

# Design of an Automatic Luggage Carrying Robot

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**Abstract:** Carrying luggage during travel can be difficult and inconvenient, particularly in crowded places such as airports, railway stations, and bus terminals. Travelers often face difficulty managing heavy bags while navigating through busy environments. To address this problem, an automatic luggage carrying robot can be developed to assist users by automatically transporting their luggage while following them. The proposed system uses RFID technology and sensor-based navigation to identify and track the user. The robot consists of hardware components such as an Arduino microcontroller, RFID reader, motor driver, DC motors, ultrasonic sensors, buzzer, and rechargeable battery. The RFID reader detects the tag carried by the user and enables the robot to follow the correct person. Ultrasonic sensors help detect obstacles and prevent collisions during movement. When the RFID signal is lost, the buzzer generates an alert sound to notify the user. The proposed system reduces human effort, improves luggage safety, and enhances convenience for travelers. The robot can be implemented in many public places where luggage assistance is required.

**Keywords:** RFID, Arduino, Autonomous Robot, Ultrasonic Sensor, Smart Luggage System

## I. INTRODUCTION

Robotics technology has significantly advanced in recent years and has become an important part of modern engineering applications. Robots are widely used in industrial automation, medical services, transportation systems, and domestic environments. These systems help improve efficiency, reduce human effort, and perform repetitive tasks more effectively. One of the common difficulties faced by travelers is carrying heavy luggage while moving through transportation hubs such as airports and railway stations. Managing multiple bags can be physically demanding and inconvenient, especially for elderly people, children, and passengers with disabilities. Therefore, there is a need for an automated system that can assist travelers by carrying their luggage. The automatic luggage carrying robot is designed to solve this problem by following the user automatically. The robot uses RFID technology to identify its owner and ultrasonic sensors to detect obstacles during movement. The microcontroller processes signals from these sensors and controls the motors accordingly. This robotic system provides a convenient and efficient solution for luggage transportation in crowded environments. It reduces physical effort and enhances the overall travel experience.

## II. OBJECTIVE

The primary objective of this project is to design and develop an autonomous robotic system capable of assisting travelers by transporting luggage. The specific goals are as follows.

To Develop a Human-Following Mechanism: To implement RFID (Radio Frequency Identification) technology that allows the robot to uniquely identify and follow its owner in real-time.

To Ensure Collision Avoidance: To integrate Ultrasonic Sensors to detect static and dynamic obstacles, ensuring the robot navigates safely in crowded environments like airports and stations.

To Automate Luggage Handling: To minimize human physical exertion by providing a self-propelled platform capable of carrying heavy loads using high-torque DC motors.

To Implement a Real-time Alert System: To provide security features via a Buzzer that notifies the user if the RFID signal is lost or if the robot deviates from the intended path.

To Create a Cost-Effective Solution: To utilize an Arduino-based architecture to keep the design affordable, accessible, and easy to maintain compared to expensive vision-based systems.

### III.SYSTEM COMPONENTS

The proposed automatic luggage carrying robot consists of several hardware components that work together to perform its operation.



#### A. Microcontroller

The Arduino microcontroller acts as the brain of the robotic system. It processes signals received from the RFID reader and ultrasonic sensors and controls the DC motors accordingly.

#### B. RFID Reader

The RFID reader detects the RFID tag carried by the user and sends the identification information to the microcontroller.

#### C. RFID Passive Tag

The RFID tag contains a unique identification code that helps the robot recognize its owner.

#### D. Motor Driver

The motor driver module (L293D) is used to control the direction and speed of the DC motors.

#### E. DC Motors

DC motors provide mechanical movement for the robot and allow it to move in different directions.

#### F. Ultrasonic Sensor

Ultrasonic sensors measure the distance between the robot and obstacles to prevent collisions.

#### G. Buzzer

The buzzer produces an alert sound when the RFID connection is lost or when a warning condition occurs.

#### H. Battery

A rechargeable battery supplies electrical power to all components of the system.

#### I. ESP32-CAM

In the automatic luggage carrying robot, the ESP32-CAM module is used to provide vision and wireless communication capabilities. It contains an inbuilt camera and Wi-Fi module, which allows the robot to capture images and stream live video to a mobile phone or computer. The camera helps the robot monitor its surroundings and identify the path or the person carrying the luggage. Through Wi-Fi connectivity, the robot can be controlled and monitored remotely. Thus, the ESP32-CAM plays an important role in enabling real-time video monitoring, object detection, and wireless control in the luggage carrying robot system.

### IV.SYSTEM DESIGN AND ASSEMBLY



The construction of the automatic luggage carrying robot begins with the design of the robot chassis. The chassis acts as the base structure that supports all electronic and mechanical components. The DC motors are attached to the wheels and mounted on the chassis. These motors are connected to the motor driver module, which controls their speed and direction. The Arduino microcontroller is mounted at the center of the robot and connected to the motor driver. The RFID reader is placed in a position where it can easily detect the RFID tag carried by the user. Ultrasonic sensors are installed on the front side of the robot to detect obstacles. The buzzer is connected to the microcontroller to generate warning sounds. Finally, the battery is connected to power the entire system. After assembling all components and uploading the control program, the robot is ready for operation.

