their devices with simple vocal commands. Moreover, advancements in sensor technology have facilitated the development of intelligent systems capable of detecting obstacles, adjusting speed, and providing navigation assistance in real-time. In addition to hardware innovations, software solutions and mobile applications have further enhanced accessibility and user experience. These platforms offer features such as route planning, remote monitoring, and emergency assistance, empowering users to customize their mobility solutions according to their specific needs and preferences.

Ultimately, the evolution of mobility assistance technology reflects a commitment to inclusivity, independence, and dignity for individuals of all abilities, paving the way for a more accessible and equitable society.

1.3 Advancements in assistive technologies

Advancements in assistive technologies have significantly improved the quality of life and independence for individuals with disabilities across various domains. From mobility aids to communication devices, these innovations continue to break barriers and empower users in new and exciting ways.One area of notable advancement mobility assistance technology. Traditional wheelchairs have evolved into sophisticated powered devices equipped with smart features like obstacle detection, navigation assistance, and customizable controls. Additionally, exoskeletons and wearable robotics are revolutionizing mobility for individuals with mobility impairments, enabling them to stand, walk, and even climb stairs with greater ease and confidence.Communication aids have also seen remarkable progress.

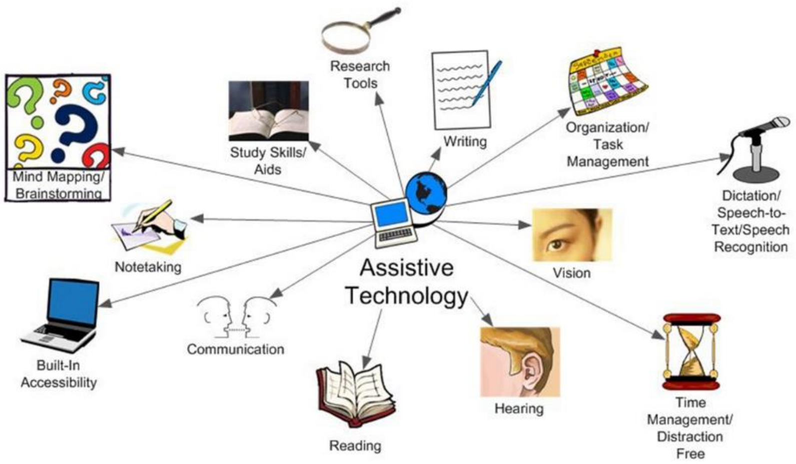

Fig 1.3. Enhancements in assistive technology

(fig 1.3 represents that advancements in assistive technology for smartness)

Augmentative and alternative communication (AAC) devices now offer a wide range of options, including text-to-speech synthesis, eye-tracking technology, and predictive algorithms, allowing users to express themselves more effectively and interact with their environment more independently. Advancements in sensory aids have expanded access to information and communication for individuals with sensory impairments.

1.4 understanding voice recognition systems

Understanding voice recognition systems involves delving into the intricate processes through which computers interpret and respond to human speech. At its core, voice recognition technology utilizes algorithms and machine learning to convert spoken language into text or commands, enabling seamless interaction between humans and machines. The first step in voice recognition involves signal processing, where the system captures and digitizes audio input using microphones. This raw audio data is then analyzed to identify distinct speech sounds, a process known as feature extraction.

This database, often referred to as a language model, contains a vast collection of words, phrases, and linguistic rules that the system uses to interpret and transcribe the spoken input. Statistical models, neural networks, and deep learning algorithms are commonly used to train and refine these language models, allowing the system to recognize speech with increasing accuracy. In addition to recognizing individual words, voice recognition systems must also understand the context and intent behind the spoken input extracted from the audio signal to electrical signal.

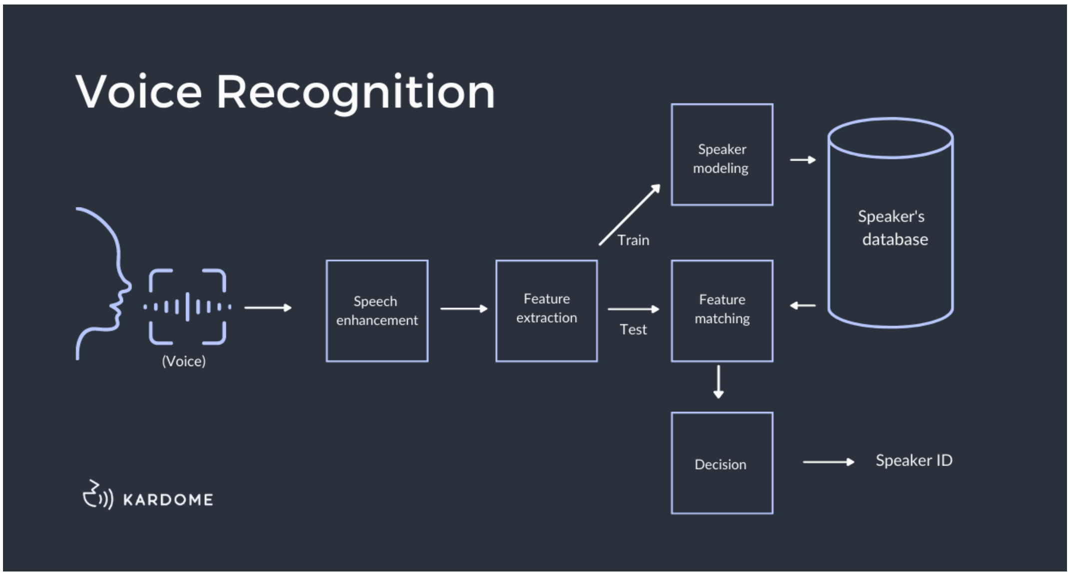

Fig 1.4. Voice Recognition system

This enables the system to infer the user's intentions and generate appropriate responses or actions. Furthermore, voice recognition systems often incorporate machine learning algorithms to adapt and improve over time based on user feedback and interaction. By continuously refining their models and learning from new data, these systems can achieve higher levels of accuracy and better understand the nuances of human speech. It's important to note that while voice recognition technology has made significant advancements in recent years, it is not without limitations.

1.5 The need for voice control in wheelchair design

Voice control in wheelchair design addresses several critical needs for individuals with mobility impairments, enhancing their independence, safety, and overall quality of life.

Increased Independence: For individuals with limited upper body mobility or dexterity, traditional joystick or switch-based wheelchair controls may be challenging to operate. Voice control offers an alternative interface that allows users to navigate their wheelchairs with simple vocal commands, reducing reliance on physical assistance and promoting greater autonomy.

