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Voice Controlled Mobility Chair

Sub-title: Voice Controlled wheel chair for Disabled persons using Arduino

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Abstract: The "Voice Controlled Mobility Chair" is an innovative wheelchair designed for disabled individuals, utilizing Arduino technology to enable hands-free navigation. By integrating voice recognition, users can control the wheelchair's movement, enhancing independence and mobility. The system ensures ease of use, accessibility, and improved quality of life for users.

I. INTRODUCTION

The advent of assistive technology has transformed the lives of people with disabilities, offering innovative solutions to enhance their mobility and independence. One such breakthrough is the development of a voice-controlled mobility chair, also known as a voice-activated wheelchair. A Voice-Controlled Mobility Chair is an innovative assistive technology. Designed to help individuals with mobility impairments navigate their Environment using voice commands. This type of mobility device integrates Speech recognition software with the functionality of a powered wheelchair or Mobility scooter, allowing users to control the chair's movement, speed, and Direction without needing to use their hands or other physical controls. The primary goal of a voice-controlled mobility chair is to enhance independence and improve the quality of life for users, particularly for those with conditions Such as spinal cord injuries, stroke, or other physical disabilities that limit their Ability to operate traditional mobility devices. By utilizing advanced technologies Such as natural language processing (NLP) and speech recognition algorithms, these chairs can understand and respond to a variety of vocal commands.

Key Features of a Voice-Controlled Mobility Chair: Speech Recognition System: The heart of the system, enabling users to Give verbal commands like "move forward," "turn left," or "stop." Adaptive Control: The chair can be customized to recognize specific Speech patterns, preferences, or commands, making it highly flexible. Hands-Free Operation: Ideal for people who have limited or no use of their hands or arms. Integration with Other Devices: Some models can also sync with Smartphones, smart home systems, or other IoT devices to further enhance the user experience. Safety Features: Many models include built-in safeguards like obstacle Detection, emergency stop functions, and voice feedback to confirm Commands. The Arduino platform's flexibility allows users to customize the design, adding additional features such as automatic speed adjustment, obstacle detection, or integration with smart home devices for further independence. The voice-controlled mobility chair powered by Arduino represents a significant leap forward in assistive technology, merging affordability with functionality. By empowering individuals with disabilities to control their environment through simple voice commands, this technology not only enhances mobility but also promotes dignity, independence, and quality of life. As advancements in voice recognition and microcontroller technology continue, future iterations of this system could become even more accessible and efficient, opening up new possibilities for disabled individuals to interact with the world around them.

II. PROBLEM IDENTIFICATION

Challenges faced by individuals with disabilities: Difficulty in controlling traditional manual wheelchairs. Lack of independence in navigating spaces like homes, workplaces, or public areas. Limited access to mobility aids that provide ease of use for people with severe physical impairments. Need for innovative solutions that use technology to aid in mobility. Mobility is a significant challenge for individuals with physical disabilities, especially those who struggle with traditional manual or joystick-controlled wheelchairs. Such individuals may have limited upper-body strength, dexterity, or coordination, making conventional solutions inadequate for their needs. The lack of independence and reliance on caregivers for mobility negatively impacts their quality of life, self-esteem, and productivity. In this context, a voice-controlled wheelchair presents a transformative solution. By leveraging voice recognition technology, individuals with physical impairments can operate a wheelchair with simple spoken commands, reducing their dependency on external assistance. However, implementing such a system involves addressing several technical and practical challenges.

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The system needs to accurately recognize and respond to voice commands in real time, even in noisy environments or when users have speech impairments. The integration of microcontrollers, such as Arduino, with motorized wheelchair components must be reliable and cost-effective to ensure widespread accessibility. Furthermore, safety mechanisms, such as obstacle detection and emergency stop functions, are essential to prevent accidents during operation. The system must also accommodate customization to suit individual user needs and preferences. Overall, the development of a voice-controlled mobility chair represents a convergence of assistive technology, automation, and user-centric design, aiming to empower disabled individuals with greater independence and dignity in their daily lives

III. LITERATURE REVIEW

In recent studies focused on the development and evaluation of voice-controlled mobility aids, several limitations have been identified that could impact their effectiveness and generalizability.

