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AI-ENABLED MULTI-MODE SMART WHEELCHAIR WITH VOICE AND GESTURE CONTROL FOR DISABLED PERSON

Mrs. Shilpa V[1], Sindhu JJ[2], Supriya K[3], Tanujashree M[4], Yashasvi MS[5]

Assistant Professor, ECE, East West Institute of Technology, Bangalore, India[1]

Student, ECE, East West Institute of Technology, Bangalore, India[2]

Student, ECE, East West Institute of Technology, Bangalore, India[3]

Student, ECE, East West Institute of Technology, Bangalore, India[4]

Student, ECE, East West Institute of Technology, Bangalore, India[5]

Abstract: This smart wheelchair integrates IOT and AI technologies to improve mobility and independent for individuals with disabilities. By combining hand gesture recognition, voice command processing, and intelligent automation, it provides a flexible, user-friendly, and adaptive solution for diverse needs. The IOT framework allows real-time monitoring and communication between the wheelchair and connected devices, enabling remote supervision and diagnostics. Hand gesture control, via motion sensors, ensures intuitive self-navigation, while the voice recognition module, powered by AI, interprets spoken commands for users with limited hand mobility. AI optimizes movement, detects obstacles, and ensures safe navigation. Additional features, such as emergency stop, fall detection, and health monitoring, enhance safety and provide timely alerts to caregivers. This multi-modal control system empowers users with greater independence, safety, and comfort, representing a significant advancement in smart assistive technology, fostering inclusivity and improving quality of life for people with mobility impairments.

Keywords: IOT (Internet of Things), AI (Artificial Intelligence), Hand gesture recognition, Voice command processing, Health Monitoring.

I. INTRODUCTION

Mobility is a fundamental aspect of independent and quality of life, yet for individuals with physical disabilities, it often becomes a major challenge. Traditional wheelchairs, while providing essential support, rely heavily on manual effort or basic electric controls, which may not always be suitable for people with severe motor impairments. In this context, the development of smart wheelchairs powered by Internet of Things (IOT) and Artificial Intelligence (AI) technologies offers a promising solution to address these limitations. This paper introduces an advanced, multi-functional smart wheelchair system designed to enhance the mobility, safety, and independence of disabled individuals. By combining IOT connectivity, hand gesture recognition, voice control, and AI driven automation, the proposed system offers a highly adaptable and user-friendly interface. The IOT framework ensures seamless communication between the wheelchair and connected devices, enabling real-time monitoring, remote control, and data analysis for improved performance and maintenance. Hand gesture control is facilitated through motion-sensing technology, allowing users to navigate the wheelchair through simple and intuitive hand movements. For individuals with limited hand mobility, the system incorporates an intelligent voice recognition module that accurately interprets spoken commands, offering an alternative and efficient means of control. Moreover, AI algorithms play a crucial role in optimizing movement, detecting obstacles, and ensuring safe and smooth navigation.

II. METHODOLOGY

The design and development of the multimode smart wheelchair system are centered around the Arduino Mega 2560 microcontroller, which acts as the central processing unit interfacing with various input and output components. This methodology outlines the step- by-step integration and functioning of the system. The wheelchair is equipped with several

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input sensors for real-time monitoring and control. An accelerometer and gesture detection sensor are used for movement control through body gestures, while a joystick controller provides an alternative manual mode for navigation. Ultrasonic sensors are deployed for obstacle detection and avoidance. Health monitoring is facilitated through a heartbeat sensor, temperature sensor, and SpO2 sensor, which track vital signs and send alerts when abnormal values are detected. A fall detection sensor enhances user safety by detecting sudden drops or tilts, immediately notifying caretakers. The emergency button allows the user to manually send distress signals. GPS and Wi-Fi modules ensure real-time location tracking and remote connectivity.

On the output side, the system uses a DC motor for wheelchair motion control. An LCD displays system status and health readings. A buzzer is included for audible alerts during emergencies or system faults. The voice module provides audio feedback to the user, enhancing accessibility for visually impaired individuals. Telegram and Bluetooth modules are integrated for communication with caregivers via mobile applications.

