

Smart Wheelchair

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Abstract: *For people with disabilities and older adults, mobility assistance devices are vital for improving their quality of life. The project presents the design and implementation of a Smart Wheelchair equipped with Automated Braking and GPS, intended to enhance safety, navigation, and independence. The system utilizes both infrared and ultrasonic sensors to monitor its surroundings and detect potential obstacles. Upon detection, an automatic braking system activates to prevent collisions and ensure user safety. A microcontroller that processes user commands and sensor inputs in real time coordinates the movement of the wheelchair. Developed to improve the mobility, safety, and autonomy of people with physical challenges, the Smart Wheelchair features automated braking and GPS. The system incorporates sensors, microcontrollers, With the GPS module, real-time tracking and route guidance are possible, providing caregivers or family members the ability to monitor the user's location for enhanced security. This innovation merges automation with assistive technology to enhance accessibility, safety, and convenience for wheelchair users, fostering increased autonomy and confidence in their everyday lives.*

Keywords: Smart Wheelchair, Automated Braking, GPS Tracking, Obstacle Detection, Microcontroller, Ultrasonic Sensor, Assistive Technology, IoT System, Safety Enhancement

I. INTRODUCTION

In the modern world, technology is crucial for enhancing the quality of life for people with physical disabilities. For individuals who struggle to walk or move independently, a wheelchair is one of the most vital mobility aids. Nevertheless, conventional wheelchairs frequently do not come equipped with sophisticated safety and navigation features, which complicates safe movement for users in crowded or unknown settings.

To meet these challenges, the Smart Wheelchair with Automated Braking and GPS incorporates advanced technologies like sensors, microcontrollers, and global positioning systems (GPS). Ultrasonic sensors are used by the automated braking system to identify obstacles in the wheelchair's route and engage brakes without delay to avert accidents or collisions. This guarantees enhanced safety and stability, particularly for users who are elderly or have physical challenges.



Moreover, the GPS module offers real-time tracking of location and navigational support. To ensure security and provide support during emergencies, caregivers or family members can keep track of the user's location. The system's intelligent merging of electronics and automation boosts mobility while fostering users' independence and self-assurance. This project seeks to develop a wheelchair that is reliable, intelligent, and cost-effective, with user safety, convenience, and accessibility as top priorities. This reflects the increasing importance of assistive technology in contemporary healthcare.