1. International Journal of Advanced Research in Computer Science and Software Engineering, 2015, Limited to basic commands, reliance on Bluetooth's range, and accuracy of voice recognition. This paper presents a voice-controlled wheelchair system using an Arduino microcontroller and Bluetooth communication. The system receives commands from a voice recognition module and moves the wheelchair accordingly. The limitations include a small range of commands and Bluetooth connectivity, which can cause issues in crowded or obstructed environments.

2 .International Journal of Scientific & Engineering Research, 2016, The voice recognition system requires a clear voice input and might not function well in noisy environments. This research focuses on developing a wheelchair that can be controlled using voice commands. The system uses Arduino to interface with sensors and actuators. The major challenge highlighted is its performance in noisy environments, where the voice commands may not be clearly recognized.

3. Journal of Electrical Engineering & Technology, 2017, Limited accuracy of gesture recognition and susceptibility to external noise interference. The paper presents an integrated system that allows for both voice and gesture control for an intelligent wheelchair. It combines Arduino, sensors, and a voice recognition module. The system can be challenging in environments with background noise and the accuracy of gesture recognition can vary.

4. International Journal of Computer Applications, 2018, The wheelchair may not recognize multiple voice commands simultaneously, limiting its ability to handle complex instructions. This research describes an autonomous wheelchair controlled via voice commands. It uses Arduino to process the speech recognition and control the wheelchair's movement. One of the primary limitations is the system's inability to handle multiple commands at once, which can affect its overall efficiency.

5. International Journal of Engineering Trends and Technology, 2017, Limited to simple commands, lacks real-time feedback for the user. The study proposes a system for controlling a wheelchair using Arduino and a voice module. Users can issue basic commands for movement, but the system does not provide immediate feedback on the wheelchair's status, which could lead to potential user confusion.

6. Journal of Robotics and Mechatronics, 2019, Object detection is not perfect, and voice recognition may fail in noisy environments. This paper discusses a voice-activated wheelchair system integrated with object detection sensors. The wheelchair autonomously moves and avoids obstacles using voice commands. However, object detection still faces limitations in accurately detecting objects, and voice recognition may fail in environments with high background noise.

7. International Journal of Control and Automation, 2018, System requires training to recognize specific voice commands, limiting general usability. The article presents an intelligent wheelchair system controlled via voice commands. The system includes a voice recognition module connected to an Arduino microcontroller. However, it requires users to train the system with specific commands, limiting the ease of use for people who are not familiar with the training process.

8. International Journal of Research in Engineering and Technology, 2016, Relies on GSM for remote control, but has limited range and potential security issues. This paper introduces a voice-controlled wheelchair using GSM for remote control, along with Arduino to interface with sensors and motors. While the remote feature is useful, it is restricted by the range of GSM signals and may pose security concerns for users who require privacy.

9. Journal of Applied Computing and Informatics, 2017, Vulnerable to incorrect voice recognition due to background noise. The research presents a system for controlling a wheelchair through voice commands processed by an Arduino system. The main limitation is the vulnerability of the voice recognition to environmental noise, which affects the accuracy and reliability of the wheelchair's response.

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10.Journal of Electrical Engineering, 2018, Difficulty in gesture recognition and system's dependency on specific environmental conditions. This study proposes a combined voice and gesture-controlled wheelchair. Using an Arduino system, the wheelchair can be steered with both voice and gestures. However, the effectiveness of gesture recognition can be reduced by poor lighting and other environmental factors.