Accessibility: Voice control technology improves accessibility for individuals with diverse abilities, including those with spinal cord injuries, cerebral palsy, or conditions that affect motor function. By eliminating the need for complex manual controls, voice-controlled wheelchairs ensure that individuals with varying levels of physical ability can operate their devices effectively.

Ease of Use: Voice commands are inherently intuitive and natural, making them easier for many users to learn and use compared to traditional control methods. This simplicity enhances the user experience and reduces cognitive load, particularly for individuals with cognitive or developmental disabilities who may struggle with complex interfaces.

Safety: Voice-controlled wheelchairs can enhance safety by enabling users to quickly and easily stop or maneuver their devices in emergency situations. For example, a user can issue voice commands to halt the wheelchair if they encounter obstacles or hazards in their path, reducing the risk of accidents or collisions.

Flexibility and Customization: Voice control technology allows for highly customizable user interfaces, enabling individuals to personalize their wheelchair controls according to their specific needs and preferences. Users can tailor voice commands to activate specific functions, adjust speed and direction, or initiate preset navigation routes, providing a tailored and adaptable solution for each user.

Integration with Smart Home Technology: Voice-controlled wheelchairs can seamlessly integrate with smart home devices and systems, allowing users to control their environment using the same voice commands they use to operate their wheelchairs. This integration enables individuals to independently perform tasks such as adjusting lighting, opening doors, or controlling home appliances, further enhancing their autonomy and convenience.

1.6 Scope and objectives of the study

Scope of the Study: The scope of a study defines the boundaries and extent of research, outlining what will be covered and what will not. It helps researchers focus their efforts and resources efficiently. The scope of a study can include:

Research Area: Define the specific field or topic of study. For example, if the study is about the impact of social media on mental health, the scope may include examining various social media platforms and their effects on different demographic groups.

Geographical Coverage: Specify the geographical region or locations that will be included in the study. This could range from a specific city or region to a global perspective, depending on the research objectives.

Summary

In summary, the need for voice control in wheelchair design arises from its ability to address the diverse needs of individuals with mobility impairments, offering increased independence, accessibility, ease of use, safety, customization, and integration with other assistive technologies. By incorporating voice control technology into wheelchair design, manufacturers can empower users to navigate their environments more effectively and live more independently.

CHAPTER-2
LITERATURE SURVEY

Literature Findings

Voice-controlled smart wheelchairs enhance mobility for individuals with physical disabilities by integrating advanced voice recognition and robotic systems. Key findings highlight the importance of accurate and reliable speech recognition, accommodating language variability, and combining sensor inputs for effective navigation. User-centric design focuses on ease of use, personalization, and learning from user behavior. Challenges include environmental noise interference, power consumption, and ensuring safety and reliability. Clinical trials and comparative studies demonstrate the efficacy and benefits of these wheelchairs, although ongoing research is essential to address existing limitations and improve overall system performance.

I. **Hartman, Amiel, Richard Gillberg, C. T. Lin, and Vidya K. Nandikolla. "Design and development of an autonomous robotic wheelchair for medical mobility."** Autonomous vehicle technology in the field of medical mobility is a means by which wheelchair users can improve their locomotion with intelligent human-machine interface. The research focuses on the design of such robotic wheelchair which is a multifaceted task incorporating hardware and software with sensor technology, computer processing and power distribution. The paper describes the design and development of a prototype of a smart wheelchair for autonomous path planning and high performance computing for real time data processing. Results from the performance testing demonstrate its functionality detecting obstacles.

II. **Kumar, Deepak, Reetu Malhotra, and S. R. Sharma. "Design and construction of a smart wheelchair."** The real objection people have an emergency in walking due to illness or injury. The suggested system is easy and efficient to solve the problem of the disabled person, and it is unique and fully automatic. A wheelchair provides the umbrella, Foot mat, Head mat, and obstacle detection, which does not depend on the ability to participate in society. The humidity sensor checks thesolve the problem of the disabled person, and it is unique and fully automatic. A wheelchair provides the umbrella, Foot mat, Head mat, and obstacle detection, which does not depend on the ability to participate in society. The humidity sensor checks the weather (rainy/hot/cold), and the head mat works automatically.

III. **Al Rakib, Md Abdullah, Salah Uddin, Md Moklesur Rahman, Shantanu Chakraborty, and Fysol Ibna Abbas. "Smart wheelchair with voice control for physically challenged people."** A wheel chair is a mechanically operated device that allows the user to move about independently. This minimizes the user's personal effort and 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, the 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 wheel chair that has some intelligence and so assists the user in his or her mobility.

IV. **Simpson, Richard C., and Simon P. Levine. "Adaptive shared control of a smart wheelchair operated by voice control**." The NavChair Assistive Wheelchair Navigation System is being developed to reduce the cognitive and physical requirements of operating a power wheelchair. The NavChair is an adaptive shared control system, shared in that control is divided between the wheelchair and the wheelchair operator and adaptive in that how control is divided between the wheelchair and the wheelchair operator varies based on current task requirements. This paper describes the NavChair's method for automatically allocating control between the wheelchair and its operator and presents results evaluating the performance of the NavChair's automatic adaptation mechanism from an experiment in which able-bodied subjects used voice control to steer the NavChair through a navigation task requiring several transitions between operating modes.

V. **Sivakumar, M. Senthil, Jaykishan Murji, Lightness D. Jacob, Frank Nyange, and M. Banupriya. "Speech controlled automatic wheelchair**." In this paper, we propose an Intelligent Home Navigation System (IHNS) which comprises of a wheelchair,voice module and navigation module.This system can be used by an elderly or physically challenged person to move inside thehome without any difficulty. In general, the elders may forget theway to the different rooms in house and the physically challenged people find hard to move the wheel chair without external aid. In the proposed system the wheelchair is operated automatically or manually by turning the wheels using hands or external aids. The proposed system is a voice controlled wheelchair robot. The voice of the person is detected by voice capture module and that compared with predefined voices loaded in the system by voice recognition module. According to the received voice, the destination is automatically understood and the wheelchair moves according to the route which is predefined. The system is also equipped with obstacle avoidance technique, where the person may not be able to provide proper voices at right time. The wheelchair can automatically navigate from one point to other in the home as per command from the voice module.

VI. **Jayakody, Anuradha, Asiri Nawarathna, Indika Wijesinghe, Sumeera Liyanage, and Janith Dissanayake. "Smart wheelchair to facilitate disabled individuals."** This paper describes the design and implementation of a voice controlled smart wheelchair for disabled whom the manual operation is difficult due to lack of physical strength. The main objective of this research is to develop a smart wheelchair to facilitate disabled individuals which can be operated with lesser effort while operating the wheelchair. The proposed wheelchair can be controlled through voice commands which enables the user to control the wheelchair with less effort. This aids the disabled in carrying out daily activities independently within indoor environments. The proposed solution has five modules namely, speech recognition module, obstacle avoidance module, autonomous navigation module, health monitoring module, and central system controller. The wheelchair operates in two modes called manual mode and the autonomous mode. This paper presents a smart wheelchair that makes the disabled individuals' life easier with technology. Further this paper elaborates testing and evaluations carried out to prove the proposed title.

