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Transforming Shopping with IOT: Exploring the Intelligent Way to Design the Smart Trolley using IOT Principles

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Abstract - The Internet of Things (IoT) is significantly improving the way everyday systems operate, especially in the retail sector. This paper presents the design and implementation of an IoT-based smart shopping trolley that simplifies the billing process and enhances customer convenience. The system uses RFID technology to automatically identify products placed in the trolley, eliminating the need for manual barcode scanning at checkout counters. As a result, waiting time is reduced and the overall shopping experience becomes faster and more efficient. In addition to billing, the system supports real-time inventory management by transmitting product data to a central server through wireless communication modules. A prototype model is developed to evaluate the performance and reliability of the system. The results demonstrate accurate product detection, smooth communication between components, and effective billing functionality. Overall, the proposed smart trolley provides a practical, cost-effective, and user-friendly solution for modern retail environments. It reduces human effort, minimizes errors, and offers a foundation for future advancements such as smart stores and automated retail systems.

Keywords: Transforming Shopping, IoT, Intelligent Trolley, Internet of Things, Smart Trolley, ST, IoTAST

1. INTRODUCTION

The retail sector is undergoing continuous transformation with the adoption of digital technologies that improve efficiency and customer experience. In conventional shopping systems, customers must scan each product manually at billing counters, which often leads to long queues and delays. In addition, inventory management using traditional methods can be less accurate and difficult to maintain in large stores. The emergence of the Internet of Things (IoT) makes it possible to connect devices such as shopping trolleys, shelves, and products into a unified system. This enables automation of key processes including product identification, billing, and inventory tracking. Smart trolleys equipped with RFID readers and sensors can automatically detect items, generate bills instantly, and support real-time monitoring of stock.This project focuses on the development of an IoT-based intelligent smart trolley using the Arduino Uno microcontroller. The system identifies products through RFID tags, calculates the total cost automatically, and sends transaction details to a cloud platform using Wi-Fi or GSM modules. A weight sensor is included to verify the items and ensure accurate billing. The proposed solution aims to reduce checkout time, improve operational efficiency, and provide a convenient and reliable shopping experience, while also supporting better inventory management for retail stores.

2. SYSTEM ANALYSIS Existing System:

Current existing shopping system:

• The existing shopping system mainly depends on manual barcode scanning at the checkout counter. This process takes more time and creates long queues in supermarkets.

• Inventory management is usually done manually or with limited automation, which may cause errors and difficulty in tracking products.

• Some systems use RFID-based carts to detect items automatically, but they often lack proper integration with IoT for real-time monitoring.

• Advanced systems may use high-cost controllers and separate modules, making them expensive and complex to implement.

• Due to these limitations, the existing system may lead to billing delays, reduced efficiency, and difficulty in managing large retail stores.

Limitations of Existing Systems:

• Possibility of billing errors or product misplacement.

• Manual barcode scanning takes more time and causes long queues.

• Reduced efficiency in large retail environments.

• Limited security features may lead to issues such as item misplacement or unauthorized product removal.

3. PROPOSED SYSTEM

The proposed system introduces an IoT-based smart trolley that automates the shopping and billing process. It uses an Arduino Uno as the main controller along with RFID technology to identify products placed in the trolley. Each item has an RFID tag, and the RFID reader automatically detects the product details when it is added.

Weight sensors are included to verify the items and ensure accurate billing. A Wi-Fi or GSM module sends the transaction data to a cloud server, allowing real-time inventory monitoring and data analysis. This system reduces checkout time, minimizes human effort, and improves the overall shopping experience by providing automatic billing and efficient inventory management.

