SMART WHEELCHAIR USING VOICE, GESTURE AND EYE MOVEMENT RECOGNITION

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ABSTRACT

This project proposes the development of a smart wheelchair that can be controlled using voice commands, hand gestures, and eye movements. The system aims to provide individuals with severe motor disabilities, such as quadriplegia, amyotrophic lateral sclerosis (ALS), and spinal cord injuries, with a more intuitive and independent way of navigating their surroundings. The smart wheelchair will utilize a multimodal interface, combining voice recognition, computer vision, and electrooculography (EOG) to detect and interpret user inputs. The system will consist of a wheelchair-mounted computer, a voice recognition module, a camera for gesture recognition, and an EOG sensor for eye movement.

Keyword :- *Smart Wheelchair, Voice Recognition, Gesture Recognition, Eye Movement Recognition, Disability, Rehabilitation.*

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1. INTRODUCTION

Assistive technology has revolutionized the lives of individuals with disabilities, enabling them to navigate their surroundings with greater ease and independence. Smart wheelchairs are a prime example of this technology, incorporating innovative features to enhance user experience. A smart wheelchair is a motorized wheelchair equipped with advanced sensors, artificial intelligence, and IoT connectivity. These wheelchairs can be controlled using various input methods, including:

1. Voice Recognition: Users can issue voice commands to navigate, adjust settings, or access additional features.
2. Gesture Recognition: Hand or head gestures can be used to control the wheelchair, providing an alternative to traditional joysticks.
3. Eye Movement Recognition: This feature utilizes eye-tracking technology, allowing users to control the wheelchair with their gaze.

2.COMPONENTS

2.1 Hardware requirement

2.1.1 Arduino Uno: Arduino Uno acts as the brain of the smart wheelchair, processing user inputs and sensor data to control the chair's movements. It integrates with sensors, motors, and other components to enable features like obstacle avoidance and navigation. Arduino Uno's microcontroller processes algorithms and commands, executing precise control over the smart wheelchair**.**

2.1.2 Battery: The battery powers the smart wheelchair's motors, sensors, and control systems, enabling mobility and functionality. A reliable and efficient battery ensures prolonged usage and reduces downtime for recharging. Advanced battery management systems optimize energy consumption, extending the smart wheelchair's range and overall performance.

2.1.3 ESPNOW RF Transmitter and Receiver: ESP-NOW RF Transmitter and Receiver enable wireless communication between the smart wheelchair's control system and external devices. The transmitter sends commands and data to the receiver, which interprets and executes the instructions, facilitating features like remote control and navigation. ESP-NOW's low-latency and reliable communication ensure seamless and efficient control of the smart wheelchair.

2.1.4 Accelerometer Sensor: The accelerometer measures the smart wheelchair's acceleration, orientation, and vibration, providing vital data for navigation and stability. It detects changes in movement and adjusts the wheelchair's control systems accordingly, ensuring a smooth and safe ride. The accelerometer's data also enables features like tilt detection and fall prevention.

2.1.5 Bluetooth Module: Bluetooth enables wireless connectivity between the smart wheelchair and external devices, such as smartphones, tablets, and wearable devices. It facilitates features like remote control, navigation, and health monitoring, allowing users to interact with their smart wheelchair seamlessly. Bluetooth connectivity also enables software updates, data transfer, and voice assistant integration**.**

2.1.6 Motor Driver: The motor driver controls and regulates the smart wheelchair's motor movements, enabling precise and efficient navigation. It receives commands from the control system and translates them into motor actions, adjusting speed, direction, and torque as needed. The motor driver ensures smooth, reliable, and safe movement of the smart wheelchair.

2.1.7 DC Motor: The DC motor propels the smart wheelchair forward, backward, and turns it left and right, providing mobility and maneuverability. It converts electrical energy into mechanical energy, generating the torque and speed needed for smooth movement. The DC motor's reliability, efficiency, and quiet operation make it an ideal choice for smart wheelchairs.