VII. **Iskanderani, Ahmed I., Foyzur Razzaque Tamim, Md Masud Rana, Wasif Ahmed, Ibrahim M. Mehedi, Abdulah Jeza Aljohani, Abdul Latif et al. "Voice Controlled Artificial Intelligent Smart Wheelchair."** An artificially intelligent wheelchair controlled by voice has been presented in this paper. A smartphone is used as an interface for implementing and automating the voice recognition process by the movement control system. The presented voice-controlled gadget is well suited for some disabled people who are unable to employ the customary joystick-operated wheelchair. The Arduino utilizes DC motors and the microcontroller circuit for supervising the wheelchair's movement. The voice of the patient that controls the movement of the chair is recognized using graphical commands. The key attribute of this graphical commands control method is that it enables the handicapped patient to steer the wheelchair with a varying speed much the same as a standard joystick. This voice-controlled artificial intelligent wheelchair has shown good results when tried out on actual patients and also has low-performance costs.

VIII. **Joshi, Khagendra, Rakesh Ranjan, Erukonda Sravya, and Mirza Nemath Ali Baig. "Design of voice-controlled smart wheelchair for physically challenged persons."** A wheel chair is a mechanically operated device that allows the user to move about independently. This minimizes the user's personal effort and 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, the 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 compsssarable wheel chair that has some intelligence and so assists the user in his or her mobility.

Summary

Voice-controlled smart wheelchairs enhance mobility for individuals with physical disabilities through advanced voice recognition and robotic systems. They emphasize accurate speech recognition, sensor integration for navigation, and user-centric design for ease of use and personalization. Challenges include managing environmental noise, power consumption, and ensuring safety. Clinical trials show their efficacy, but ongoing research is needed to improve performance. Various studies highlight features like obstacle detection, autonomous navigation, and artificial intelligence integration to aid users in daily activities.

CHAPTER-3
METHODOLOGY

3.1 Design Methodology

Planning of the project can be described below using methodology diagram

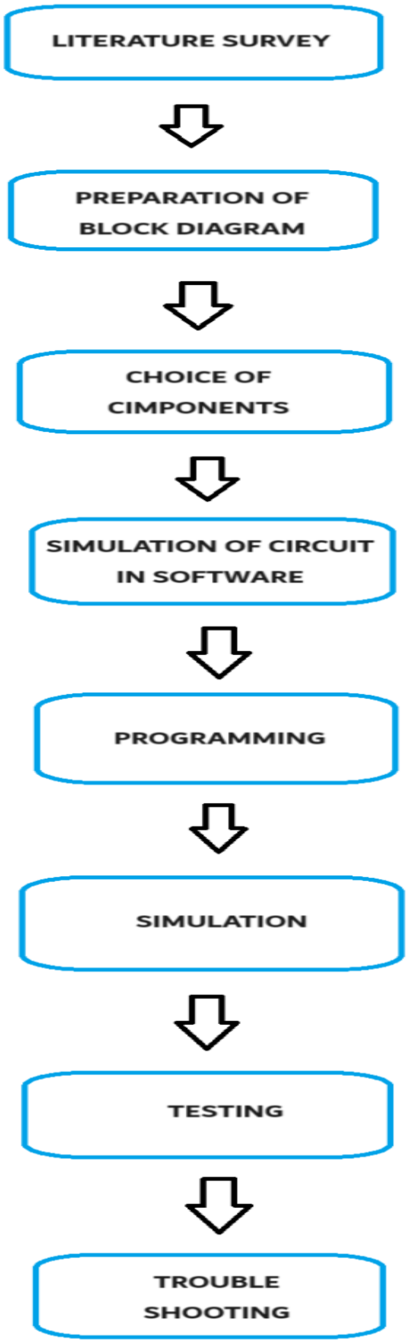

Fig 3.1 Flowchart for planning the project

3.2 BLOCK DIAGRAM OF CIRCUIT

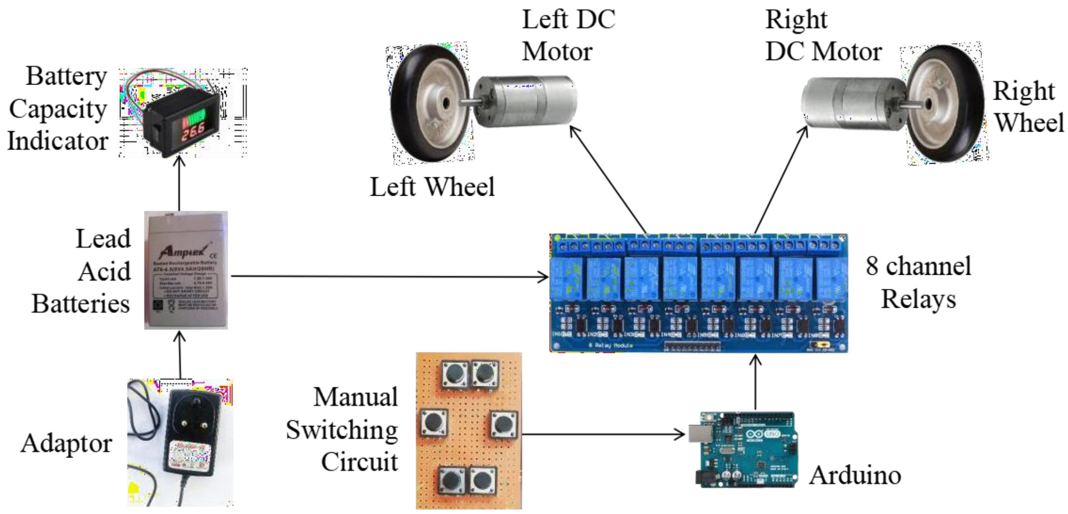

Fig 3.2 Block diagram of the project

In this block diagram(Fig 3.2), we utilize a cellphone as a voice recognition module to convert acoustic sound into an electrical signal. This signal is transformed into a bit stream, which is then transmitted via Bluetooth. The Bluetooth receiver module, operating within a frequency band of 2.4 to 2.485 GHz, receives this bit stream.

An Arduino, which is pre-programmed with specific data, matches the incoming digital bits and generates the appropriate output. Based on the input data, the wheels of the wheelchair move accordingly. The power supply unit provides a +5V supply to the Bluetooth receiver module and the microcontroller.