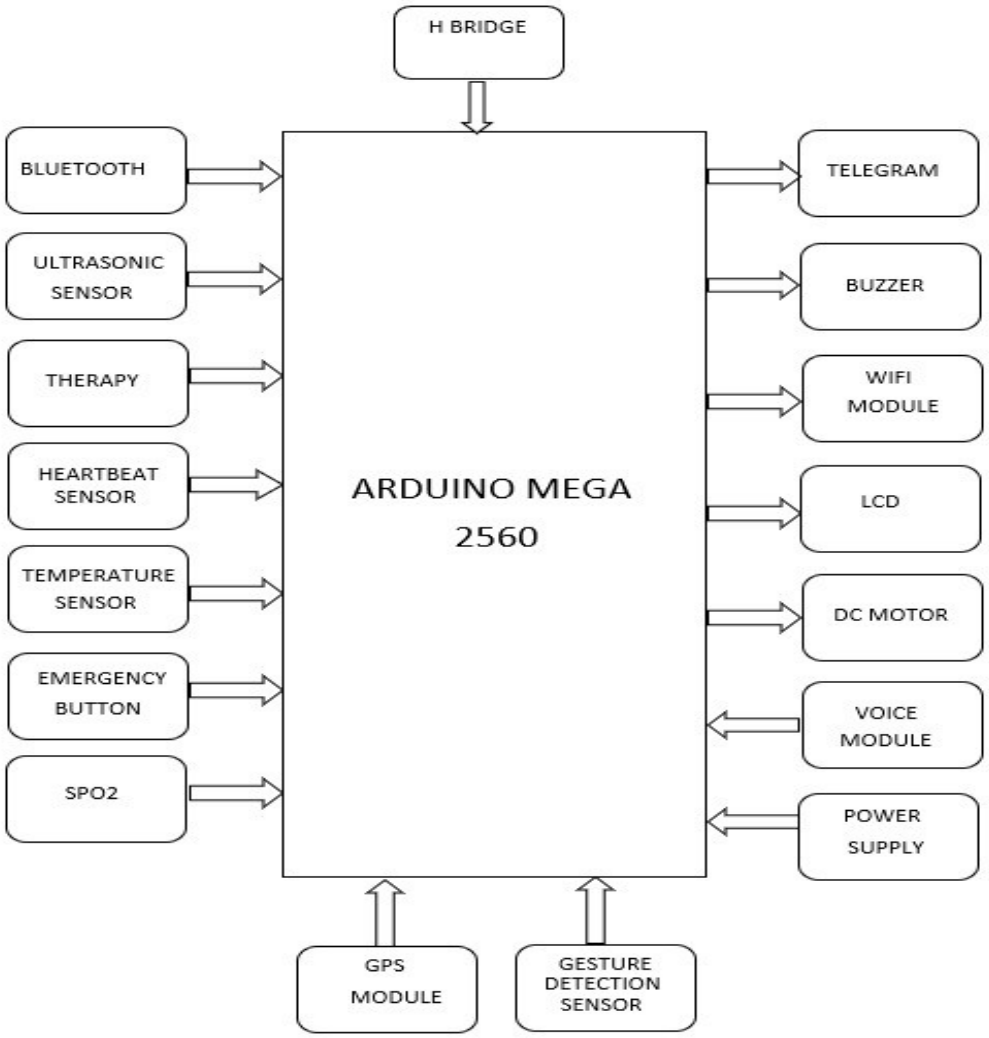

Figure 1: Block Diagram of AI-Enabled Multi-Mode Smart Wheelchair with Voice and Gesture Control for Disabled Person