#### V. WORKING PRINCIPLE

The working of the automatic luggage carrying robot is based on RFID identification and sensor-based navigation. Initially, the user carries an RFID tag. When the robot's RFID reader detects this tag, it identifies the owner and begins to follow them. The microcontroller continuously processes signals from the RFID reader and ultrasonic sensors. Based on this data, it sends commands to the motor driver to control the DC motors. If the ultrasonic sensor detects an obstacle, the microcontroller stops the robot or changes its direction to avoid a collision. If the RFID signal is lost, the robot activates the buzzer to alert the user. This ensures that the luggage remains secure and within the user's control.

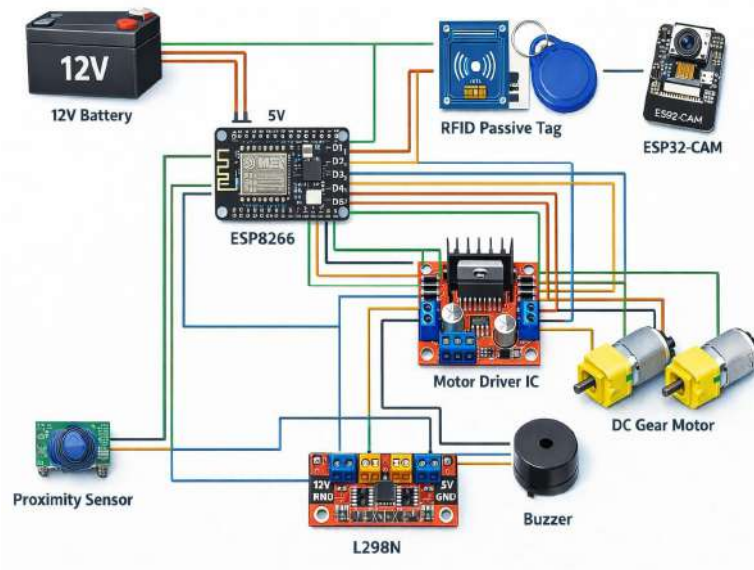
#### VI. APPLICATION

The automatic luggage carrying robot has several practical applications in different environments.

- Airports for assisting passengers with luggage
- Railway stations for helping travelers carry bags
- Hotels for transporting guest luggage
- Hospitals for moving medical equipment
- Shopping malls for customer assistance

Robotics Education: Arduino-based six-axis robotic arms are widely used in educational settings to teach students about robotics, programming, and automation. Students can learn about

#### VII. CIRCUIT DIAGRAM

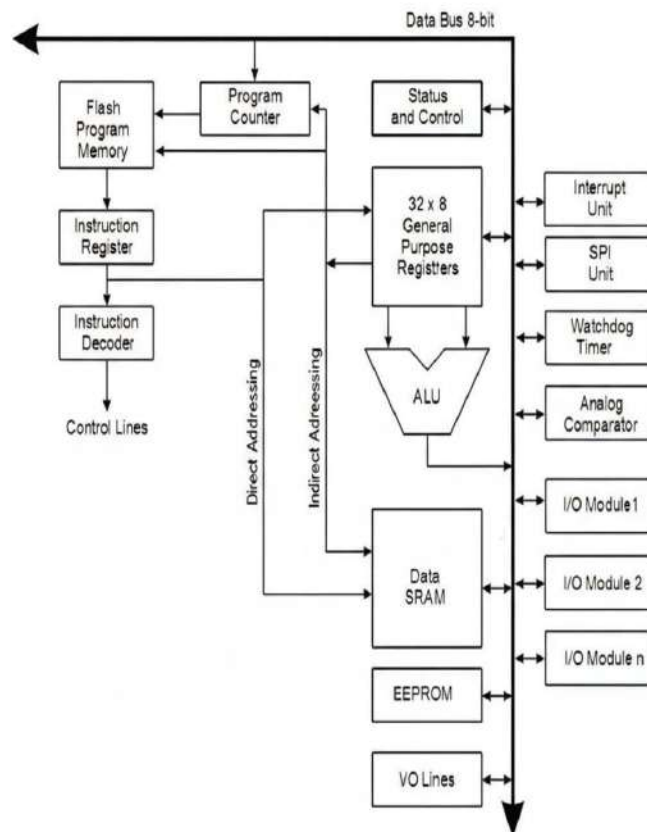


#### VIII. Advantages

The proposed system offers several advantages.

- Reduces physical effort for travelers
- Improves luggage safety and security
- Provides automatic navigation and obstacle avoidance
- Simple and cost-effective design
- Easy to implement and maintain

### IX. FLOW CHART



### XI. CHALLENGING

Despite its benefits, the system has some limitations. RFID signals may experience interference in crowded environments. Battery life may also limit the operating time of the robot. Obstacle detection accuracy is another challenge that must be addressed to ensure safe navigation. Future improvements in sensor technology and artificial intelligence can enhance the performance and reliability of the system.

### X. FUTURE DIRECTIONS

In the future, the automatic luggage carrying robot can be improved by integrating advanced technologies such as artificial intelligence, computer vision, and GPS tracking. A camera-based tracking system could allow the robot to follow the user visually. Smartphone applications could also be used to control and monitor the robot. Improved battery systems and better navigation algorithms can further enhance the efficiency of the system.

### XII. CONCLUSION

The automatic luggage carrying robot is an innovative solution that helps travelers transport their luggage easily and safely. The system uses RFID technology and sensor-based navigation to follow the user automatically. This robotic system reduces human effort, improves convenience, and enhances luggage safety in crowded transportation environments. With further advancements in robotics technology, such systems can become widely used in the future.

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