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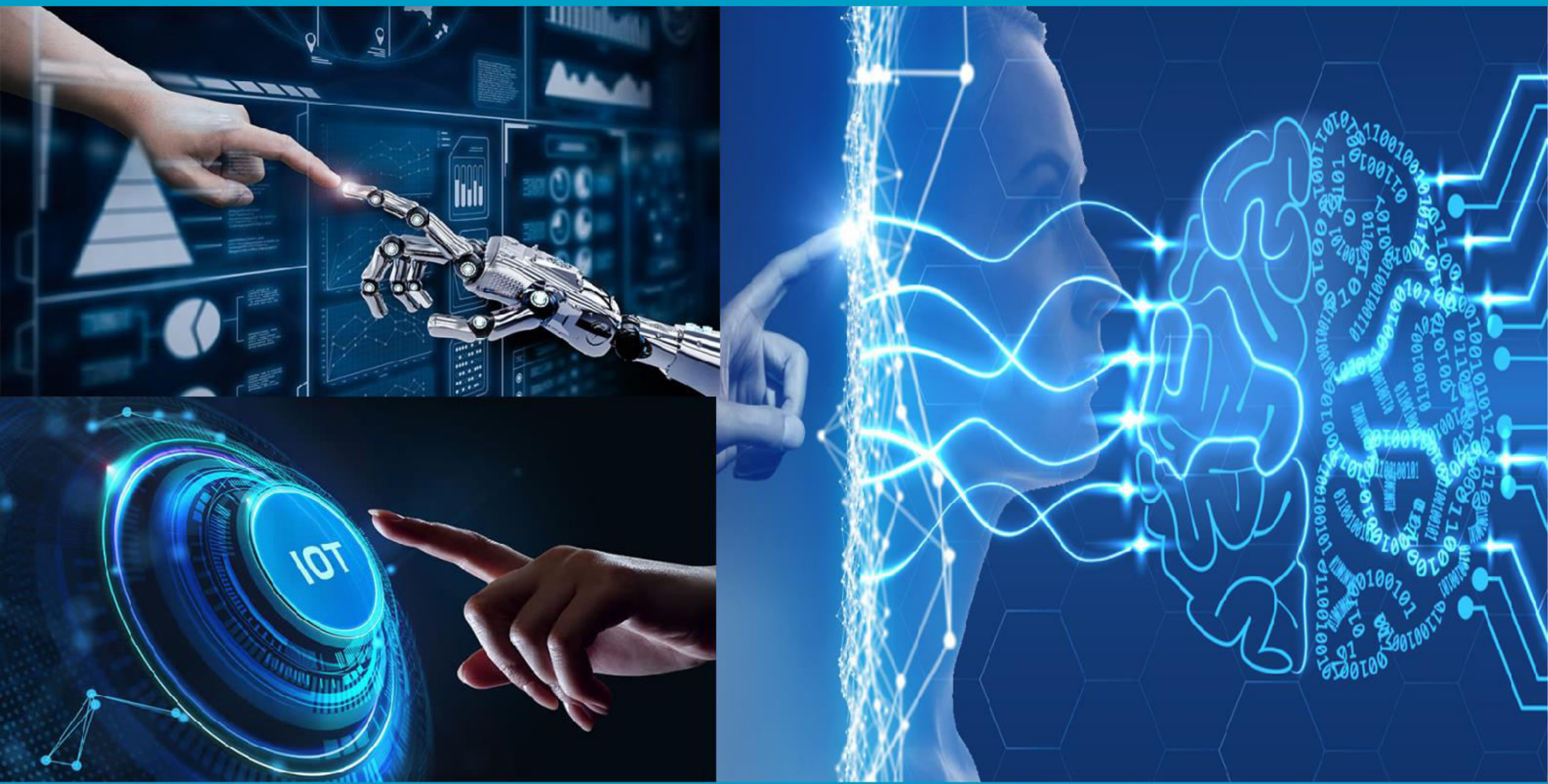

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Development of Smart Automated Wheelchair

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ABSTRACT: This research paper presents the design, development, and implementation of a smart automated wheelchair equipped with advanced features such as obstacle detection, joystick control, and Bluetooth connectivity via a mobile application. The primary aim of this project is to enhance the mobility and independence of users with mobility impairments by incorporating intelligent technologies into traditional wheelchair designs. The wheelchair's ability to detect obstacles in its path, offer multiple control options including joystick and mobile app control, and establish seamless connectivity with smartphones through Bluetooth technology contributes significantly to improving user experience and accessibility.