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III. IMPLEMENTATION

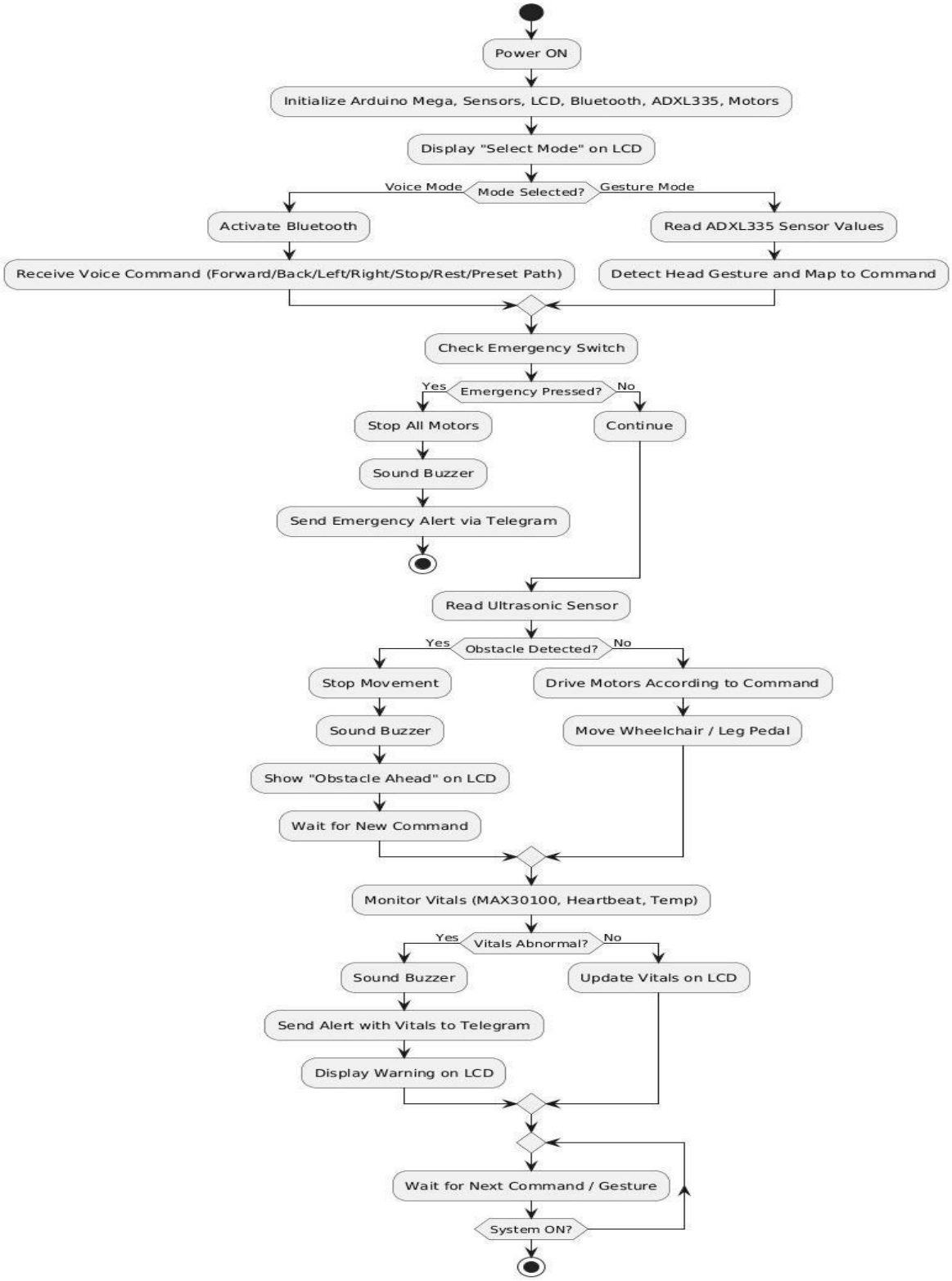

Figure 2: Implementation steps AI-Enabled Multi-Mode Smart Wheelchair with Voice and Gesture Control For Disabled Person