2.1.8 PCB: The Printed Circuit Board (PCB) serves as the backbone of the smart wheelchair's electronics, connecting and supporting various components. It provides a compact and organized platform for mounting and interconnecting sensors, microcontrollers, motor drivers, and other essential components. The PCB enables efficient communication and power distribution, ensuring reliable operation of the smart wheelchair.

2.1.9 Connecting Wires: Connecting wires link various components of the smart wheelchair, such as sensors, microcontrollers, motor drivers, and batteries. They enable the transmission of signals, power, and data between components, facilitating communication and control. Reliable and secure connections ensured by the wires are crucial for the smart wheelchair's safe and efficient operation.

2.2 Software Requirement

2.2.1 Arduino IDE: The Arduino IDE (Integrated Development Environment) is used to write, compile, and upload code to the Arduino board controlling the smart wheelchair. It provides a user-friendly platform for programming and debugging the wheelchair's functions, such as navigation and sensor integration. The Arduino IDE enables developers to create customized and efficient code for the smart wheelchair.

2.2.2 Arduino -C: Arduino C is the programming language used to write code for the smart wheelchair's Arduino board, controlling its movements and functions. It provides a simple and efficient way to program the wheelchair's sensors, motors, and other components. Arduino C's flexibility and versatility enable developers to create customized and complex behaviors for the smart wheelchair.

2. BLOCK DIAGRAM

Conncetions a smart wheelchair that can be controlled using voice commands, gestures, and eye movement involves integrating multiple components such as sensors, microcontrollers, and actuators

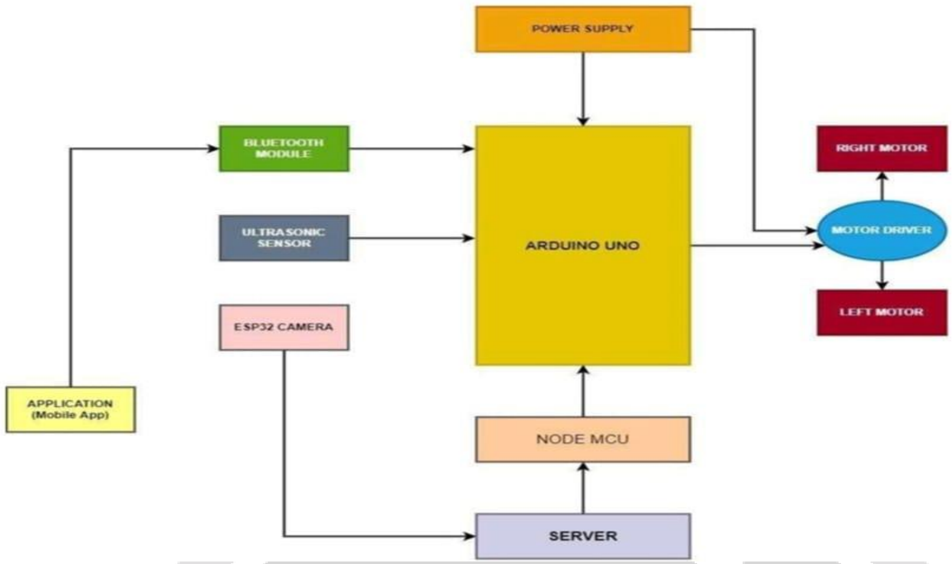

Fig-1 : Block diagram

3. WORKING PRINCIPLE

3.1 Voice Recognition

Voice control in smart wheelchairs enables users to navigate using voice commands. The system uses speech recognition technology to analyze audio signals, extract features, and match them to pre-recorded commands. The control system then executes the intended action. Voice control enhances user experience, increases independence, and improves safety. Advanced speech recognition, natural language processing, and integration with other technologies like gesture recognition and eye tracking will further improve the system's accuracy and functionality, providing a more intuitive and natural way of interacting with the wheelchair.