KEYWORDS: Smart wheelchair, obstacle detection, joystick control, Bluetooth connectivity, mobile application.

I. INTRODUCTION

The increasing demand for assistive technologies to improve the quality of life for individuals with mobility impairments has spurred innovation in the field of smart automated wheelchairs. Traditional manual wheelchairs offer limited mobility and independence to users, particularly in navigating complex environments with obstacles. In response to this challenge, researchers and engineers have been developing advanced wheelchair systems integrated with cutting-edge technologies to address these limitations. This paper presents the development process and features of a smart automated wheelchair equipped with obstacle detection, joystick control, and Bluetooth connectivity via a mobile application.

II. LITERATURE REVIEW

Previous studies have explored various aspects of smart wheelchair design and implementation. Research in this field has focused on incorporating intelligent features such as obstacle detection, autonomous navigation, and user-friendly control interfaces to enhance the functionality and usability of smart wheelchairs. Obstacle detection systems utilizing sensors such as ultrasonic, infrared, and LiDAR have been widely investigated for their effectiveness in detecting obstacles and ensuring safe navigation. Additionally, advancements in control interfaces, including joystick control and mobile app integration, have been explored to cater to diverse user preferences and requirements.

PROPOSED DESIGN

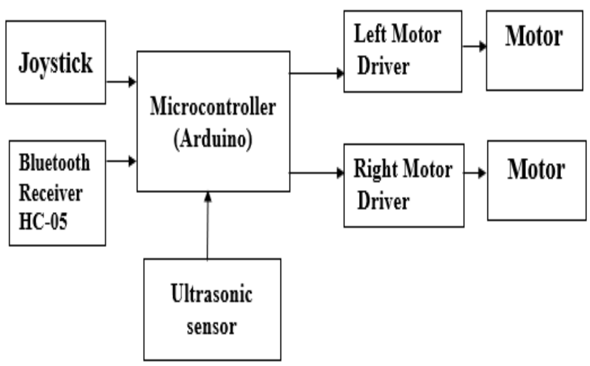

Fig.1 Block diagram of the proposed system

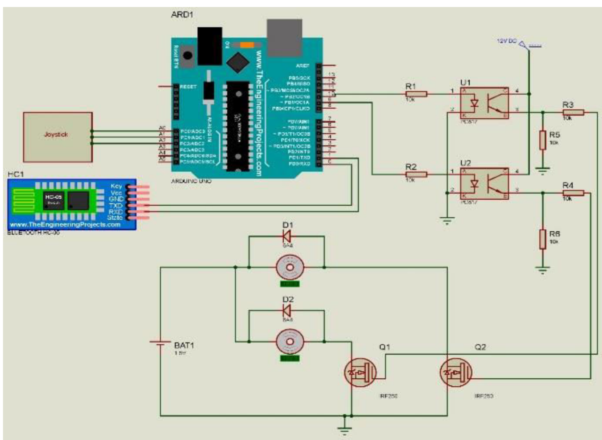

Fig.2 Simulation Circuit diagram

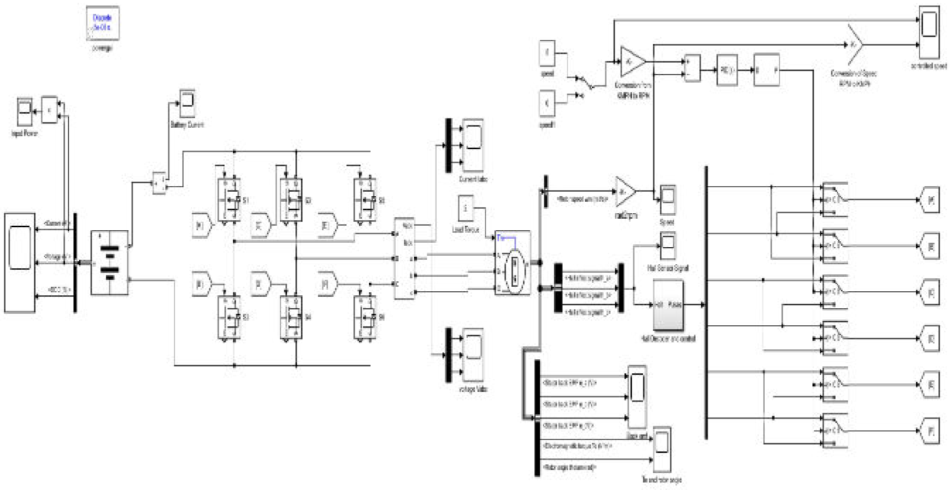

Fig.3 Simulation of Motor Control