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IV. RESULTS

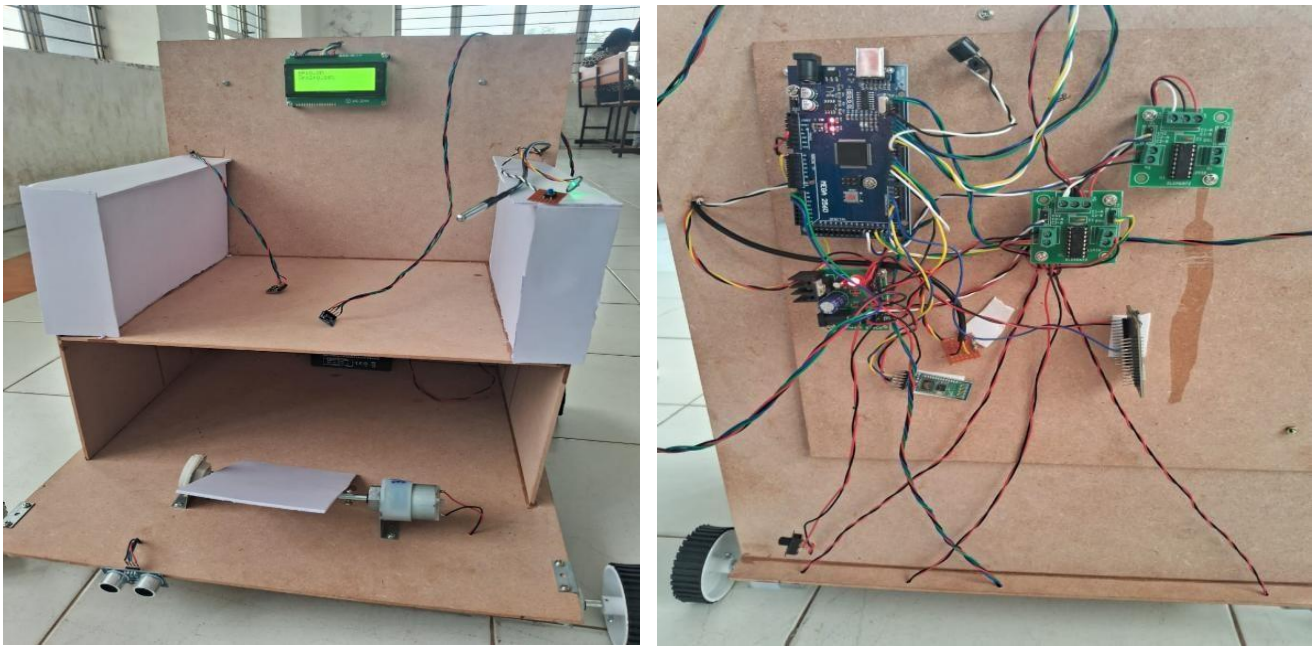

Fig 1: Prototype of Wheelchair

