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Smart shopping Line Follower Trolley that Follows customers Embedded with an RFID Reader for Scanning of Products

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Abstract: This paper presents a smart shopping trolley that utilizes RFID technology and line-following capabilities to enhance the shopping experience. The trolley is equipped with an Arduino Mega microcontroller, RFID reader, and line sensors. The RFID reader detects the presence of a customer carrying an RFID-enabled card or tag, while the line sensors guide the trolley along designated aisles. The Arduino Mega processes the sensor data and controls the trolley's motors to follow the customer and navigate the store efficiently. This innovative solution aims to improve customer convenience and streamline the shopping process.

Keywords: Internet of Things

INTRODUCTION: Shopping malls are one of the most popular places for leisure activities, shopping, and entertainment, which attract a large number of people every day. With the increasing popularity of online shopping, brick-and-mortar stores have faced challenges to retain customers. As a result, shopping malls have been looking for innovative ways to provide a more personalized shopping experience to attract and retain customers. One such solution is Smart human following shopping trolleys. Smart customer-following shopping trolleys are designed to follow customers automatically, eliminating the need for them to push the cart manually. This technology offers convenience and ease for shoppers, allowing them to focus on shopping and enjoying their experience. The smart trolley is equipped with various sensors that can detect the customers and follow them while they shop and RFID reader for scanning the RFID tag of the product, LCD display for displaying the bill, an ESP8266 Node MCU WI-FI model for manipulation and sending data to the billing unit wireless communication. One of the primary advantages of smart humans following shopping trolleys is that they provide a more personalized shopping experience. Shoppers can easily navigate through the store without the need to push their trolley or worry about losing it. Another advantage of smart human following shopping trolleys is that they can help customers with limited mobility or disabilities. For these customers, pushing a shopping trolley can be challenging, and the smart trolley provides a solution that can make shopping easier and more enjoyable. The trolley is equipped with a line-following mechanism that enables it to autonomously move around the store by following predefined paths, marked with a black line on the floor. Sensors are used to detect and follow these lines. This automation allows customers to simply place the trolley at the starting point, and it will navigate itself through different aisles or sections of the store. RFID (Radio Frequency Identification) technology is used to track and identify products automatically. Each product in the store is tagged with an RFID tag, which contains a unique identification number. When a customer places and item into the trolley, the RFID reader scans the tag, automatically adding the product to the virtual shopping list and calculating the total cost.

II. METHODOLOGY:

Define Requirements: Understand the objectives and requirements of the smart shopping line follower trolley. This includes factors such as the trolley's size, weight capacity, battery life, speed, user interface, and integration with RFID technology.

Research RFID Technology: Explore different types of RFID systems and components available in the market. Understand how RFID tags and readers work, as well as their range, frequency, and compatibility with the trolley's design.

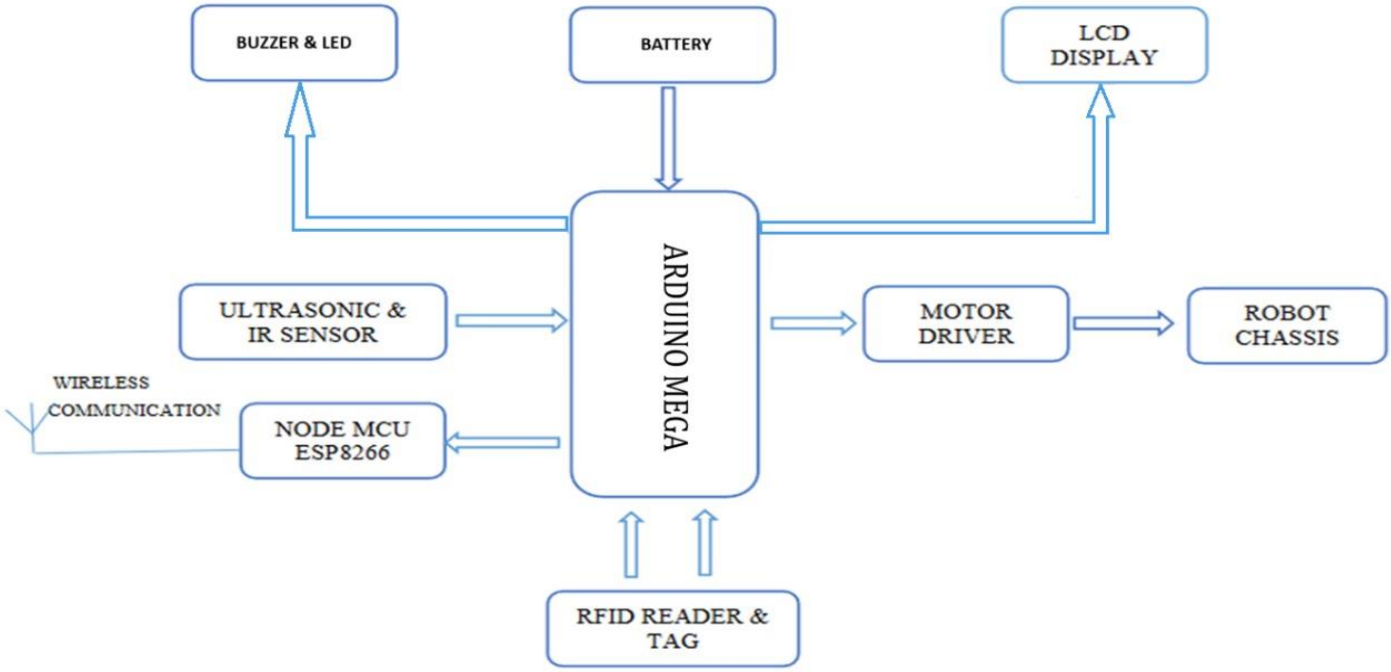
Trolley Design: Develop the physical design of the trolley, considering aspects such as materials, structure, wheels, handles, compartments, and space for the RFID reader and other electronics. Ensure that the design allows for easy integration of the RFID components without compromising functionality or aesthetics.