11. International Journal of Engineering Research & Technology, 2019, Accuracy of speech recognition varies among different users. This paper explores a system where a wheelchair is controlled via speech commands using Arduino. The speech recognition system is highly user-dependent, and its accuracy varies among different users, which can hinder the system's practicality.

12. International Journal of Innovative Research in Science, Engineering and Technology, 2016, System operates only in predefined conditions and is not adaptable to unexpected situations. The study proposes a voice-activated wheelchair system designed specifically for disabled individuals. The system uses an Arduino board and speech recognition. The main limitation is that the system is designed to work under specific, predefined conditions, and it is not adaptable to unexpected environments or obstacles.

13. International Journal of Robotics and Automation, 2019, The obstacle detection system has a limited range, affecting mobility in complex environments. This paper discusses an intelligent wheelchair with voice control and real-time obstacle detection using Arduino. While it improves navigation in known environments, the limited range of the obstacle detection system restricts its performance in more complex or dynamic environments.

14. International Journal of Electronics and Communication Engineering, 2017, The low-cost nature of the system compromises performance in terms of processing power and reliability. This article presents a low-cost solution for a voice-controlled wheelchair, making it more affordable for disabled individuals. However, the limited processing power of the system may affect the reliability and responsiveness of the wheelchair, particularly for complex commands.

15. Journal of Computer Science and Technology, 2020, Dual control mode (voice and motion) is difficult to operate simultaneously. This research introduces an Arduino-based smart wheelchair that can be controlled via both voice and motion sensors. While this offers greater flexibility, the dual control mode complicates simultaneous operation, leading to potential user confusion and difficulty in control.

16. "Power Optimization in MANET using Topology Management" published in Engineering Science and Technology, an International Journal, ISSN 22150986, ELSEVIER BV, 2020. In this authors have shown how power can be optimized in any communication system. Power optimization is providing optimum power to devices that is providing less power wherever less power is required and more power wherever maximum power is required[7].

IV. OBJECTIVES

To Develop voice-controlled cheer for disable the person using Arduino which can be operated through speech commands to Henna and send independent implement voice recognition Technology interface with the motors for movement hands-free control of wheelchair moments simple voice commands for forward backward left right and stop for double and easily customizable with Arduino based design.

V. BLOCK DIAGRAM

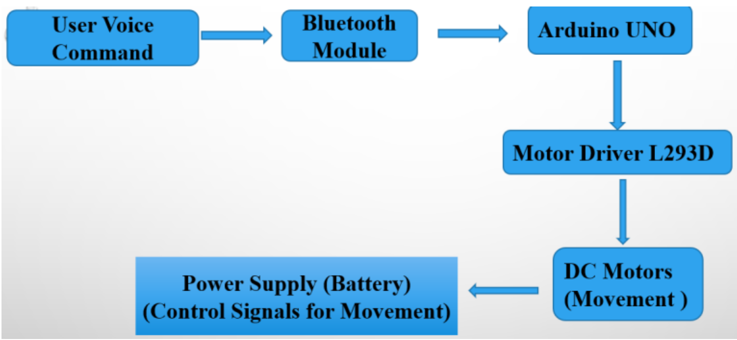

Fig 1: Block Diagram of Voice Controlled mobility chair

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Voice Command: The user issues a voice command, such as “move forward,” “turn left,” or “stop.” These commands are captured by a voice recognition module or smartphone app, which processes the speech and converts it into digital signals that can be interpreted by the system.

Bluetooth Module: The Bluetooth module serves as the communication link between the voice recognition device (such as a smartphone) and the Arduino Uno. It receives the processed voice commands via Bluetooth and sends them to the Arduino, enabling wireless control of the wheelchair.

Arduino Uno: The Arduino Uno acts as the central controller, processing the incoming Bluetooth commands. It interprets the received signals and generates control signals for the motor driver. Based on the command, the Arduino sends the appropriate signals to the motor driver to control the wheelchair’s movement.