II. LITERATURE SURVEY

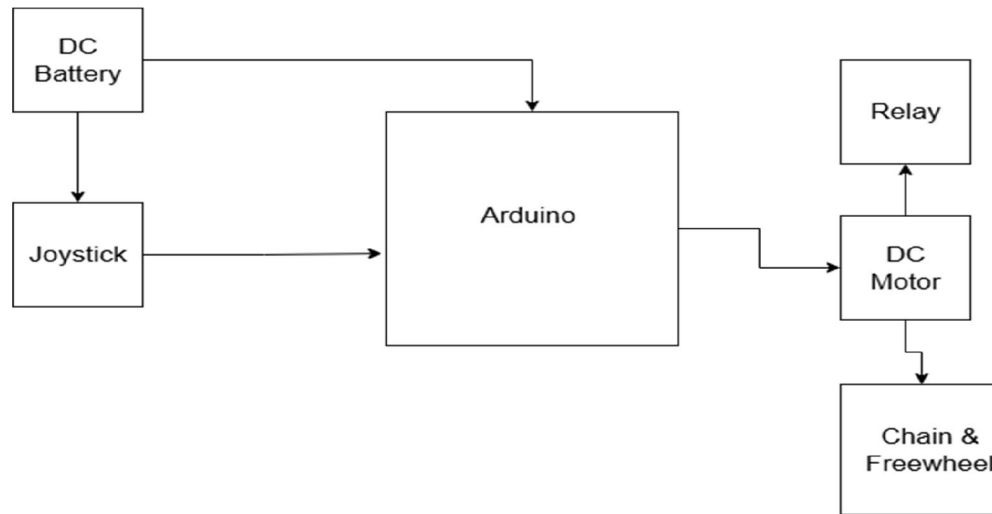
Author	Focus of Investigation	Key Findings	Limitations/Gaps
Leaman, J. and La, H. M. [1]	Comprehensive review of smart wheelchair research from 2005-2015, covering input methods, operating modes, and human factors.	Advancements in biometrics, BCI, vision-based inputs, and autonomous navigation enhance independence; prototypes demonstrate sensor and algorithm integration.	Expensive modifications, limited to indoor use, few real-world trials with users, regulatory and acceptance barriers.
Kim, Y. et al. [2]	Literature review on evolution of smart wheelchair systems, including BCI, controls, navigation, and human factors.	SWs integrate AI and sensors for better usability; BCI like mu rhythm improves accuracy; future includes RL for autonomy.	EEG noise and variability, fatigue in visual inputs, limited commercialization, privacy concerns.
Simpson, R. et al. [3]	Design and evaluation of modular Smart Wheelchair Component System for navigation assistance.	Interfaced with multiple wheelchairs, met obstacle clearance and detection criteria in tests.	Needs commercialization development, limited user trials with disabled, not safe outdoors without enhancements.
Patel, S. M. et al. [4]	Intelligent wheelchair navigation with sensor and vision-based obstacle avoidance and situation recognition.	98.3% outdoor place recognition accuracy, 92% path avoidance, reduced collisions in user tests.	Occasional collisions due to joystick issues, limited to five participants, needs broader testing.
Rane, M. et al. [5]	Smart wheelchair using hand gestures for control and ultrasonic sensors for automatic braking.	Precise gesture detection, obstacle stopping, IoT emergency alerts improve safety.	Gesture accuracy varies with user/environment, sensor limitations for certain obstacles, high cost.
Sivakanthan, S. et al. [6]	Robotic wheelchair taxonomy and readiness	132 RWs identified, focus on indoor avoidance; 10 commercial but low	Lack of end-user involvement, indoor bias,



	model based on 2015-2020 review.	autonomy (Level 1-3).	slow market translation, no advanced AI.
Ageyev, S. and Yaroyvi, A. [7]	Problems and challenges in developing smart power wheelchairs for home use.	Addresses perception/planning via collision avoidance and autopilot; requirements for precision and safety.	Dynamic home changes, noisy inputs like tremor, reliability in auto driving.
Chili, V. and Brahma, L. H. H. [8]	Smart wheelchair with voice navigation, obstacle avoidance, and GPS/GSM emergency.	Successful voice command and auto mode operation, GPS location sharing.	Cost-accuracy trade-off, battery limitations, requires technical knowledge.
Jayasekera, N. et al. [9]	AssistEase smart wheelchair with app integration for control, tracking, and communication.	80-95% control success, 95% guidance precision, high app accuracy.	Affected by noise/lighting, power consumption, limited outdoor ruggedness.
Erturk, E. et al. [10]	Detachable driving module with DWA algorithm for electric wheelchair obstacle avoidance.	Effective real-time avoidance in straight/oblique/corner movements, easy attachment.	Indoor only, no dynamic obstacles, needs diverse environment testing.
Pokyse, E. et al. [11]	Implementation of smart wheelchair with ultrasonic obstacle detection and joystick control.	Detects/stops at 20cm, resumes on clear path, accurate speed adjustments.	High costs/complexity in designs, dependency on user inputs.
Sahoo, S. K. and Choudhury, B. B. [12]	Review of autonomous navigation and obstacle avoidance methodologies in smart wheelchairs.	Sensor/algorithm integration enables complex environment navigation.	Localization accuracy issues, dynamic environment modeling challenges.
Pieniazek, J. and Szaj, W. [13]	Augmented manual control for safe collision with movable obstacles in wheelchairs.	Speed limiting near obstacles allows controlled pushing, consistent simulation/experiments.	Distance measurement assumptions, model-specific adaptation.



III. PROPOSED METHODOLOGY



This block diagram represents a simple system for controlling a DC motor using an Arduino and various connected components. Here's a breakdown of the key elements:

DC Battery: Powers the system. It supplies energy to the circuit, including the Arduino and motor.