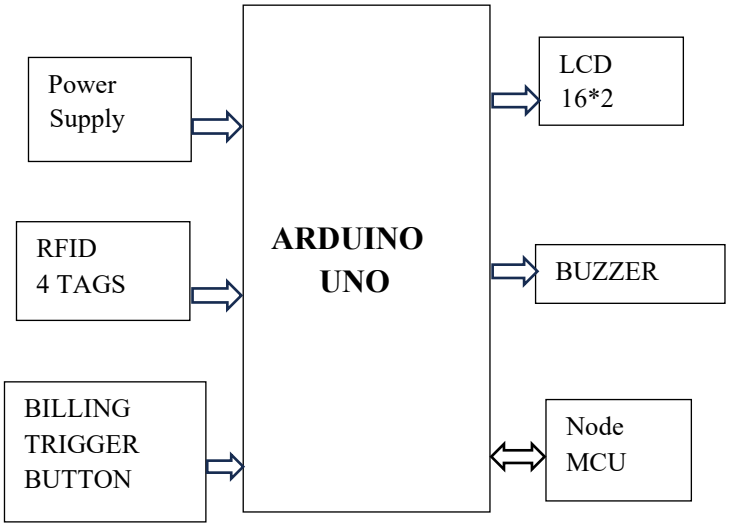

Fig.1 Block Diagram

The proposed system is an IoT-based smart billing trolley that automates the shopping and billing process. The Arduino Uno acts as the main controller that manages all connected components. Products are identified using RFID tags through an RFID reader, and the item details are processed by the controller. A billing trigger button is used to generate the bill. The product information and total cost are displayed on a 16×2 LCD display for the user. A buzzer provides alerts for successful scanning or errors. The NodeMCU module sends billing and inventory data to the cloud for monitoring. This system reduces manual billing, saves time at checkout counters, and improves the overall shopping experience.

3.1 Core Concept

ARDUINO UNO:

Fig.2 Arduino uno board

In the smart trolley system, the Arduino Uno acts as the central controller that manages all the connected components. It receives product information from the Radio Frequency Identification reader when an item with an RFID tag is scanned. The Arduino processes this data and updates the product details and price on the LCD display. It also activates the buzzer for alerts and works with the NodeMCU to send billing information to the cloud. In this way, Arduino Uno controls the overall operation of the smart trolley and enables automatic billing.

NodeMCU:

Fig.3 NodeMCU

In the smart trolley system, the NodeMCU provides Wi-Fi connectivity for the device. It receives

processed data from the Arduino Uno and sends the product and billing information to a cloud server. This allows real-time monitoring of shopping details and inventory updates. By transmitting data through the internet, the NodeMCU helps the system maintain accurate records and improves the efficiency of the shopping process.

RFID Reader and RFID Tags:

In the smart trolley system, RFID tags are attached to each product and store the item's identification data. When a product is placed near the RFID reader, the reader detects the tag using radio signals and retrieves the stored information. This data is then sent to the Arduino Uno, which processes the item details and updates the product information on the display. This process helps the system automatically identify products and supports quick and accurate billing.

Fig.4a RFID Reader Fig.4b RFID Tags

Fig.4 RFID Reader and RFID Tags

LCD:

Fig.5 LCD Display

In the smart trolley system, the LCD display is used to show information to the user. It receives data from the Arduino Uno after a product is scanned using Radio Frequency Identification. The display shows details such as the product name, price, and total bill amount. This helps the customer easily view the items added to the trolley and track the billing process in real time.

BUZZER:

Fig.6 Buzzer

In the smart trolley system, the buzzer is used to provide audio alerts. It is controlled by the Arduino Uno. When a product is successfully scanned through Radio Frequency Identification, the Arduino activates the buzzer to produce a short sound. This sound notifies the user that the item has been detected and added to the billing system.

Advantages of Proposed System:

- Enables automatic product billing using Radio Frequency Identification.
- Reduces waiting time at the billing counter.
- Sends transaction data online using NodeMCU for monitoring.
- Displays item details and total cost on the screen for customers.

EXPERIMENTAL RESULTS:

Fig.7 Displaying the cost of product and total of all products

Fig.8 OUTPUT THROUGH MOBILE

The experimental results based on the implemented prototype show that the smart trolley system operates effectively in real-time conditions. From the images, the RFID reader successfully detects product tags, and the LCD display clearly updates product names and corresponding prices instantly as items are scanned. The system dynamically calculates and displays the total amount, confirming accurate billing functionality.

