

LINE FOLLOWING TROLLEY WITH RFID BILLING SYSTEM

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Abstract

In this project, we can design a line following trolley with RFID billing system who follows a path which can be basically black line with the help of infrared (IR) sensors. This trolley can be also equipped with various components like motors, sensors, billing system etc. It reduce the manual efforts especially for elderly peoples, and also very helpful for people with disabilities. For shopping malls customers need to wait in long billing lines, this can be so frustrating for customers and sometimes customers put the extra items in their trolley without looking for price and worries later, so we can install a radio frequency identification (RFID) for scan the price of items on time and can see the total bill, and no need to wait in long frustrating billing lines. It leads to satisfaction of customers and make shopping more efficient, enjoyable, and easy for customers.

Beyond shopping, there are more uses of this trolley, for industrial and heavy loads carriers, airports, and hospitals for efficient material handling. In hospitals for transferring machines without manual efforts, and at the airport for heavy bags we can use this trolley. It reduces time and no need push heavy trolley as it follows a predefined path.

[Keywords- Line-following, Arduino, sensors, RFID billing]

INTRODUCTION

The line following trolley with RFID billing system is a autonomous robot designed to follow a predefined path using infrared (IR) sensors, It is efficient and reduce human efforts, so no need to push trolley manually. Nowadays shopping malls are one of the most popular places for shopping and entertainment, which attract a large number of people every day and to increase customers experience and entertainment, shopping malls have been looking for innovative ideas to gain more customers. Many times, while shopping some customers take too much or useless items without looking at the price and may regret later, to solve this problem we can install a Radio frequency identification (RFID) system so that customers can take items by looking at the total price.

Sometimes customers need to wait in long billing lines and their time can be wasted so to solve this problem RFID is helpful and innovative idea. This trolley equipped with various sensors and other equipments. As a result we can design a line following trolley with RFID billing system. Advantage of this trolley is that they provide a more personalized shopping experience.

One of the major advantage of this trolley is that it can be very helpful for people with limited mobility and disabilities, for these customers, pushing a trolley can be very challenging, as

well as for elderly customers, this trolley provides a solution that can make shopping easier. Furthermore, line following trolley offer a more efficient shopping experience, customers can quickly find the

products they want, and move on to the next item without the need to keep track of their trolley, this means that customer can shop more efficiently, saving time and reducing the stress related to shopping.

By increasing the size of the trolley, we can also use it for transfer the heavy load, like heavy boxes, iron things etc., which is hard to transfer manually, we can also make it like that so it can handle more weight than normal shopping trolleys, so we can easily use for heavy load transfer.

In conclusion, line following trolley is a promising solution for shopping malls and industries that transfer heavy loads.

This system can be consists of following major components:

1. Arduino Nano: 1] The central processing unit that can be receives sensor input and controls the motors.

2] It can be acts as brain of the system.

3] It can also control sensors, motor drivers, and communication between modules.

4] It is compact and can consume low power and can be suitable for applications like a trolley and load transferring device.

2. IR Sensors: 1] It can be useful for detect the black line on the floor and to follow the black line.

2] We can install multiple IR sensors which improves accuracy and tolerance of the trolley.

3] If left sensor detect the line then trolley can move towards left side and if right sensor detect the line then trolley moves towards the right side, and both sensors detect the line then trolley can be go straight.

3. Ultrasonic Sensors: 1] It can be used to detect obstacle in the path of the trolley to prevent collision and it can be stop if a person is within 40cm.

2] It can be useful in crowded areas like malls or airports.

3] It can prevent collision.

4. Motor Driver: 1] Motor driver can be used to controls the direction of trolley and also controls speed.

2] Allows smooth turns and movement of the trolley.

5. LCD Display Module: 1] IT can be useful for displaying information.

2] It displays status messages for user interaction.

3] Can also show error messages

6. Battery & Buck Converter: 1] Can provides power to all components and can regulates voltage.

2] Battery can be rechargeable for portability.

3] It can be also converts higher battery voltage to required levels.

7. Load Sensors: 1] Can be used to measure the weight of items placed.

8. Chassis & wheels: 1] can be used to carry heavy load safely.

1. Real World Use Cases and Implementation Studies:

I) Human-Friendly Smart Trolley This system is design for shopping malls & supermarkets using line following + obstacle avoidance to guide customers. It integrates IR sensors and ultrasonic sensors, Arduino used to control LCD and keypad, and automatic billing displayed in real time, provide a convenient

II] Smart Trolley V2 (ICCSAI 2021) It is equipped with “omnidirectional Mecanum wheels”, this trolley use a combination of line tracking (with IR sensors) and RFID based localization for quick navigation. Arduino is used to processes sensor input and reader data, enabling exact destination targeting and efficient routing scholar.its.ac.id.