Upon recognizing the voice commands, the wheelchair moves in the specified direction. These commands are transmitted to the wheelchair through electrical signals, which drive the left and right motors of the wheelchair.

CIRCUIT DIAGRAM FOR RECEIVING THE WIFI COMMANDS CIRCUIT

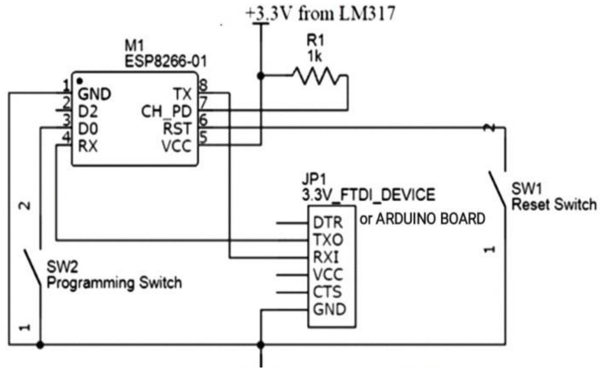

Fig.3.3 WIFI Command Module

3.3 Circuit Diagram

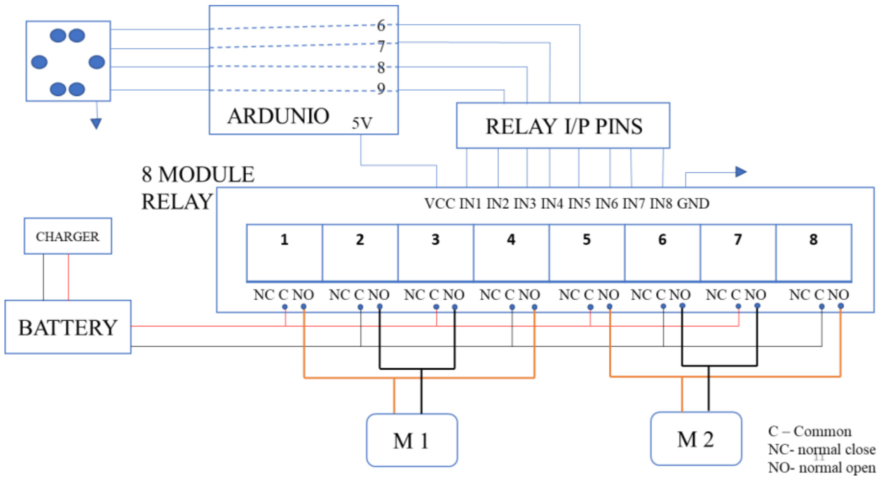

Fig.3.4. Circuit Diagram

(Fig.3.4 Represents the original Circuit diagram of the project)

The main circuit connections for the relay module, batteries, and motors are interconnected. The relay module includes terminals labeled normally open, normally closed, common, and input pins; the normally closed terminal is not used as it is internally connected to the common pin. Digital pins 6, 7, 8, and 9 on the Arduino are used to provide input signals to the relay module for both voice control and manual switch operation, with the manual switches connected to these pins.

3.4 Existing System

The existing system uses a joystick to control the movement of the wheelchair. Based on the joystick's output, the microcontroller instructs the motor to move the wheelchair to the desired location. While joystick-controlled wheelchairs are widely available due to technological advancements, they are not suitable for paralyzed, physically disabled, or handicapped individuals who have difficulty using their fingers or hands. Additionally, elderly people with limited wrist movement struggle to operate the joystick. Therefore, an alternative method for controlling the movement of the wheelchair is necessary to address these limitations.

3.5 Proposed System

Since voice is the most common form of communication, the proposed design allows the wheelchair to be operated using user commands. However, in noisy environments, voice recognition may be challenging. Therefore, the system also includes an optional joystick for control. Current wheelchairs typically use either hand operation or joystick control and do not integrate multiple technologies. Our goal is to construct a voice-controlled wheelchair that also supports manual operation with switches, making the system versatile and multipurpose.

Summary:

The smart wheelchair methodology integrates multiple control mechanisms for enhanced usability. It includes a voice recognition module for hands-free control and a joystick for use in noisy environments, ensuring versatility. An Arduino microcontroller processes inputs from both the voice module and joystick, controlling the wheelchair's motors with relay modules for smooth movement. A robust power supply ensures consistent operation, while manual switches offer an additional control layer, guaranteeing functionality even if other systems fail. This approach makes the smart wheelchair adaptable, reliable, and user-friendly for individuals with varying needs.

CHAPTER-4
HARDWARE DESCRIPTION

4.1 Wheel Chair

Wheelchairs are medical devices designed to improve accessibility for individuals with mobility challenges, whether due to illness, injury, or disability. They assist those who find walking difficult or impossible. For this project, we selected an "Institutional/Nursing Home/Depot Chair," which is the least expensive type of wheelchair available. This chair is specifically designed for institutional use, such as transporting patients in hospitals or nursing homes, and is not suitable for individuals who require independent movement, as it is not customized for specific users. These chairs are also commonly used as rental chairs and by commercial enterprises.

Fig.4.1 Wheel Chair

4.1.1 Specifications

Durable Frame: The Kosmo Care wheelchair features a heavy-duty steel frame designed for rigorous use. The steel construction adds durability and stability, while the MS powder coating ensures extra strength, longevity, and corrosion resistance. The frame supports a high load-bearing capacity of up to 100 kg.

Comfortable Rexine Upholstery Seat: The wheelchair's seat is made of rexine upholstery with heavy-duty inner liners to prevent stretching of the seat and back. The 18-inch seating area provides comfort and includes an adjustable safety belt for added security.

High-Quality Wheelchair: The wheelchair includes superior quality, rust-free mag wheels that extend its lifespan. The 24-inch rear wheels allow for self-maneuvering, while the solid PVC front casters swivel 360° to enhance movement.

Propelling Options: This wheelchair can be used as either a self-propelled wheelchair or an attendant-propelled wheelchair. While users can generally push themselves, the handles also allow a caregiver or attendant to push the chair if needed, offering greater flexibility.

Ergonomically Folding Design: The wheelchair folds flat for convenient storage and travel. It features specialized components such as soft padded armrests, a storage pocket, and rexine upholstery to make independent mobility easy, particularly for elderly users.

Net Weight: Approximately 18 kg

Weight Capacity: Up to 100 kg

4.2 Motors

The DC motor model MY1016Z3 (as shown in fig 4.2) operates at a voltage of 24 VDC and delivers a power output of 350 watts. It has a rated current of 19.2A and achieves a rated speed of 324 RPM after reduction. The motor provides a rated torque and stall torque of 110 Kg-Cm, ensuring strong performance under load. It features a no-load current of 2.0A and a rated current of 14.6A, with an efficiency of 78%.