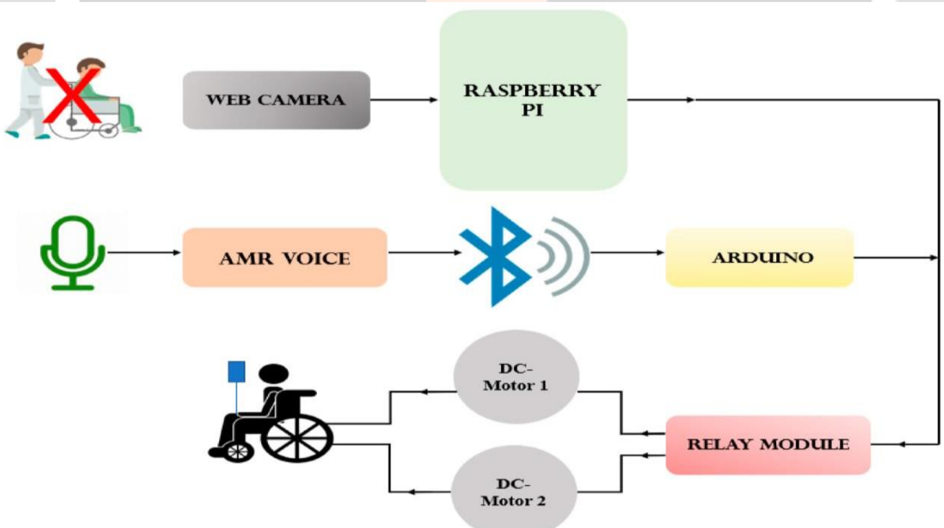

Fig-2 : voice recognition

3.2 Gesture Recognition

Gesture control in smart wheelchairs enables users to navigate using hand or body gestures. A camera captures gestures, which are processed using computer vision and machine learning algorithms. The recognized gesture triggers a corresponding action. Gesture control increases independence, improves safety, and enhances user experience. Advanced computer vision, machine learning, and integration with other technologies will further improve accuracy and functionality. Gesture control provides a natural and intuitive way to interact with the wheelchair, promoting autonomy and mobility for users with disabilities.

Fig-3 : Gesture Recognition

3.3 Eye Movement Recognition

Eye moment recognition in smart wheelchairs enables users to control the wheelchair using eye movements. A camera tracks eye movements, which are processed using computer vision and machine learning algorithms. The recognized eye movement triggers a corresponding action, such as moving forward, backward, or changing direction. This feature provides an intuitive and natural way to interact with the wheelchair, promoting autonomy and mobility for users with severe disabilities. Eye moment recognition enhances user experience, increases independence, and improves.