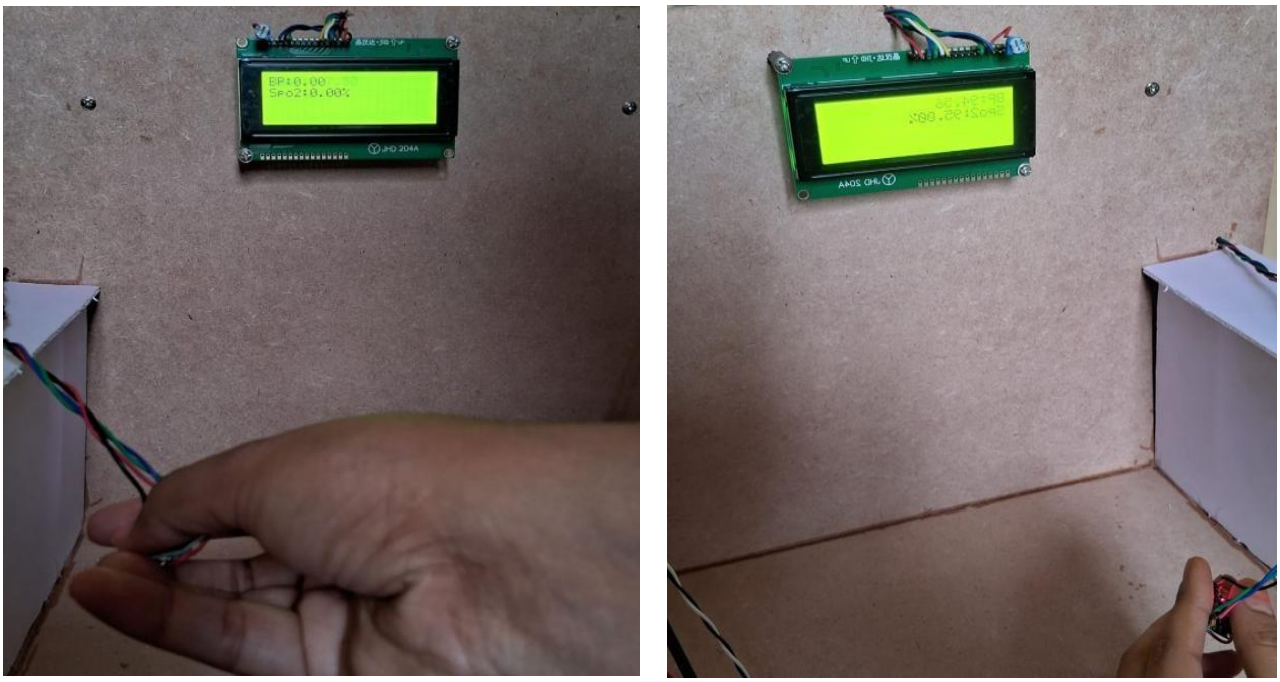

Fig 2: Detection of BP and SPO2

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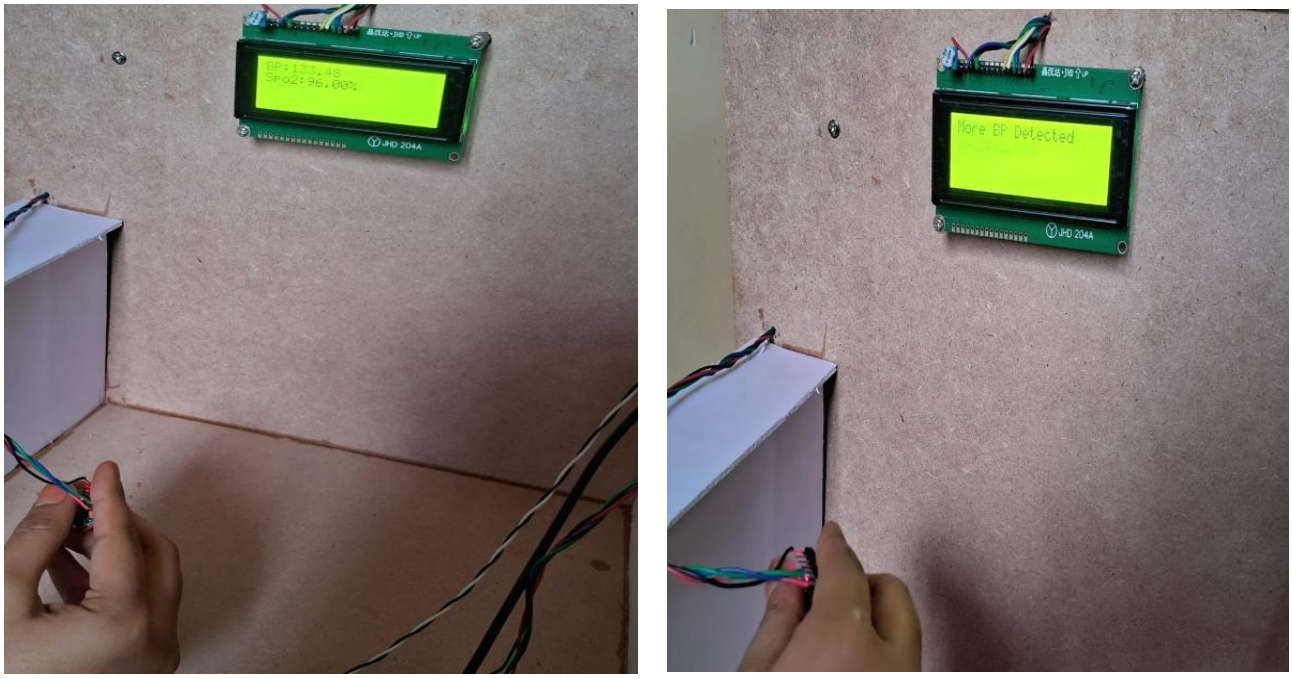