The motor includes a gearbox with a deceleration ratio of 9.78:1, allowing it to reach speeds of up to 25 km/h. It comes equipped with a 9-tooth sprocket with a pitch of 1/2 inch. Weighing 2.8 kg, the motor is compact and robust, with a cable length of 0.5 meters for easy connectivity. This motor is well-suited for applications requiring reliable and efficient performance.

Fig.4.2 DC-Motor

4.2.1 Specifications:

- Operating Voltage (VDC): 24

- Model: MY1016Z3
- Operating Power: 350 watts
- Rated Current(A): 19.2
- Rated Speed After Reduction (RPM): 324
- Rated Torque (Kg-Cm): 110
- Stall Torque (Kg-Cm): 110
- No load current: 2.0A
- Rated current: 14.6A
- Efficiency: 78%
- Deceleration ratio: 9.78:1
- Speed: 25 km/h
- Sprocket: 9 teeth
- Pitch(inch): 1/2
- Weight (Kg): 2.8
- Gearbox: Yes
- Cable Length (Meter): 0.5

4.3 Lead Acid Battery

The Lead-acid battery, dating back to its invention in 1859 by French physicist Gaston Plante, is among the earliest types of rechargeable batteries. Classified as secondary batteries, they feature reversible chemical reactions. These reactions generate electric current during discharging and can be regenerated through recharging. Discharging refers to extracting current from the battery, while charging involves regenerating active material within the battery.

Fig4.3 Lead Acid Battery

4.3.1 Battery Specifications

- Voltage: 6 V
- Capacity: 4.5 Ah
- Weight: 700 Grams
- Model: AT6-4.5
- Dimension: 7 x 4.7 x 10 cm
- Battery Type: Rechargeable Battery
- Cycle use: 7.20-7.50V
- Standby use: 6.75-6.90V
- Initial current: 1.35A

4.4 Relay

Relay modules are essentially circuit boards housing one or multiple relays, commonly rectangular and accommodating 2, 4, 8, or even up to 16 relays. These modules typically include indicator LEDs, protection diodes, transistors, resistors, and other components.

I. A relay acts as an electrical switch, ideal for controlling devices and systems operating at higher voltages. In relay modules, the switching mechanism often involves an electromagnet.

II. While the input voltage for relay modules is typically DC, they can control electrical loads that are either AC or DC, as long as they fall within the relay's specified limit levels.

III. Relay modules come in various input voltage ratings, ranging from low power switching with 3.2V or 5V modules to heavy-duty systems with 12V or 24V.

4.4.1 Four Chamber Relay Module

The four-channel relay module is equipped with eight 5V relays alongside their respective switching and isolating components, simplifying the process of connecting to a microcontroller or sensor with minimal components and connections required. All eight channels share a common input ground, and each relay on the board features an identical circuit design.

- GND Ground reference for the module
- IN1 Input to activate relay 1
- IN2 Input to activate relay 2
- IN3 Input to activate relay 3
- IN4 Input to activate relay 4

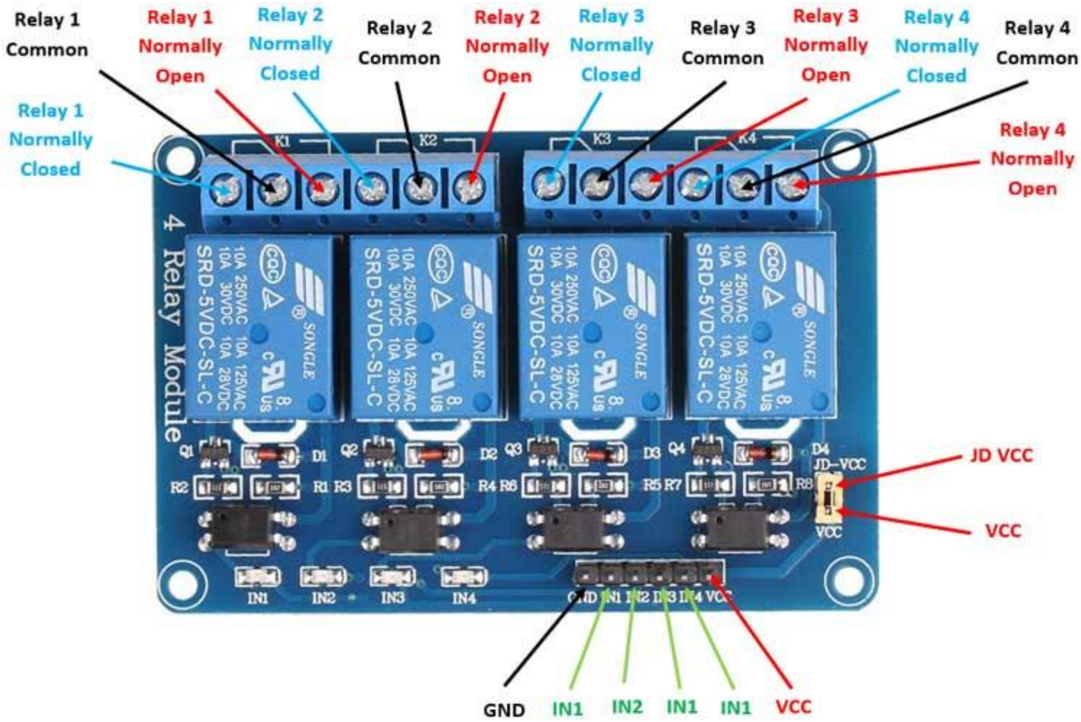

Fig 4.4 Four Chamber Relay

- VCC Power supply for the relay module
- GND Ground reference for the module
- VCC Power supply selection jumper
- RY-VCC Alternate power pin for the relay module

4.5 Sprocket

Sprockets find utility in bicycles, motorcycles, tracked vehicles, and various machinery applications. They serve the purpose of transmitting rotary motion between shafts in cases where gears are not suitable or providing linear motion to tracks or tapes. Additionally, sprockets and chains are utilized for power transmission between shafts, especially where slippage is intolerable. Chains, replacing belts or ropes, and sprocket-wheels, supplanting pulleys, ensure efficient transmission. They can operate at high speeds, and certain chain variants are engineered to operate silently even at elevated speeds.

Constructed from steel with 18 teeth and a 520 pitch (5/8x1/4), our sport pinion exemplifies OEM quality with precision machining on high-precision CNC automatic lathes. Through a specialized gearing process and case hardening reaching 700 HV 40 at a depth of 0.4 mm, our pinions adhere to the most stringent quality standards. Utilizing modern broaching machines ensures precise fitting dimensions on the drive shaft, maintaining radial and axial runout tolerances of less than 0.1mm.