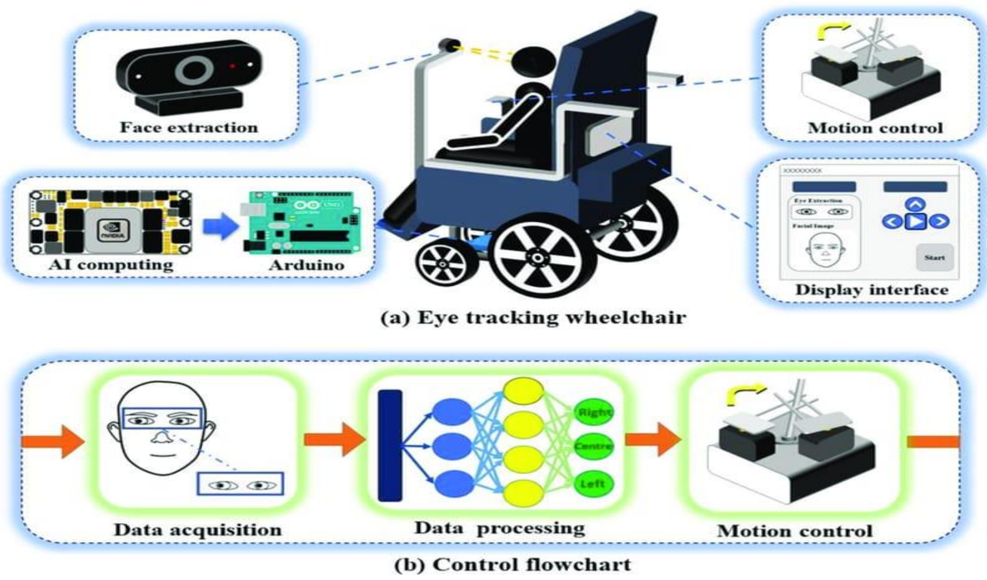

Fig-4 : Eye movement recognition

4.HAREWARE MODEL

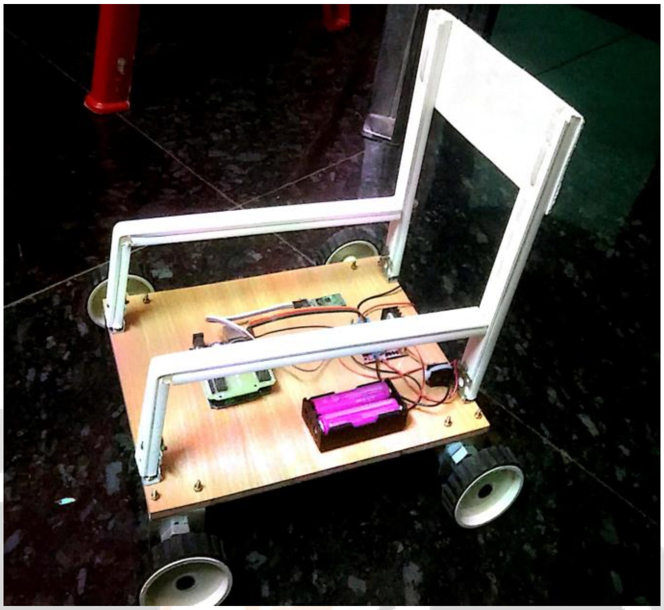

Fig-5: Hardware model for smart wheelchair

5. ADVANTAGES

1.Enable young disabled children and their families to enjoy „ordinary" lives, through access to childcare, early education and early family support to enable them to care for their child effectively and remain socially and economically included;
2.Improving the life chances of disabled people
3.Depending on the direction given through voice and gesture, the Arduino controls the wheelchair directions.
4.Ultrasonic sensors are used to detect obstacles.
5.The prototype is designed in such a way that it can be used independently and efficiently with less effort.
6. It saves time, reduces cost and energy of the users.
8.This gesture controlled wheelchair will help the handicapped person to be self dependent for the purpose of movements for which they mostly dependent on other people

6. APPLICATIONS

6.1Healthcare Applications

1. Rehabilitation Centers: Smart wheelchairs can be used in rehabilitation centers to help patients regain mobility and independence.
2. Hospitals: Smart wheelchairs can be used in hospitals to transport patients safely and efficiently.
3. Home Healthcare: Smart wheelchairs can be used in home healthcare settings to provide patients with mobility and independence.

6.2Daily Living Applications

1. Indoor Navigation: Smart wheelchairs can be used to navigate indoor environments, such as shopping malls, airports, and offices.

2. Outdoor Navigation: Smart wheelchairs can be used to navigate outdoor environments, such as sidewalks, parks, and trails.
3. Social Interactions: Smart wheelchairs can be used to facilitate social interactions, such as visiting friends and family, or participating in community events.

7. CONCLUSION

The smart wheelchair project demonstrates the potential for assistive technology to improve the lives of individuals with mobility impairments. By integrating advanced sensors, artificial intelligence, and IoT connectivity, the smart wheelchair provides a safe, efficient, and personalized mobility solution.

8.ACKNOWLEDGMENT

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