The hardware setup, including the Arduino board, RFID module, and display unit, works in proper coordination without noticeable delay. Overall, the results demonstrate that the system achieves automated product identification, real-time billing, and user-friendly output, validating its efficiency and practicality for smart retail applications.

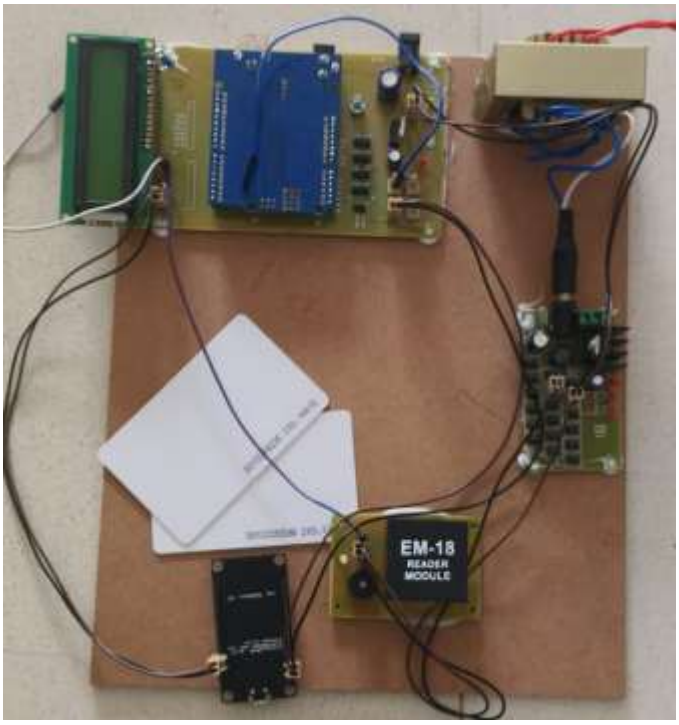

Fig.9 Hardware kit

4. CONCLUSION

The project presents a practical implementation of an IoT-based intelligent smart trolley that simplifies and modernizes the shopping process. . By combining RFID technology, sensors, and wireless communication, the system enables automatic product identification, accurate billing, and efficient data handling. It reduces human effort, minimizes errors, and improves overall customer convenience. The integration of real-time inventory updates also helps store management in monitoring stock levels and making timely decisions. Additionally, the system enhances security by verifying items through sensor validation, reducing the chances of fraud or mismatch. Overall, the results confirm that the system is efficient, reliable, and suitable for real-world retail applications, with strong potential for scalability and future enhancements such as mobile integration and advanced analytics.

FUTURE SCOPE

The future scope of this project includes enhancing the system with advanced technologies to make it more efficient and user-friendly. The smart trolley can be integrated with mobile applications to allow customers to view billing details, make digital payments, and receive personalized offers. Artificial intelligence and data analytics can be added to analyze customer behaviour and improve inventory management. The system can also be upgraded with improved sensors and security features such as automatic theft detection. Furthermore, expanding the solution to support large-scale supermarkets with centralized cloud systems and real-time tracking can make it more scalable and widely applicable in modern retail environments.

REFERENCES

1. M. Jayaprakash et al., “Transforming Shopping with IoT: Exploring the Intelligent Way to Design the Smart Trolley using IoT Principles,” *IEEE*, 2024.

2. S. Kumar & P. Sharma, “IoT-Based Smart Retail Systems Using Arduino Uno,” *International Journal of Electronics and IoT*, 2023.

3. R. Patel, “RFID-Enabled Smart Shopping Carts for Automated Billing,” *Journal of Retail Technology*, 2022.

4. T. Velusudha et al., “Inventory Management in IoT-Assisted Smart Trolleys,” *International Conference on Intelligent Systems*, 2023.

5. A. Hency Juliet et al., “Cloud-Integrated IoT Solutions for Smart Retail,” *IEEE Sensors Journal*, 2022.