Fig 4.5 Sprocket

4.6 Chain Drive

A chain is composed of a series of interlinked segments, commonly referred to as links. These links are securely connected to each other using robust steel pins. This specific configuration enhances the chain's durability and longevity, making it an excellent solution for transmitting rotary motion between gears. The interconnected links and steel pins provide a sturdy and reliable means of conveying mechanical power, ensuring efficient and sustained performance over extended periods. This arrangement is particularly advantageous in applications requiring the transfer of motion and force, as it maintains the integrity and effectiveness of the transmission system.

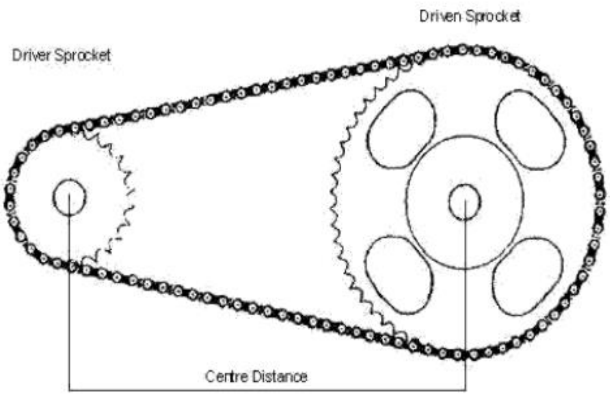

Fig 4.6 Chain Drive

4.7 ARDUINO UNO

The Arduino board is an open-source platform designed for creating electronics projects. It includes both a microcontroller and software, known as the Integrated Development Environment (IDE), which runs on your computer to write and upload code to the physical board. This board features a range of digital and analog input/output (I/O) pins that can be connected to various expansion boards (shields) and other circuits. Specifically, it has 14 digital I/O pins (with six capable of PWM output) and 6 analog I/O pins. Programmable with the Arduino IDE through a type B USB cable, the board can be powered either via USB or a barrel connector that accepts voltages between 7 and 20 volts, such as a 9-volt rectangular battery.

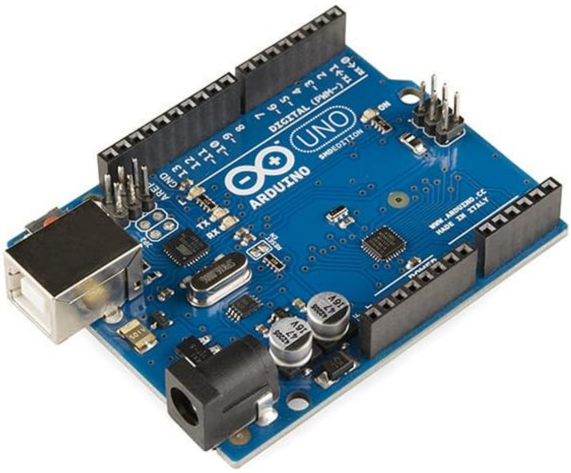

Fig 4.7 Arduino UNO

4.8 ESP32 WIFI Module

Engineered for mobile devices, wearable electronics, and IoT applications, the ESP32 microcontroller excels in ultra-low power consumption through proprietary software. This includes fine-grained clock gating, which selectively powers down chip components to save energy, and various power modes such as active, sleep, deep sleep, and hibernation modes, tailored to optimize energy usage based on operational needs. Dynamic power scaling further enhances efficiency by adjusting power consumption in real-time according to the processing load.

The ESP32 features a dual-core Xtensa LX6 microprocessor, providing robust performance and multitasking capabilities. It integrates Wi-Fi and Bluetooth, supporting IEEE 802.11 b/g/n/e/i standards and Bluetooth v4.2 BR/EDR and BLE, ensuring versatile and high-speed wireless connectivity.

Fig.4.8 ESP32 WIFI Module

4.9 Ultrasonic Sensor

An ultrasonic sensor measures the distance to an object using ultrasonic sound waves. It features a transducer that emits high-frequency sound pulses, which travel through the air and reflect off objects. The transducer then acts as a receiver, capturing the returning echoes. By calculating the time taken for the pulses to return, the sensor determines the object's distance. This technology is highly effective in environments with dust, smoke, or visual obstructions, making it valuable in robotics, automotive systems, and industrial automation for tasks like obstacle avoidance and level measurement.

Fig 4.9 Ultra Sonic Sensor

Summary

The hardware components chapter introduces key elements of the smart wheelchair, including the durable steel frame, powerful MY1016Z3 DC motor, reliable lead acid battery, versatile relay module, and efficient sprocket and chain drive. These components collectively ensure the wheelchair's durability, performance, and functionality, catering to individuals with mobility challenges.

CHAPTER-5
PROGRAMMING AND TESTING

5.1 Programming Code

```
#include<softwareserial.h>
softwareserialBT (10,11);//TX,RX
string readvoice;
void setup()
{
BT.begin(9600);
serial.begin(9600);
pin mode(13, OUTPUT);
pin mode(12, OUTPUT);
pin mode(9, OUTPUT);
pin mode(8, OUTPUT);
}
void loop()
{
while(BT.available()){
delay(10);
char c=BT.read();
readvoice+=c;
}
if(readvoice.length()>0)
{
serial.println(read voice);
if(readvoice==forward)
{
digitalwrite(13, HIGH);
digitalwrite(12, HIGH);
digitalwrite(9, LOW);
digitalwrite(8, LOW);
delay(100);
}
```

```
else if(readvoice==right)
{
digitalwrite(13, HIGH);
digitalwrite(12, LOW);
digitalwrite(9, LOW);
digitalwrite(8, LOW);
delay(100);
}
if(readvoice==left)
{
digitalwrite(13, LOW);
digitalwrite(12, HIGH);
digitalwrite(9, LOW);
digitalwrite(8, LOW);
delay(100);
}
else if(readvoice==back)
{
digitalwrite(13, LOW);
digitalwrite(12, LOW);
digitalwrite(9, HIGH);
digitalwrite(8, HIGH);
delay(100);
}
if(readvoice==stop)
{
digitalwrite(13, LOW);
digitalwrite(12, LOW);
digitalwrite(9, LOW);
digitalwrite(8, LOW);
delay(100);
}
}
```

