IOT BASED SMART WHEELCHAIR

***Project Reference No.:** 48S_BE_4027*

College : Yenepoya Institute of Technology, Moodbidri, Mangaluru
Branch : Electronics And Communication Engineering
Guide(S) : Prof. Praveen M
Dr. Prasanna Kumar C
Student(S): Ms. Suha Shafee
Mr. Abdul Razik
Mr. Mohammed Yaseen
Ms. Mariyam Shireen

Keywords:

Interface, Functionality, Web, Microcontroller, Module, Usability, Javascript, Html, Client, CSS

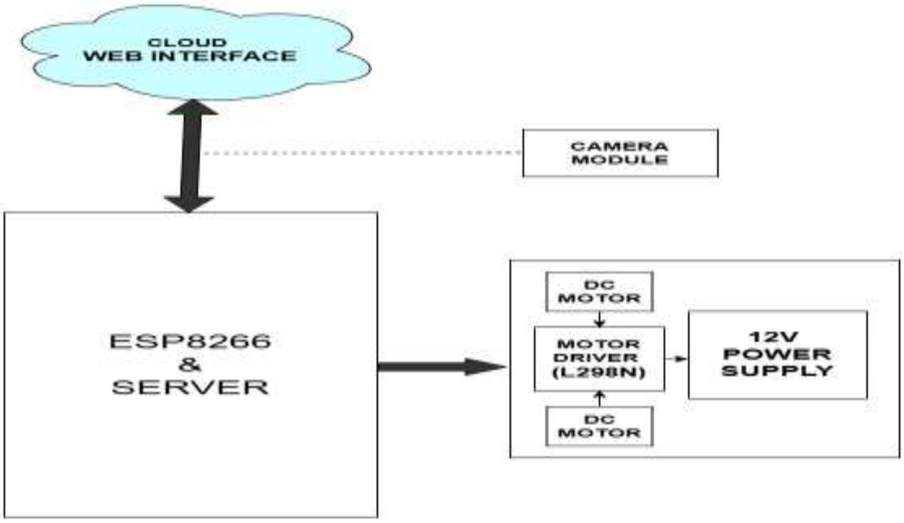
Introduction:

Wheelchairs are essential mobility aids for individuals with disabilities, injuries, or medical conditions that limit movement. Traditional manual wheelchairs require physical effort or caregiver assistance, while electric wheelchairs improve mobility but can be expensive and lack advanced connectivity. With advancements in IoT and embedded systems, smart wheelchairs now integrate wireless control, automation, and real-time monitoring to enhance user convenience and safety. This project utilizes an ESP8266 microcontroller, WebSocket-based real-time control, and a camera module for live video streaming, offering a cost-effective alternative to conventional motorized wheelchairs. Designed for differently-abled individuals, elderly users, and patients in healthcare facilities, this system ensures greater autonomy and ease of use. Future improvements such as obstacle detection and AI-driven navigation could further enhance smart wheelchair technology, making it more adaptive and user-friendly.

Objectives:

Provide users with mobility impairments the flexibility to control the wheelchair using voice commands or through a web interface, catering to different user preferences and needs.

Methodology:



1. System Design and Architecture: The wheelchair system consists of an ESP8266 microcontroller for control, an L298N motor driver for motor operation, a camera module for live video streaming, and a web interface for remote user control. WebSocket enable real-time communication, while the camera feed is transmitted via HTTP.
2. System Hardware Integration: The motor driver is connected to the ESP8266 for movement control using PWM signals. The camera module streams video via ESP8266, and a 12V battery powers the system.
3. Software Development: The ESP8266 is programmed via Arduino IDE to process movement commands and stream video. The web interface, built with HTML, CSS, and JavaScript, provides control buttons and displays the camera feed. WebSockets ensure real-time data exchange.
4. Communication Protocols:
   - Wi-Fi: Enables wireless connectivity.
   - WebSockets: Facilitates instant bidirectional communication.
   - HTTP Streaming: Transmits live video feed to the user’s device.
   - Program ESP32/ESP8266 for web interface and sending serial commands to Arduino.
   - Program Arduino to process voice commands and control motor driver.
5. Testing and Calibration: The system undergoes testing for movement responsiveness, video streaming quality, and real-time communication. PWM values are adjusted for smooth motor control, and the WebSocket connection is optimized.