As per (fig.1) proposed joystick-controlled automatic wheelchair system comprises seven modules: power supply, joystick, mobile control, relay, driver circuit, motor, and microcontroller serving as the main controller. Input commands from the joystick or mobile device are processed by the microcontroller, directing the wheelchair's movement—forward, backward, left, or right—by controlling two PMDC motors via four relays. When the joystick or mobile control issues commands, the microcontroller orchestrates motor actions accordingly, with both motors rotating in opposite directions for forward and backward motion and individual motor control for turning left or right. Additionally, an ultrasonic sensor integrated with the microcontroller detects obstacles, triggering an immediate system shutdown to ensure safety. speed and direction adjustments for wheelchair movement.

In above fig. PMDC (Permanent Magnet DC) motor control simulation for a smart automated wheelchair involves modeling the motor dynamics, implementing control algorithms, and simulating the wheelchair's movement in a virtual environment. The control algorithms typically include speed and direction control, possibly incorporating feedback mechanisms for stability and obstacle avoidance. The simulation aims to validate the control system's effectiveness, optimize performance, and ensure safe and reliable operation of the smart wheelchair in real-world scenarios.

III. HARDWARE IMPLEMENTATION

Here the proposed model is made up of hardware which was previously explained in the description of the system design hardware.

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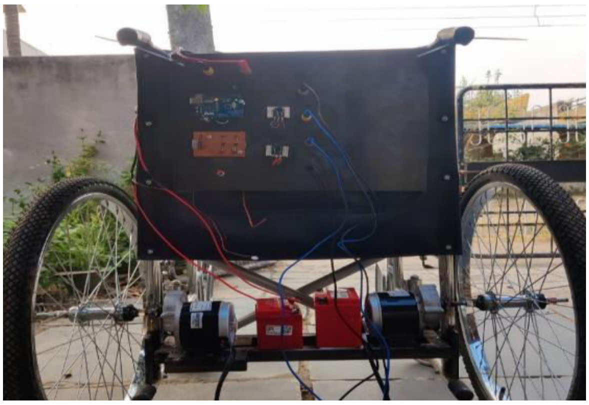

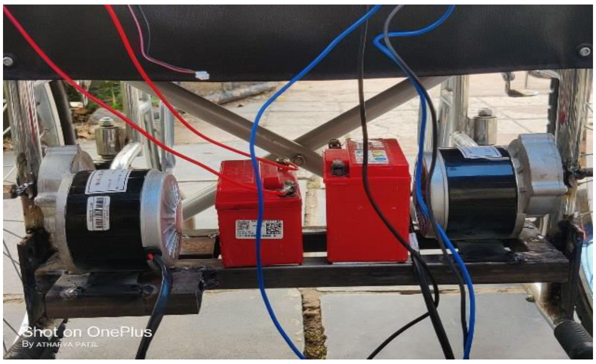

VI. METHODOLOGY

The development process of the smart automated wheelchair involved several key steps, including design conceptualization, component selection, prototyping, and testing. The wheelchair's hardware components include an array of sensors for obstacle detection, a motorized propulsion system, a microcontroller unit for processing sensor data and controlling wheelchair movements, and Bluetooth modules for wireless connectivity. The software component comprises algorithms for obstacle detection and avoidance, as well as user interfaces for joystick control and mobile application interaction.