Fig 3: Detection of more BP

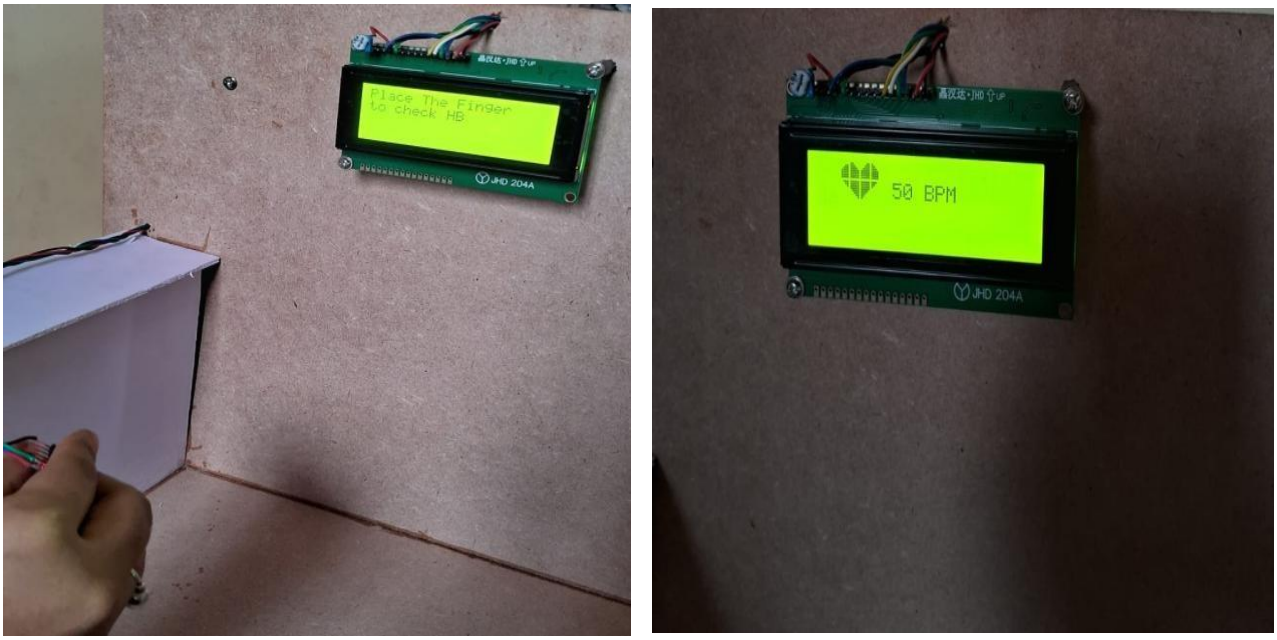

Fig 4: Detection of Heart Beat

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Fig 5: Detection of temperature