Joystick: Likely used for user input, allowing the operator to control the motor's direction and possibly speed by manipulating the joystick.

Arduino: Acts as the central control unit. It takes input from the joystick and processes it to control the relay and motor. The Arduino can be programmed to interpret the joystick's movement and decide how to control the motor.

Relay: A switch that is controlled by the Arduino. It allows the Arduino to turn the DC motor on or off, potentially controlling the direction or other features based on the joystick input.

DC Motor: The component being controlled. The motor will likely drive a physical mechanism, possibly a vehicle or a mechanical system. Its operation is controlled via the relay, which in turn is controlled by the Arduino.

Chain & Freewheel: These components are likely part of the mechanical output system. The chain connects the motor to a moving part, and the freewheel might allow the motor to rotate freely in one direction without engaging the drive system.

The control system intended to operate a DC motor with the use of an Arduino is depicted in the block diagram. The system's central controller is the Arduino, which takes input from a joystick and manages the other components in the circuit accordingly. A DC battery powers the system, providing electrical energy to both the motor and the Arduino. The operator uses the joystick to control the motor's behavior by changing its position, as the joystick functions as the user input device. The input from the joystick is processed by the Arduino, which decides on the suitable action. The Arduino connects to a relay in order to regulate the motor's functioning. Functioning as an electrical switch, the relay allows the Arduino to operate the DC motor. Depending on the system's design, the relay may also control the motor's direction. The motor, which drives a mechanical system, is energized by the relay after it is activated by the Arduino. The motor is linked to a chain and freewheel mechanism, indicating that the motor serves to drive a moving component,



as found in robotic or vehicular systems. The chain conveys the motor's rotational movement to the linked mechanical part, whereas the freewheel can permit movement in one direction without connecting to the drive system.

IV. RESULTS



This image shows a prototype of a mechanical or motorized wheelchair, likely designed for stair-climbing or mobility assistance. It features:

A metal frame with multiple levels and platforms.

Large bicycle-style wheels for movement.

A motor and wiring system visible at the base, suggesting powered functionality.

A unique structure that may support stair navigation or lifting.





This image shows the **electronic and mechanical components** of a motorized or automated wheelchair system. Key elements include:

Two DC batteries (likely 12V) used for power supply.

A **plastic container** housing an **Arduino microcontroller** and a **relay module** for control.

Two DC motors with gear systems, connected to each rear wheel.

Wiring and switches for power and control connections.





The image shows a prototype of wheelchair. It has a sturdy metal frame with a seat, backrest, and armrests. Two large wheels on either side are connected to DC motors, powered by batteries mounted underneath the seat platform. A joystick controller is fixed on the right armrest for user control. The setup appears to be part of a project or prototype model possibly designed for assisting mobility-impaired users through motorized movement.

V. CONCLUSION

The project on the smart wheelchair featuring automated braking and GPS successfully showcases the potential of technology to improve mobility, safety, and independence for elderly people and those with physical disabilities. The system effectively detects obstacles, prevents collisions through automatic braking, and provides real-time location tracking by integrating ultrasonic sensors, a microcontroller, and a GPS module. Thanks to its GPS-based monitoring, this smart wheelchair guarantees safety for the user while also providing reassurance for caregivers. With the



combination of automation and assistive technology, it serves as a dependable and user-friendly mobility aid. This project showcases the application of embedded systems and IoT in healthcare and rehabilitation devices to enhance quality of life. The system can be further improved in the future by incorporating features like voice control, obstacle mapping, and IoT connectivity for remote monitoring, transforming it into an even more advanced and efficient assistive device.

To summarize, the creation of a smart wheelchair featuring automated braking and GPS illustrates the considerable progress made in assistive technology designed to improve life quality for people facing mobility challenges. The wheelchair tackles major issues associated with safety and mobility by incorporating state-of-the-art microcontroller systems and sensors. This project stresses the significance of user-centered design and showcases technology's promise in developing solutions that provide users with increased independence and confidence. With the advancement of the project, there exists a significant opportunity for additional innovation and enhancement, which will help to maintain the smart wheelchair's value for users and caregivers alike.

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