Motor Driver (L293D): The L293D motor driver acts as an interface between the Arduino and the DC motors. It amplifies the control signals from the Arduino, enabling it to drive the motors with sufficient power. It also controls the direction and speed of the wheelchair’s movement based on the commands.

DC Motors (Movement): The DC motors are responsible for the physical movement of the wheelchair. The L293D motor driver controls the motors’ direction and speed, causing the wheelchair to move forward, backward, or turn, according to the voice commands given by the user.

Battery (Power Supply): The battery provides the necessary power to run the entire system, including the Arduino, Bluetooth module, motor driver, and DC motors. It ensures that the wheelchair is operational and can move in response to the voice commands, providing continuous power throughout its usage.

VI. WORKING PRINCIPLE

- Voice Command: The user speaks a command (e.g., “Move Forward”, “Turn Left”) into a smartphone or Bluetooth device.

- Bluetooth Module: The Bluetooth module (HC05) receives the voice command from the smartphone or voice app and transmits it to the Arduino.

- Arduino Processing: The Arduino processes the received command and sends a signal to the motor driver shield.

- Motor Activation: Based on the processed command, the motor driver powers the DC motors, resulting in movement of the wheelchair (forward, backward, left, right, or stop). The system begins when the user speaks a voice command, such as “Move Forward,” “Turn Left,” or “Stop,” into a smartphone or Bluetooth-enabled device. This voice command is captured by a voice recognition application or module on the smartphone. The app processes the speech and converts it into a digital signal that can be transmitted wirelessly.

- The Bluetooth module (typically an HC-05 or HC-06) receives the processed voice command from the smartphone. The Bluetooth module acts as a communication bridge, transmitting the data wirelessly to the Arduino Uno, which serves as the central controller for the system.

- Once the Arduino receives the command, it processes the incoming signal and determines the appropriate action. Based on the received input, the Arduino generates corresponding control signals and sends them to the motor driver shield. The motor driver, such as the L293D or similar, receives these control signals and drives the DC motors accordingly.

- The DC motors are responsible for moving the wheelchair. Depending on the command, the motor driver directs the motors to move forward, backward, turn left, turn right, or stop. The motors receive the necessary power from a battery, ensuring smooth and responsive movement of the Command: The user speaks a command (e.g., "Move Forward", "Turn Left") into a smartphone or Bluetooth device.