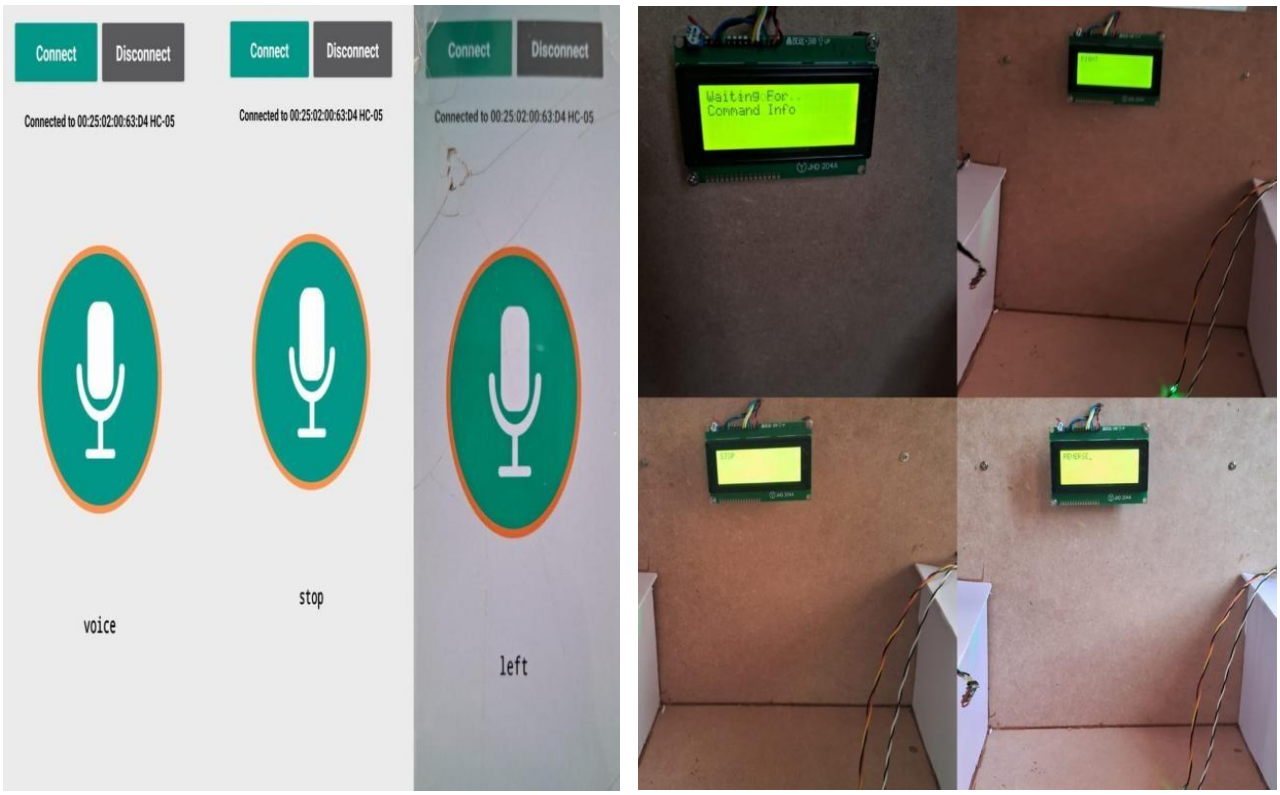

Fig 6: Voice command

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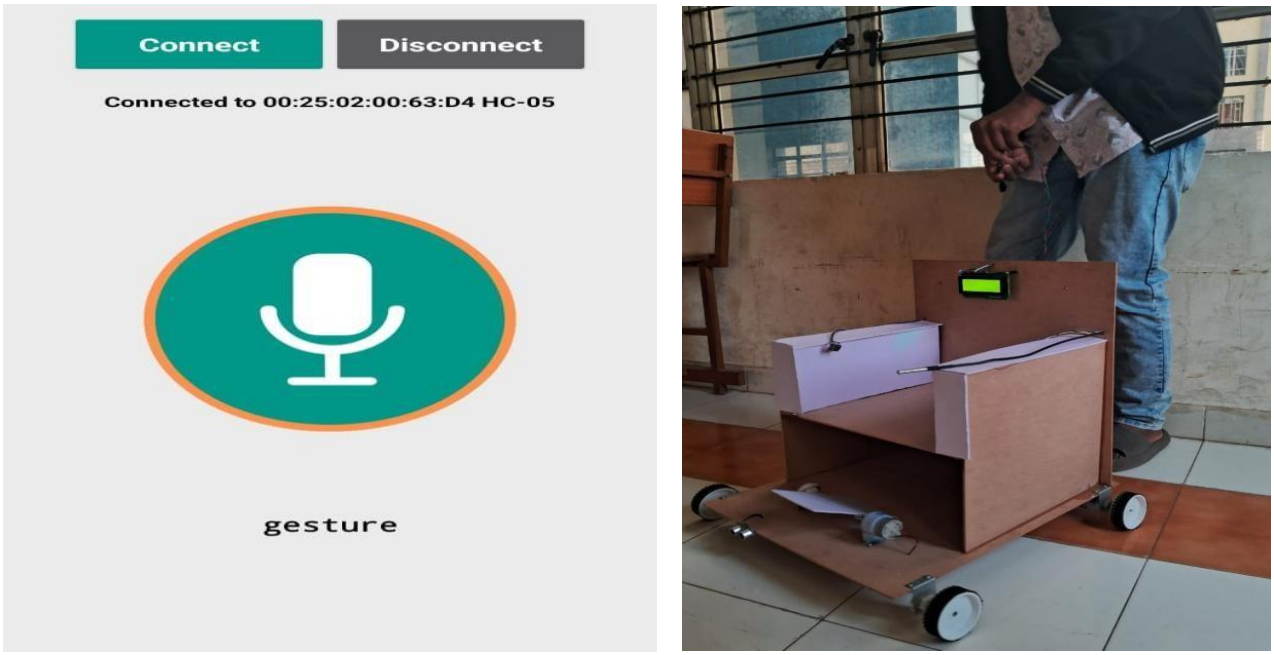

Fig 7: Gesture Mode

Fig 8: Working pedal

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Fig 9: Emergency mobile tracking

V. CONCLUSION

The development of an AI-enabled multi-mode wheelchair is an important step forward in assistive technology for people with physical disabilities. By combining artificial intelligence with different control modes, like voice, gesture, and joystick inputs, the system offers more flexibility, safety, and independence to users with various mobility challenges. The smart control algorithms provide accurate obstacle detection, and efficient navigation, which boosts the user's confidence and independence. This innovative solution shows how AI and IOT technologies can change traditional mobility aids into smart, adaptable, and user-focused systems that encourage inclusivity and a better quality of life for differently-abled individuals.

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This project would not have been possible without the contributions of all these individuals, and I am truly grateful for their support.

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