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SMART HUMAN FOLLOWING TROLLEY

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Abstract:

The **Smart Human Following Trolley** is an automated assistive device developed to follow a human user without manual control. The system uses sensors to detect human movement and measure distance, while a microcontroller processes this information to control motor actions.. This reduces physical effort during carrying tasks and improves user convenience. The proposed model is economical, reliable, and easy to implement. It has potential applications in shopping centers, airports, hospitals, warehouses, and other public or industrial environments.

Keywords — Node MCU, Ultrasonic sensors, RFID authentication, Smart Trolley, Embedded Systems, Sensors, Microcontroller, Obstacle Avoidance, LCD display.

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INTRODUCTION

The smart human following trolley utilizes sensor-based detection and microcontroller-driven control to interpret human movement in real time. By combining distance measurement, direction tracking, and obstacle avoidance techniques, the trolley achieves reliable and adaptive following behavior. This approach improves user comfort while maintaining operational safety. This research focuses on the design and implementation of a cost-effective and efficient human following trolley. The proposed system demonstrates how automation and embedded technologies can be effectively employed to create intelligent mobility solutions with real-world applicability.

Conventional trolleys require continuous manual effort and user attention, which may lead to fatigue, especially in locations such as airports, shopping malls, hospitals, and industrial facilities. To overcome these limitations, automated trolleys integrated with sensors, control units, and motorized mechanisms offer a hands-free alternative.

LITERATURE SURVEY

Research on human-following robotic systems has expanded significantly due to growing demand for intelligent assistive technologies in public and industrial environments. Early studies primarily focused on mobile robots that used ultrasonic and infrared sensors to maintain a fixed distance from a human target.

Human-following trolleys are mobile platforms designed to detect and autonomously track a person while maintaining a safe following distance. Research and prototype work in this area have clustered around four main approaches: low-cost proximity sensors, vision-based tracking, range-finder (LiDAR) solutions, and multi-sensor fusion with advanced filtering and control. Each approach trades off cost, robustness, computation, and privacy, and the choice depends on the intended deployment environment—supermarkets, hospitals, airports or domestic setting

The concept of human-following mobile systems has attracted considerable research interest due to its applications in service robotics, assistive devices, and automated material handling. A smart human-following trolley is designed to autonomously track and follow a user while maintaining a safe distance and avoiding obstacles. Various approaches have been proposed in the literature, differing mainly in sensing techniques, control strategies, and computational complexity. Early research on human-following systems primarily relied on **proximity-based sensing methods**. Ultrasonic and infrared sensors were widely used to detect human presence and estimate distance. These systems typically employed microcontrollers such as Arduino for real-time processing and motor control. Studies reported that ultrasonic sensors are effective for short-range distance measurement and perform reliably under varying lighting conditions. However, these methods exhibit limited directional accuracy and are susceptible to interference from surrounding objects, making them less reliable in crowded or dynamic environments. The development of smart human-following trolleys has gained increasing attention in recent years due to the growing demand for automation in service-oriented environments such as shopping malls, hospitals, airports, and warehouses. These systems aim to reduce human effort by autonomously following a user while maintaining a safe distance and ensuring smooth navigation. Various researchers have proposed human-following mechanisms using embedded systems combined with distance sensing, identification techniques, and motor control strategies.

METHODOLOGY

The system uses an ESP32 microcontroller, an ultrasonic distance sensor, an RFID reader, a motor driver, DC motors, and a 16×2 LCD. The ultrasonic sensor continuously measures the distance between the user and the trolley to enable human-following operation, while the RFID module verifies authorized users before activation.The integrated control logic ensures smooth movement, automatic stopping.

a) ESP32

The ESP32 microcontroller acts as the central processing unit of the smart human-following trolley. It is responsible for acquiring data from all connected sensors, executing control logic, and generating output signals for actuators. Due to its high processing speed, low power consumption, and multiple GPIO pins, the ESP32 efficiently handles real-time distance monitoring, RFID verification, motor control, and display updates.