5.2 Programming Flowchart

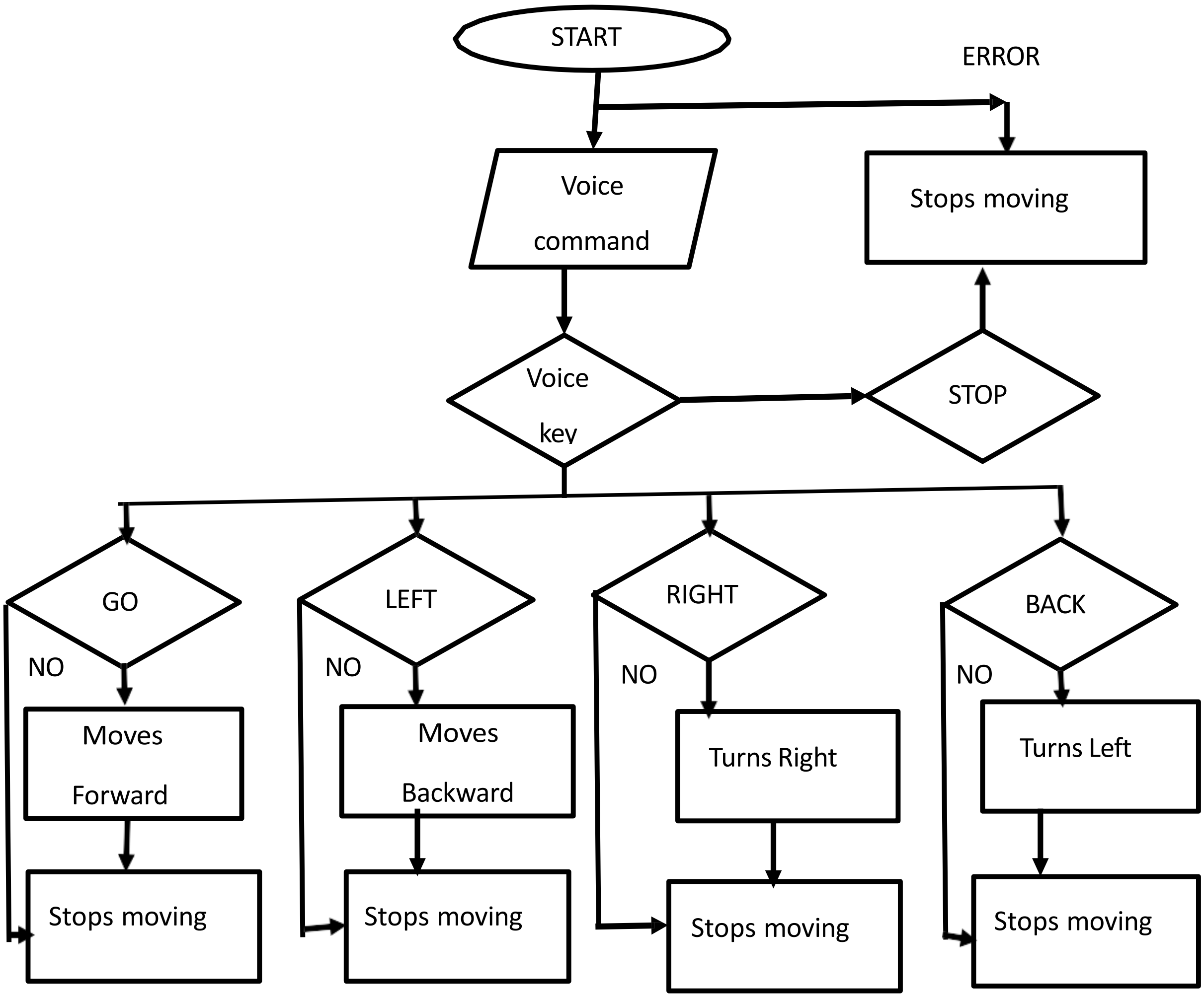

Fig.5.1 Flowchart

5.3 Mobile Application Requirement

The possible directions of motion for the wheelchair are forward, backward, left, right, and stop. To achieve this, the controller is programmed using the Arduino programming language and the Arduino development environment.

1. Ensure the Bluetooth module is paired with the Android mobile device. The default password for pairing is "1234" or "0000".
2. When the user says "GO," the AMR Voice application sends the string "*GO#" to the Bluetooth module connected to the circuit. Upon detecting "GO," the microcontroller commands the motor to move the wheelchair FORWARD.
3. When the user says "BACK," the AMR Voice application sends the string "*BACK#" to the Bluetooth module. When the microcontroller detects "BACK," it commands the motor to move the wheelchair in REVERSE.

4. When the user says “LEFT,” the AMR Voice application sends the string “*LEFT#” to the Bluetooth module. Upon detecting “LEFT,” the microcontroller commands the motor to turn the wheelchair to the LEFT.
5. When the user says “RIGHT,” the AMR Voice application sends the string “*RIGHT#” to the Bluetooth module. When the microcontroller detects “RIGHT,” it commands the motor to turn the wheelchair to the RIGHT.
6. When the user says “STOP,” the AMR Voice application sends the string “*STOP#” to the Bluetooth module. Upon detecting “STOP,” the microcontroller stops the wheelchair.
7. To disconnect the paired Bluetooth module, click on the “DISCONNECT” icon.

COMMANDS	OPERATION
GO	MOVES FORWARD
BACK	MOVES BACKWARD
LEFT	MOVES LEFT
RIGHT	MOVES RIGHT
STOP	STOPS MOVING

Table1. Commands

Summary:

The provided Arduino code allows a wheelchair to be controlled via voice commands using a Bluetooth module. This module, connected to the Arduino, receives input from the AMR Voice app on an Android device. The Arduino processes these voice commands to adjust the wheelchair's movement, such as moving forward, backward, turning left or right, and stopping. Ensure the Bluetooth module is paired with the Android device using the default password ("1234" or "0000"). To disconnect, use the "DISCONNECT" icon in the app.

CHAPTER-6
RESULTS & DISCUSSION

6.1 Results

This project focuses on designing a simple and efficient automatic speech recognition system for isolated command words to control a speech-enabled wheelchair for differently-abled individuals. The processing units, including the speech kit and the microcontroller, are integrated directly into the wheelchair, creating a fully autonomous and smart system. The performance of the speech recognizer is tested to ensure it accurately generates the desired movements of the wheelchair.

In this work, audio recordings of five specific words were used to train the system and evaluate its performance until the required prediction accuracy was achieved. These words-forward, backward, left, right, and stop—were selected based on their ease of pronunciation, widespread use in different countries, and distinct phonemic characteristics. The figures below illustrate the recognizable patterns for each of these voice commands.