V. FEATURES AND FUNCTIONALITY

The smart automated wheelchair boasts several innovative features aimed at enhancing user experience and accessibility. These include:

Obstacle Detection: The wheelchair is equipped with an array of sensors strategically positioned to detect obstacles in its vicinity. When an obstacle is detected, the wheelchair autonomously adjusts its trajectory to avoid collisions, ensuring user safety.

Joystick Control: Users have the option to control the wheelchair's movement manually using a joystick interface mounted on the armrest. This traditional control method offers users precision and direct control over the wheelchair's movements.

Bluetooth Connectivity: The wheelchair can be wirelessly connected to a smartphone or tablet via Bluetooth technology. A dedicated mobile application allows users to control the wheelchair remotely, adjust settings, and receive real-time updates on battery life and other diagnostic information.

VI. APPLICATIONS

• Assistive Technology for Disabilities: Smart automated chairs can provide mobility assistance for individuals with physical disabilities, allowing them to move independently.

• Elderly Care: These chairs can aid in elderly care facilities or at home, helping seniors with mobility issues to navigate their surroundings safely.

• Hospital and Healthcare Settings: In hospitals, smart automated chairs can assist in patient transportation within facilities, reducing manual handling and potential injury risks for healthcare workers.

• Rehabilitation Centers: They can be used in rehabilitation centers to aid patients recovering from surgeries or injuries, providing support and mobility during the recovery process.

• Smart Home Integration: Automated chairs can be integrated into smart home systems, allowing users to control them remotely via smartphones or voice commands for added convenience.

• Office Environments: In office settings, smart chairs can enhance accessibility and ergonomics, providing adjustable seating options tailored to individual preferences and needs.

• Event Accessibility: At events or venues, automated chairs can offer accessibility solutions for individuals with mobility challenges, ensuring they can participate fully in activities and programs.

• Outdoor Mobility: Smart chairs designed for outdoor use can enable users to navigate various terrains, such as parks, sidewalks, and uneven surfaces, enhancing outdoor mobility and independence.

• Tourism and Travel: Automated chairs can facilitate travel for individuals with disabilities, providing them with mobility assistance during sightseeing tours, airport navigation, and other travel activities.

• Industrial Applications: In industrial settings, smart chairs equipped with advanced navigation and obstacle detection capabilities can assist workers in moving around large warehouses or manufacturing facilities efficiently and safely.

VII. FUTURE SCOPE

•Advanced Navigation: Implementing advanced navigation systems such as LiDAR or computer vision for precise obstacle avoidance and path planning.

• Enhanced Connectivity: Integrating IoT capabilities to enable remote monitoring and control of the chair's status and location via smartphone or web interface.

• Personalized Assistance: Incorporating AI-powered personal assistant features to provide customized support and assistance based on user preferences and daily routines.

VIII. SIMULATION RESULTS

Preliminary testing of the smart automated wheelchair has yielded promising results regarding its performance and functionality. The obstacle detection system effectively identifies and avoids obstacles in various environments, including indoor and outdoor settings. Users have reported satisfaction with the joystick control interface, which offers intuitive and responsive control over the wheelchair's movements. The Bluetooth connectivity feature enhances user convenience by enabling remote control and monitoring via a smartphone app.