III] Smart Trolley with Automatic Billing (IJRASET2025) This design give details about overall system architecture: RFID enabled trolleys that automate item detection, billing, and real time updating with Arduino, with guidance on hardware assembly, software logic, alert systems, and deployment methodology [IJRASET](https://www.ijraset.in).

IV] Smart Trolley for Automated Billing (IJRASET 2023) This project utilizes an IOT enabled approach where customers place RFID tagged items into the trolley. RFID scans retrieve product data from a local database and display totals on LCD, streamlining trolley usage and billing [IJRASET](https://www.ijraset.in).

V] IOT Based Smart Trolley (Sinhgad Academy 2024) It combines “Raspberry Pi” with RFID to process scanned items and maintain a running bill offering a powerful and scalable platform for enhanced checkout automation [IJSREM](https://www.ijraset.in).

VI] RFID Cloud Smart Cart (2016) It is an early prototype combining Arduino Mega, OLED display, and Wi-Fi module, and RFID reader functioning as an e-billing s mart cart and featuring anti-theft RFID gates [arXiv](https://arxiv.org/abs/1605.08001)

VII] Smart Trolley Based on RFID (ICCCE 2021) It is integrates RFID with an Atmega 328 microcontroller, EM-18 reader, GSM module, and LCD Each product added triggers billing calculations visible to consumers with final total sent with SMS enhancing both convenience and scalability [SpringerLink](https://www.springerlink.com).

2. Working Methodology / Working Principle:

System Initialization: 1] The system initializes, and the Arduino can read the IR and Ultrasonic sensor values.

2] The LCD screen displays can show “Ready to follow.”

Following a person along a line: 1] The IR sensors detect a black line on the floor and can guide the trolley along the path.

2] If both IR sensors detect the black line, the trolley can be moves forward.

3] If the left sensor detects the black line, the trolley can be turns left.

4] If the right sensor detects the black line, the trolley can be turns right.

5] If both sensors detect no line, the trolley can be stops.

A. Person Detection and Stopping Mechanism:

1] The ultrasonic sensors can continuously measure the distance to objects in front of the trolley.

2] If a person is detected within 40cm, the Arduino can stop the motors immediately.

3] The LCD can display “person detected- stopping.”

4] The trolley can resume movement once the person moves beyond 40cm.

Obstacle Avoidance: 1] The ultrasonic sensors can check for obstacles in the trolleys path.

2] If an obstacle is detected, the trolley can be stops and waits for it to clear before proceeding.

B. LCD Display Updates: 1] The LCD can continuously updates with messages such as “Following path,” “Person Detected- stopping,” or “Obstacle Detected- stopping.”

3. Research Gaps and Future Directions:

I] RFID Reading Issues: 1] sometimes RFID tags do not work properly (because of wrong angle or interference) so we need more powerful and accurate RFID readers which can be more efficient.

II] Accuracy of Line Following: 1] Sensors can be smoothly work on clear lines and floor.

III] Power and Battery Life: 1] In continuous working trolley battery can be drain too early so we can implement a energy efficient motors and long-life batteries.

IV] Integration with Smart Payment: 1] In future we can implement trolley which can be used to done a payment by face recognition, mobile wallets, UPI etc.

V] Security and Billing Errors: 1] RFID data can be tamper sometimes, so we can implement secure billing system and error-detection algorithms.

VI] Cost Implementation: 1] Current system hardware can be too expensive so we can make low-cost designs.

4.Conclusion:

This LINE FOLLOWING TROLLEY WITH RFID BILLING SYSTEM can be a big automation towards shopping malls, supermarkets, airports, etc. Such system makes shopping easy for people with disabilities and for elderly customers for them pushing a trolley can be more challenging and hard. This system is also useful in hospitals, airports for heavy machines and bags carrier, it can be used to transfer loads without manual efforts. The RFID system can be very useful for scanning items at a time, often wait in long billing lines, this can be frustrating and time consuming, by implementing RFID system we can save more times of customers and they can enjoy shopping. By this system shopping can become more easy, faster, and enjoyable. This system can reduce manual efforts and make supermarkets more reliable and attractive for customers. There can be a combination of IOT, RFID billing system, and robotics. This system can reduce the manpower cost and increase the efficiency of supermarkets. We can be implementing it on malls and smart cities in future in large scale.

Overall, this system can be a important point to make stores, supermarkets, industries more reliable and can be leads towards smart automation.

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