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VII. CIRCUIT DIAGRAM

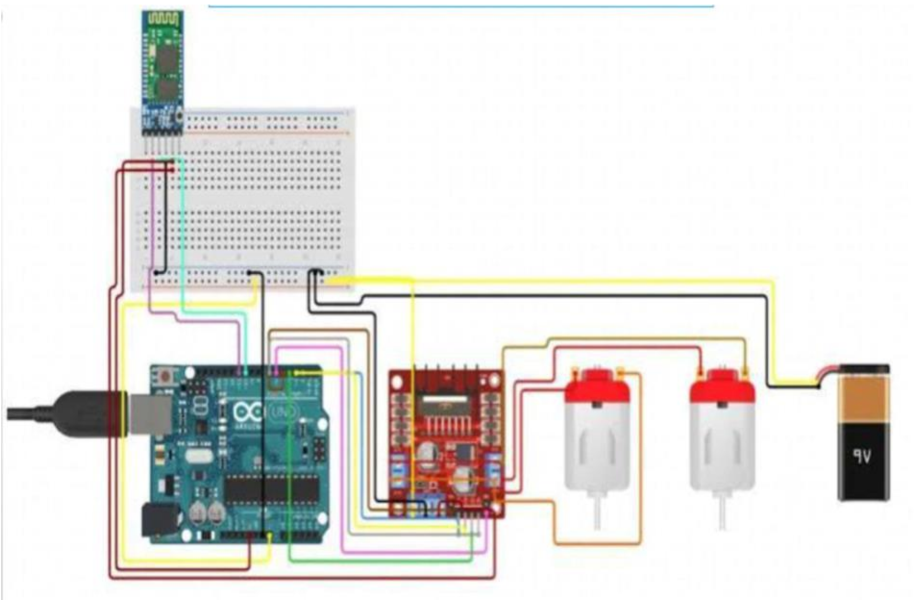

Fig 2: Connection Diagram

VIII. HARDWARE USED

- **Arduino UNO**: The Arduino UNO is a microcontroller board based on the ATmega328P, used in the voice-controlled mobility chair to process voice commands received via a Bluetooth module. It interprets these commands and sends control signals to the motor driver shield to regulate the wheelchair's movement. Its simplicity, reliability, and versatility make it ideal for such applications, ensuring precise control, efficient power management, and compatibility with various components like sensors and actuators.

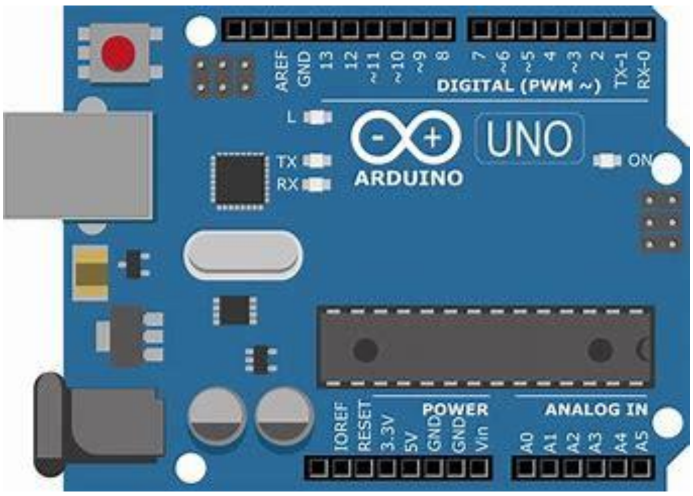

Fig 3: Arduino UNO

- **DC Geared Motor**: The DC geared motor in the voice-controlled mobility chair provides the necessary torque and speed for wheelchair movement. It operates based on control signals from the motor driver shield, enabling smooth forward, reverse, and directional motion. The integrated gear system ensures efficient power transmission, making it suitable for carrying loads and navigating varied terrains.

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Fig 4: DC Geared Motor

- **Motor Driver Shield**: The motor driver shield in the voice-controlled mobility chair acts as an interface between the Arduino UNO and the DC motors. It amplifies low-power signals from the Arduino to drive the motors efficiently. Supporting bi-directional control, it enables precise movement, including forward, reverse, and turns, ensuring smooth operation and reliable performance.

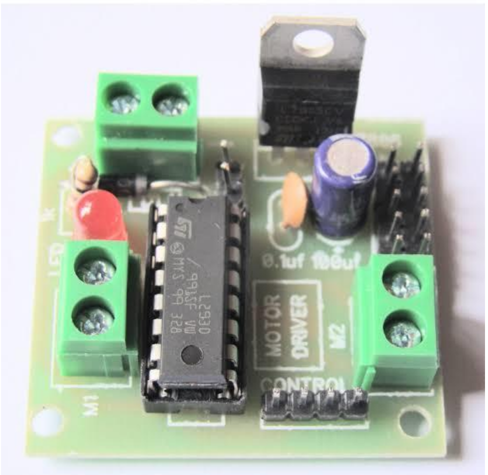

Fig 5: Motor Driver Shield

- **Bluetooth Module**: The Bluetooth module (HC-05) in the voice-controlled mobility chair enables wireless communication between the wheelchair and the user's smartphone or voice recognition system. It receives voice commands via Bluetooth and transmits them to the Arduino UNO, allowing the user to control the wheelchair's movement remotely and seamlessly.