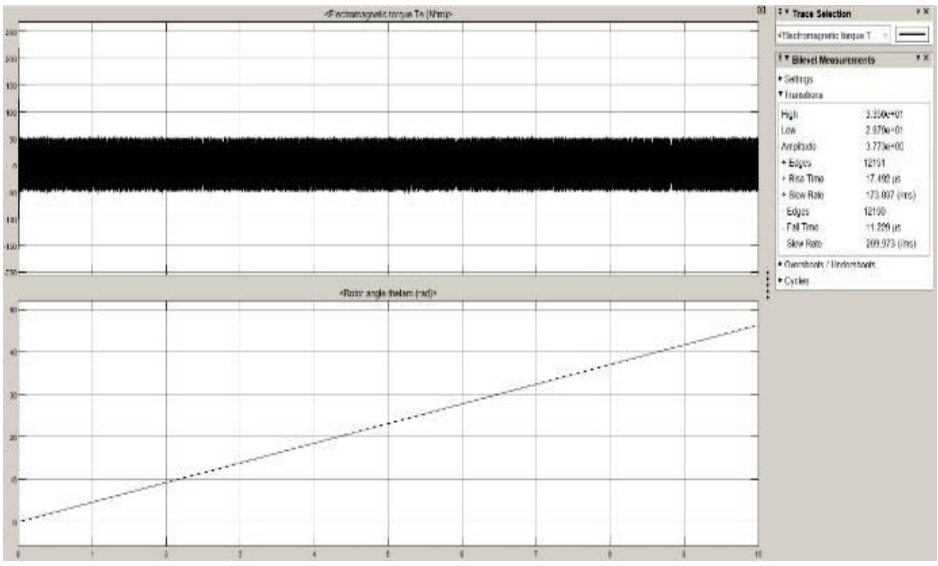

Fig.4 Torque and rotor angle Waveform

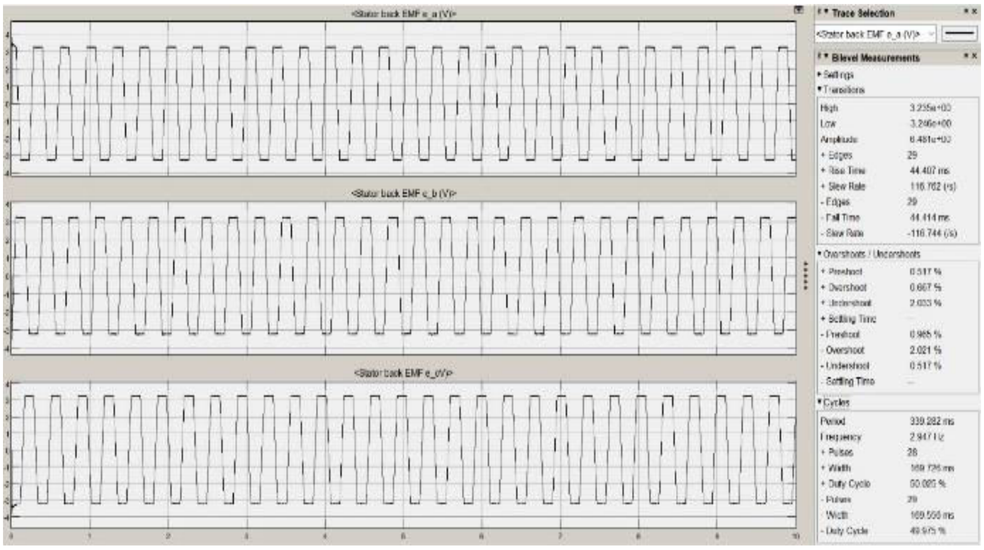

Fig.5 Back EMF of PMDC Motor

IX. CONCLUSION

In conclusion, the development of a smart automated wheelchair equipped with obstacle detection, joystick control, and Bluetooth connectivity represents a significant advancement in assistive technology for individuals with mobility impairments. The integration of intelligent features into traditional wheelchair designs offers users enhanced mobility, independence, and safety. Future research may focus on further refining the wheelchair's capabilities, improving its robustness and reliability, and conducting user studies to assess long-term usability and satisfaction.