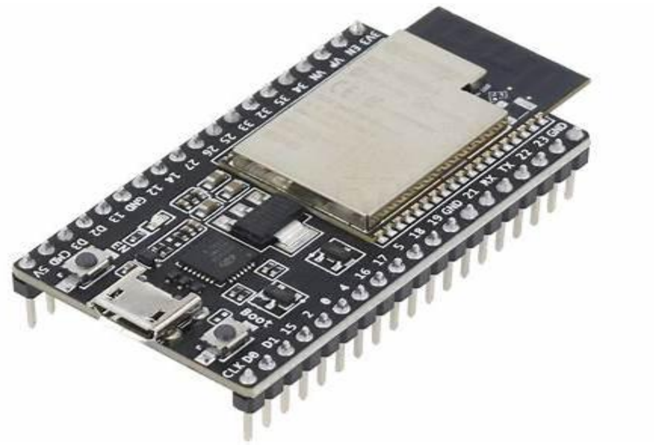

Fig.1 ESP32

b) Ultrasonic Distance Sensor (HC-SR04)

The ultrasonic sensor is used to measure the distance between the trolley and the human user. It operates by transmitting ultrasonic waves and receiving the reflected echo from the target. The measured distance helps the system determine whether the trolley should move forward, stop, or adjust its speed. This sensor plays a crucial role in enabling the human-following functionality while maintaining a safe distance.

Fig.2 Ultrasonic Distance Sensor (HC-SR04)

c) Motor Driver Module

The L298N motor driver module is used to control the direction and speed of the DC motors connected to the trolley wheels. It acts as an interface between the low-power control signals from the ESP32 and the high-power requirements of the motors. The driver enables smooth forward movement, turning, and stopping of the trolley based on control commands.

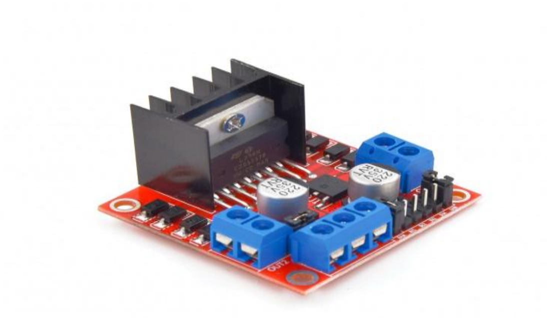

Fig.3 Motor Driver

d) RFID

The RFID RC522 module is incorporated for user identification and system authorization. It reads RFID tags presented by the user and verifies access before enabling trolley operation. This feature ensures secure usage and prevents unauthorized activation. RFID integration also allows future expansion of the system for applications such as smart billing or user tracking

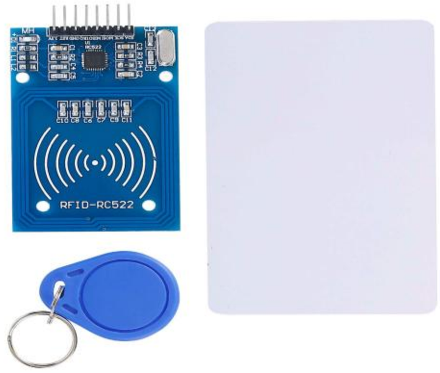

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Fig.4 RFID Reader Module (RC522)

e) Lcd display

The 16×2 LCD display provides visual feedback to the user. It displays important system information such as authorization status, operational messages, and system readiness. This enhances user interaction and improves system transparency, especially in public