Fig 6: Bluetooth Module

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- **Battery**: The battery in the voice-controlled mobility chair provides the necessary power to operate the motors, Arduino, and other electronic components. Typically, a rechargeable lithium-ion battery, it ensures extended usage time and reliable performance, delivering consistent voltage to the system, and allowing the wheelchair to function efficiently over long periods.

Fig 7: Battery

- **Wheels**: The wheels of the voice-controlled mobility chair are designed for stability and smooth movement. They are typically equipped with rubber tires for traction on various surfaces. The wheels are powered by DC geared motors, allowing for precise control of the wheelchair's movement, including turning, forward, and reverse motions.

Fig 8: Wheels

IX. SOFTWARE USED

In Arduino Bluetooth control in the voice-controlled mobility chair allows seamless wireless communication between the wheelchair and a smartphone or voice recognition system. The Bluetooth module, typically HC-05 receives voice commands from the user's mobile device or voice assistant and transmits them to the Arduino UNO. The Arduino processes these commands and sends control signals to the motor driver shield, which controls the wheelchair's movement. This system enables users to operate the wheelchair hands-free, providing greater independence for people with disabilities. Bluetooth control ensures reliable, low-latency communication, making it ideal for mobility applications requiring real-time responses.

Fig9: Arduino Bluetooth Control

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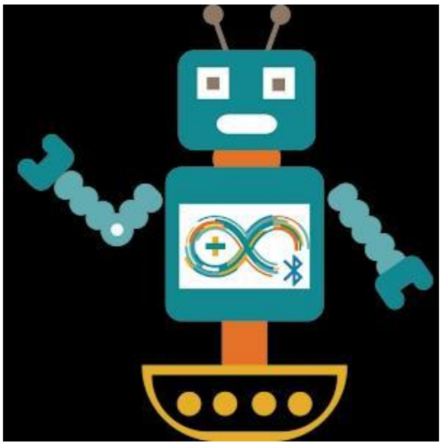

Fig10: Application Logo

X. CONCLUSION

A voice-controlled mobility chair offers a practical solution for increasing the mobility and independence of individuals with disabilities.

Using simple, low-cost components like Arduino, voice recognition, and motor drivers, we can create an affordable and effective system for improving the quality of life for users.

Continued research and development will improve the reliability, functionality, accessibility, and independence of users and serve as a stepping stone for more advanced assistive devices in the future.

The voice-controlled mobility chair represents a significant advancement in assistive technology, empowering individuals with disabilities to navigate independently. By using Arduino-based systems and Bluetooth communication, it provides a cost-effective, hands-free solution for controlling the wheelchair with simple voice commands. This innovation not only enhances mobility but also improves the quality of life by reducing dependency on caregivers. Future developments, such as advanced sensors, AI integration, and improved battery efficiency, hold great potential to further enhance its functionality and safety. Ultimately, the voice-controlled wheelchair promises to offer more autonomy and dignity to those with limited mobility.

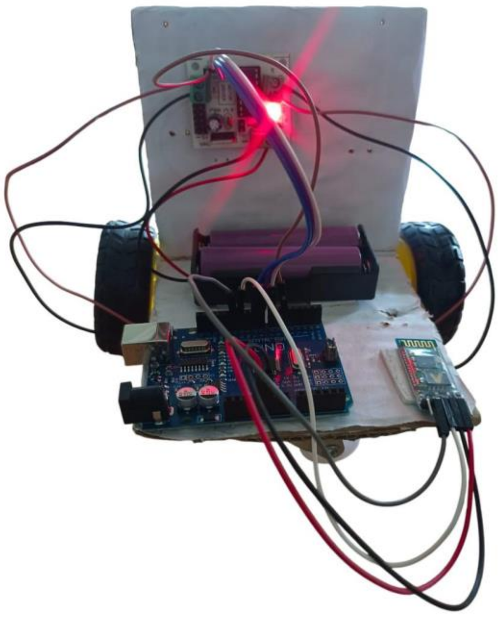

Fig 11. Final Prototype

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