RFID System Integration: Integrate the RFID reader into the trolley's design in a way that ensures optimal performance and usability. This involves positioning the reader strategically for efficient tag detection, minimizing interference, and maximizing read range.

Software Development: Develop the software system that controls the smart trolley, including RFID data acquisition, processing, and user interface. Implement algorithms for tag detection, inventory management, and user interaction.

Testing and Optimization: Conduct thorough testing of the smart trolley prototype in simulated and real-world environments. Identify and address any technical issues, performance bottlenecks, or usability concerns. Optimize the system for reliability, accuracy, and efficiency. The robot is integrated with 4 x DC Motors with wheels. This allows for easy 4 WD movement of the robotic vehicle. The Arduino uses motor drivers to drive the 4 motors. The robotic vehicle has 2 IR sensors mounted at the bottom to achieve a line follower mechanism. A centralized system would be there for any help and queries and for the billing transaction of the products by the customers. There is less user interface. The project have featured a cart equipped with an RFID reader, a data transceiver and an LCD display. This smart shopping cart keeps an account of the bill made by keeping running total of their purchases. The LCD screen will show the total bill of the items present in the cart. The robotic vehicle also has an ultrasonic sensor mounted towards the front of the robot. The ESP8266 WI-FI module is used to send the billing data to the billing counter. The sensor is used to detect the distance between the user and the robot. The robot keeps following the customer at certain distance as customer moves through the shopping lane. Thus, the system puts forth a smart shopping trolley for modern shopping malls.

III. FLOW CHART



Block diagram of Smart shopping line follower trolley embedded with RFID unit

IV. Specification

Microcontroller (e.g., Arduino Mega) – To control the trolley.

Line Follower Sensors – IR sensors to detect lines on the floor.

Ultrasonic Sensor- to detect the object

RFID Reader – For scanning products.

Motor Driver IC (L298N) – To control the motors.

DC Motors and Wheels – For movement of the trolley.

Power Supply – To power the entire system.

Battery (Rechargeable) – For powering the trolley.

Chassis – To mount the components.

Buzzer/Display (Optional) – For feedback, such as product scan success or failure.

V. Features:

Line Following:

Autonomous navigation along designated paths within the store.

Obstacle avoidance using sensors to detect and navigate around obstacle

Smooth and efficient movement, reducing the need for manual maneuvering.

RFID Integration:

Automatic product identification and tracking as customers place items in the trolley.

Potential for personalized recommendations and offers based on purchase history.

Arduino Mega Control:

Powerful processing capabilities for complex tasks and data handling.

Flexibility to integrate additional sensors and features.

Reliable and efficient control of the trolley's various components

Digital Display:

Real-time display of the total bill amount.

Product information, including price and quantity.

Benefits:

Enhanced Shopping Experience: Reduced physical effort and improved convenience and Faster checkout process.

Improved Store Efficiency: Optimized store layout and navigation and Reduced labor costs and increased sales.

Data-Driven Insights: Valuable customer data for targeted marketing and business decisions and Analysis of shopping patterns and preferences

Results:

The concept of a smart shopping trolley that follows a customer using RFID technology and is controlled by an Arduino Mega is an innovative project. Here's a general outline of the potential results

Efficiency: Increased efficiency in shopping, as customers can focus on choosing items while the trolley follows them.

User Experience: Enhanced shopping experience, particularly for individuals with mobility issues, families with children, or seniors.

Data Collection: Potential to gather data on shopping patterns and behavior if equipped with additional sensors or connectivity options.

Conclusion: The Smart Shopping Line Follower Trolley represents an innovative solution that addresses key challenges in retail, enhancing customer experience while streamlining store operations. By automating tasks like product scanning, personalized recommendations, and checkout, this system brings efficiency and convenience to both consumers and retailers.The trolley improves the shopping journey through automation, personalized recommendations, and reduced physical effort. Customers benefit from a hands-

free experience, faster checkouts, and the ability to interact with digital shopping lists, making the process more enjoyable and efficient. For retailers, the Smart Shopping Trolley offers significant gains in inventory management and labor cost reduction. By providing real time and automating product scanning, the system reduces human error, lowers manual workload, and optimizes in-store operations. The project utilizes advanced technologies like RFID and autonomous navigation, positioning retailers at the cutting edge of retail innovation. This system is scalable and adaptable, making it suitable for various store formats, from small convenience stores to large supermarkets.

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RFID BASED SMART TROLLEY FOR AUTOMATIC BILLING SYSTEM BACHELOR OF ENGINEERING IN ELECTRONICS AND COMMUNICATION ENGINEERING Submitted by K, Preethi CH, Lokesh A, Sai Krishna and Afreen Firdaus