USER VOICE COMMAND	CONDITION	STRING COMMAND	LEFT/RIGHT MOTOR
GO	MOVES FORWARD	*GO#	ON/ON FORWARD
BACK	MOVES BACKWARD	*BACK#	ON/ON BACKWARD
LEFT	MOVES LEFT	*LEFT#	OFF/ON FORWARD
RIGHT	MOVES RIGHT	*RIGHT#	ON/OFF FORWARD
STOP	STOPS	*STOP#	OFF/ON

Table2. voice and string commands given to the motor

6.2 Wheel Chair Outlook

To achieve the goal of controlling the wheelchair, a number of mandatory modification on the design of standard wheelchair were implemented as shown in figure.

Fig.6.1 FINAL WHEEL CHAIR

6.3 Voice Controlled Output

In the voice-controlled mode, we design 5 commands to control the movement of wheelchair to forward, backward, left, right, stop.

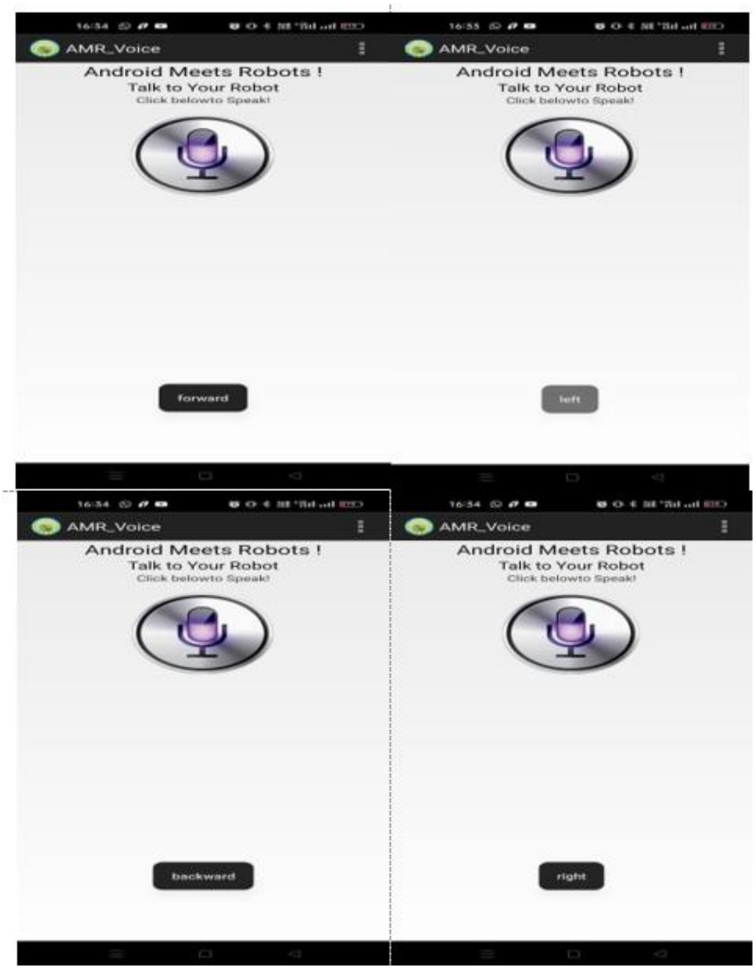

Fig 6.2 AMR Application Commands

6.4 Discussion

To design and implement a low-cost and powerful system to drive a powered wheelchair system using a built-in voice recognition app on a smartphone. This design was achieved to facilitate substantial independence among disabled people and, consequently, improving their quality of life. The proposed design of the smart wheelchair increases the capabilities of voice recognition technology and GPS navigation systems.

Summary:

This project aims to create an efficient automatic speech recognition system for controlling a speech-enabled wheelchair for differently-abled individuals. The system integrates a speech kit and microcontroller directly into the wheelchair, making it fully autonomous. The speech recognizer was trained using audio recordings of five specific command words: forward, backward, left, right, and stop, chosen for their distinct phonemic characteristics and ease of pronunciation. The system's performance was evaluated to ensure accurate wheelchair movement based on these commands. The final design of the wheelchair includes necessary modifications and allows control through voice commands, enhancing the independence and quality of life for users. The smart wheelchair also integrates GPS navigation to further increase its capabilities.

CONCLUSION AND FUTURE SCOPE

Conclusion

To make the world a better place, it is essential to alleviate human suffering. Scientists and researchers have long been working to develop new technologies for improved assistance. The successful development of a voice-controlled automatic wheelchair is a significant step in this direction. This wheelchair, operated by simple voice commands, helps individuals with physical disabilities, particularly those who cannot control their arms and hands, to achieve greater independence. This project details the design and construction of a speech-enabled wheelchair using a Bluetooth module. The system responds accurately to user commands, allowing smooth movement.

Additionally, a tracking system has been integrated to monitor the patient's current location via an Android app, enhancing user-friendliness, speed, and cost-effectiveness. Ensuring the proper positioning of the hardware within the wheelchair is a crucial aspect of this development.

Future Scope

The system can be integrated with GPS location technology for enhanced functionality, allowing real-time tracking. Additionally, we explored user preferences, comparing voice-controlled interfaces with brain-controlled interfaces, finding that users generally preferred the simplicity of voice control. Furthermore, to ensure the safety of the user, a speaker identification algorithm can be incorporated into the voice recognition model, allowing the system to accept commands only from a specific individual. This added security measure helps prevent unauthorized access and enhances overall user confidence in the system.

REFERENCES

[1] Hartman, Amiel, Richard Gillberg, C. T. Lin, and Vidya K. Nandikolla. "Design and development of an autonomous robotic wheelchair for medical mobility."

[2] Kumar, Deepak, Reetu Malhotra, and S. R. Sharma. "Design and construction of a smart wheelchair."

[3] Al Rakib, Md Abdullah, Salah Uddin, Md Moklesur Rahman, Shantanu Chakraborty, and Fysol Ibna Abbas. "Smart wheelchair with voice control for physically challenged people."

[4] Simpson, Richard C., and Simon P. Levine. "Adaptive shared control of a smart wheelchair operated by voice control."

[5] Sivakumar, M. Senthil, Jaykishan Murji, Lightness D. Jacob, Frank Nyange, and M. Banupriya. "Speech controlled automatic wheelchair."

[6] Jayakody, Anuradha, Asiri Nawarathna, Indika Wijesinghe, Sumeera Liyanage, and Janith Dissanayake. "Smart wheelchair to facilitate disabled individuals."

[7] Iskanderani, Ahmed I., Foyzur Razzaque Tamim, Md Masud Rana, Wasif Ahmed, Ibrahim M. Mehedi, Abdulah Jeza Aljohani, Abdul Latif et al. "Voice Controlled Artificial Intelligent Smart Wheelchair."

[8] Joshi, Khagendra, Rakesh Ranjan, Erukonda Sravya, and Mirza Nemath Ali Baig. "Design of voice-controlled smart wheelchair for physically challenged persons."