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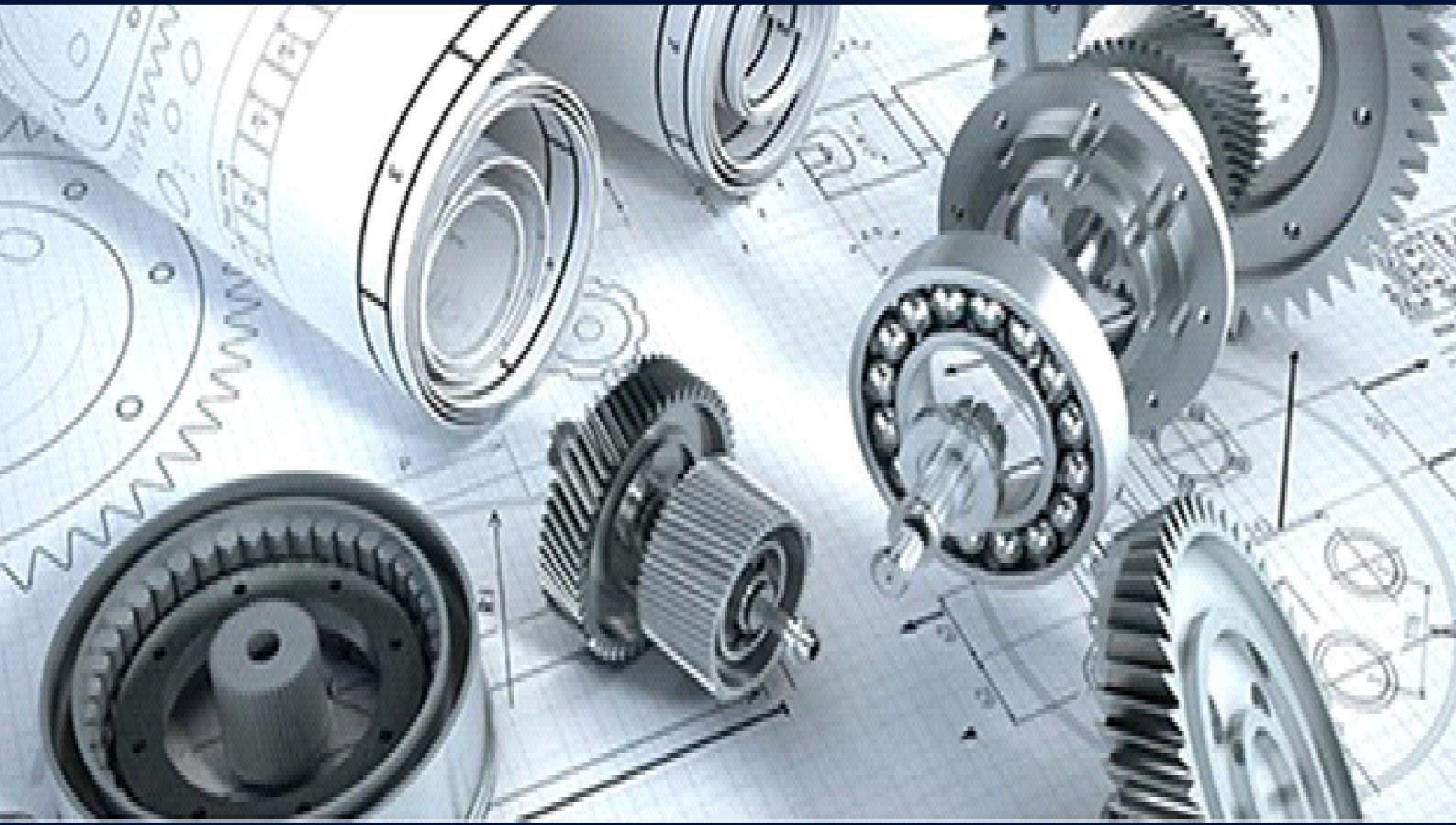

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