6. Deployment and Operation: After successful testing, the system is deployed. Users can control the wheelchair remotely through the web interface, while the live video feed ensures real-time monitoring for safe and efficient navigation.

Result and Conclusion:

The IoT-Based Smart Wheelchair System successfully achieved its goal of enhancing mobility and accessibility through remote-controlled operation, real-time monitoring, and live video streaming. The integration of an ESP8266 microcontroller, ESP32-CAM module, and WebSockets communication enabled seamless user interaction and efficient system performance.

Key Outcomes:

- Successful Remote Control: Users could navigate the wheelchair smoothly using a web interface with precise directional control and an emergency stop feature.
- Live Video Streaming: The ESP32-CAM provided clear, low-latency video, improving user awareness and remote navigation.
- Reliable Wireless Communication: The ESP8266 module maintained stable connectivity, ensuring quick response times to control inputs.
- Efficient Power Management: The system effectively utilized a 12V power supply, with battery monitoring to alert users of low power levels.
- Enhanced Safety Features: Buzzer alerts, LED indicators, and a web-based emergency alert system ensured user safety.
- High System Reliability: The wheelchair operated smoothly under various conditions, with minimal latency and self-diagnostics for detecting connection issues.
- User-Friendly Web Interface: The intuitive design enabled easy wheelchair control, live monitoring, and system status updates.

Overall, the project demonstrated a cost-effective, IoT-driven assistive technology that enhances mobility and independence for individuals with physical disabilities, setting the foundation for future enhancements like AI-based navigation and obstacle detection.

Future Scope:

The future scope of this project holds significant potential for enhancing mobility, safety, and independence for individuals with disabilities. By integrating advanced technologies such as AI, voice control, and obstacle avoidance, the wheelchair could become even more user-friendly and autonomous, providing even greater quality of life improvements for users.

1. **Voice Control Integration**
   The current system can be enhanced by incorporating voice control, enabling users to operate the wheelchair hands-free. By using voice recognition technology, such as Google Assistant or Amazon Alexa, users can issue movement commands like “move forward” or “turn left,” making the system more accessible for individuals with limited physical mobility.
2. **Obstacle Detection and Avoidance**
   Adding ultrasonic sensors or infrared sensors could allow the wheelchair to automatically detect obstacles in its path. This feature would enable the wheelchair to stop or change direction when an obstruction is detected, improving safety and preventing accidents.
3. **AI-Based Navigation**
   Incorporating AI and machine learning algorithms could enable the wheelchair to navigate autonomously, avoiding obstacles and optimizing routes. By using computer vision and sensors, the system could analyse the environment and make decisions on the best path, providing a more autonomous user experience.
4. **Improved Power Management**
   The battery life of the system could be improved with the inclusion of a solar panel or energy-efficient components to extend operational time. Additionally, implementing low-power modes when the wheelchair is idle could help conserve energy and enhance battery life.
5. **Enhanced Security Features**
   Since the system relies on Wi-Fi for remote control, ensuring secure communication is crucial. Future improvements could include encryption, multi-factor authentication, and other security measures to prevent unauthorized access and ensure safe operation.

6. **Integration with Smart Home Systems**

   The wheelchair system could be integrated with existing smart home devices, enabling seamless interaction with other assistive technologies. For example, it could be connected to smart lights or doors, allowing users to control their environment from the same interface used to control the wheelchair**.**

7. **Telemedicine and Caregiver Integration**

   Future versions of the system could incorporate telemedicine capabilities, allowing caregivers or healthcare providers to monitor the wheelchair's status remotely. This would help in offering real-time assistance or diagnostics, improving patient care.

8. **Customizable User Profiles**

   The system could include customizable settings for different users, such as personalized movement speeds or control preferences. This would make the wheelchair more adaptable for users with varying needs and abilities.