Fig.5 LCD display

CIRCUIT DIAGRAM

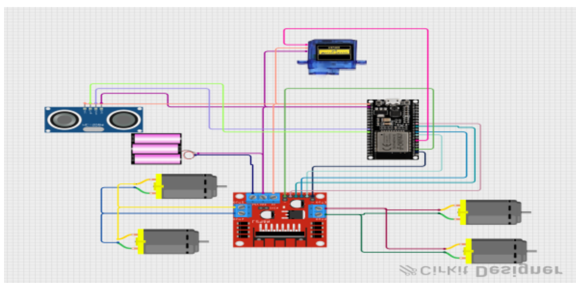


Fig.6 Circuit Diagram

FLOWCHART

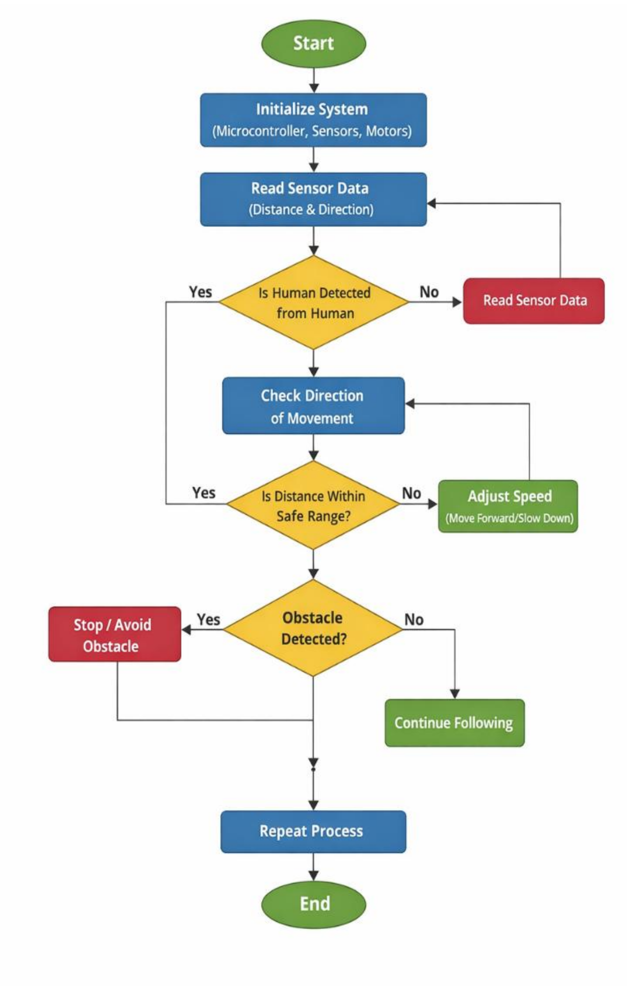


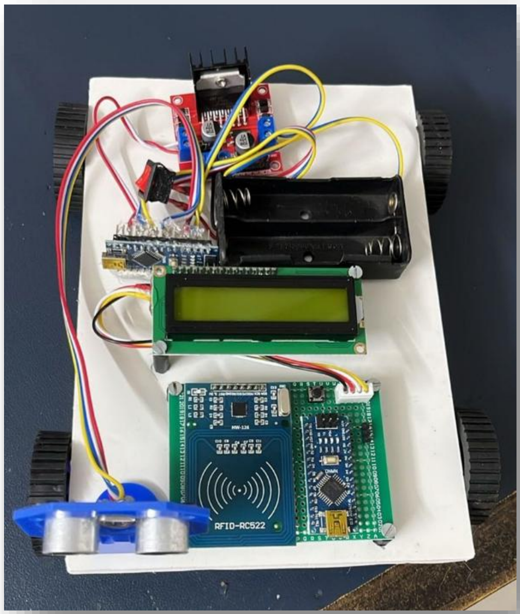
Fig.7 Flowchart

WORKING

The smart human following trolley operates by continuously sensing, processing, and responding to the movement of a human target. The system consists of sensing units, a control module, a motor driver circuit & ultrasonic modules.The smart human following trolley functions by detecting human movement using sensors and processing the data through a microcontroller. Based on the measured distance and direction, the controller regulates motor operation to follow the user while maintaining a safe gap. Obstacle detection runs simultaneously to avoid collisions, ensuring smooth and autonomous trolley movement with minimal user involvement.

RESULT

Based on the measured distance and direction, the controller regulates motor operation to follow the user while maintaining a safe gap. Obstacle detection runs simultaneously to avoid collisions, ensuring smooth and autonomous trolley movement with minimal user involvement.



CONCLUSION

This paper presented the design and implementation of a smart human following trolley aimed at reducing manual effort during load transportation. By integrating sensors, a microcontroller, andmechanisms, the proposed system is capable of autonomously tracking human movement while maintaining a safe following distance. The trolley adapts its speed and direction in real time, ensuring smooth operation and effective obstacle avoidance in controlled environments. Overall. the smart human following trolley highlights the potential of embedded systems and automation in developing practical assistive robotic solutions for real-world applications.

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