Smart Trolley Automation

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Abstract:

The Smart Trolley Automation system aims to improve the retail shopping experience by reducing billing time and automating item tracking using RFID and IoT technologies. The trolley is equipped with an RFID reader, load cell, ESP8266 Wi-Fi module, and a Django-based backend to scan products, verify their weight, and manage real-time billing. This system eliminates manual checkout, minimizes errors, and enhances inventory management. It offers customers a faster, more efficient, and hassle-free shopping experience while helping retailers streamline their operations.

I.Introduction:

Smart trolley automation is a transformative approach to modernizing the shopping experience by integrating advanced technology into traditional carts. This project uses RFID technology and an ESP8266 Wi-Fi module to automate item detection and billing. The trolley is equipped with an RFID reader to scan RFID-tagged items in real time, capturing product details such as name, price, and quantity. The data is transmitted to a Django-based application that provides seamless database connectivity to store and manage item information, user profiles, and transaction histories. We have added Load cell to check the load of the product to determine its weight with the specific weight in the database.

The system automates the billing process by updating the total amount in real time as items are added or removed from the trolley, eliminating the need for manual scanning at checkout counters. This reduces waiting times and minimizes errors. Retailers benefit from real-time inventory tracking, which enhances stock management and restocking processes. The Django application also offers a user-friendly interface for customers to monitor their carts and for store administrators to analyze sales and manage inventory effectively.

By addressing common retail challenges such as long queues, billing inaccuracies, and inefficient inventory management, the smart trolley automation system streamlines shopping and improves customer satisfaction. This innovative solution leverages IoT and RFID technologies to create a seamless, efficient, and hassle-free shopping experience while optimizing store operations.

II. Objective and Scope:

Objective:

1. To implement IOT and RFID in smart trolley for improving efficiency and automation.

2. To implement a Reader in a system to read the QR code and its amount respectively.

3. To improve a smart trolley system for billing system management by payment gateway can streamline the shopping experience.

4. To implement a buzzer system to check, this will notify the user when actual quantity weight & build quantity weights are mismatched.

5. To improve budget management by showing the total cost & items in real time budget tracking.

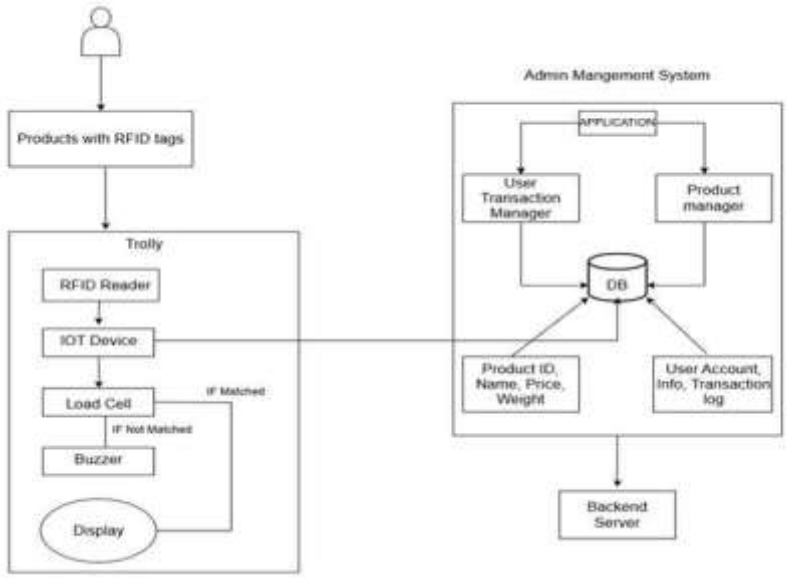
6. To improve shopping experience by seamless & hassle-free checkout & flexibility to customers.

Scope:

The Smart Trolley Automation project focuses on automating billing and item tracking in retail using RFID and IoT

technologies. It enhances customer experience by reducing checkout time and improving inventory accuracy. The system integrates hardware components with a Django-based web application for real-time monitoring. This research lays the groundwork for future advancements in smart retail and automated shopping systems.

III. Proposed System Architecture:



(Fig.1: Proposed System Architecture Diagram)

The Smart Trolley Automation system scans RFID-tagged products and verifies their weight using a load cell. If a mismatch occurs, a buzzer alerts the user and details are shown on a display. The IoT-enabled trolley sends data to a backend system that manages users, transactions, and product details in a central database, ensuring accurate and efficient processing.

IV. Modules:

1. Implementation of Automated Trolley:

The automated trolley scans products using an RFID reader and validates their weight with sensors as they are added. A microcontroller processes this data, updates the total on an LCD display, and communicates with a central server. The system is powered by a rechargeable battery, enabling a seamless and automated shopping experience.

2. Implementation of RFID reader:

The RFID Reader allows the trolley to identify the items inside by scanning RFID tags attached to the products. These tags store information about each item, which the RFID Reader captures and shares with the system. This integration helps update inventory, track item details, and manage pricing in real-time, ensuring accurate billing and inventory management.

3. **Application for Tablet:**

Displays cart items and checkout options. Auto-adds/removes items in the cart. Generates bills and processes payments.

4. **Implementation of billing module:**

The Billing Module manages the payment process for items in the trolley by tracking items and their prices using data from the RFID reader. It allows users to review their total bill, process payments through integrated payment systems, and generates a receipt, which can be provided either digitally or on paper.

5. **Implementation of Load Cell:**

The load cell module is used to measure the weight of items placed in the smart trolley. It converts the applied weight into an electrical signal, which is processed by the microcontroller using an HX711 amplifier. This helps in verifying

the weight of scanned items for accurate billing. It also supports security by detecting unauthorized item additions or overloading.

V. Results:

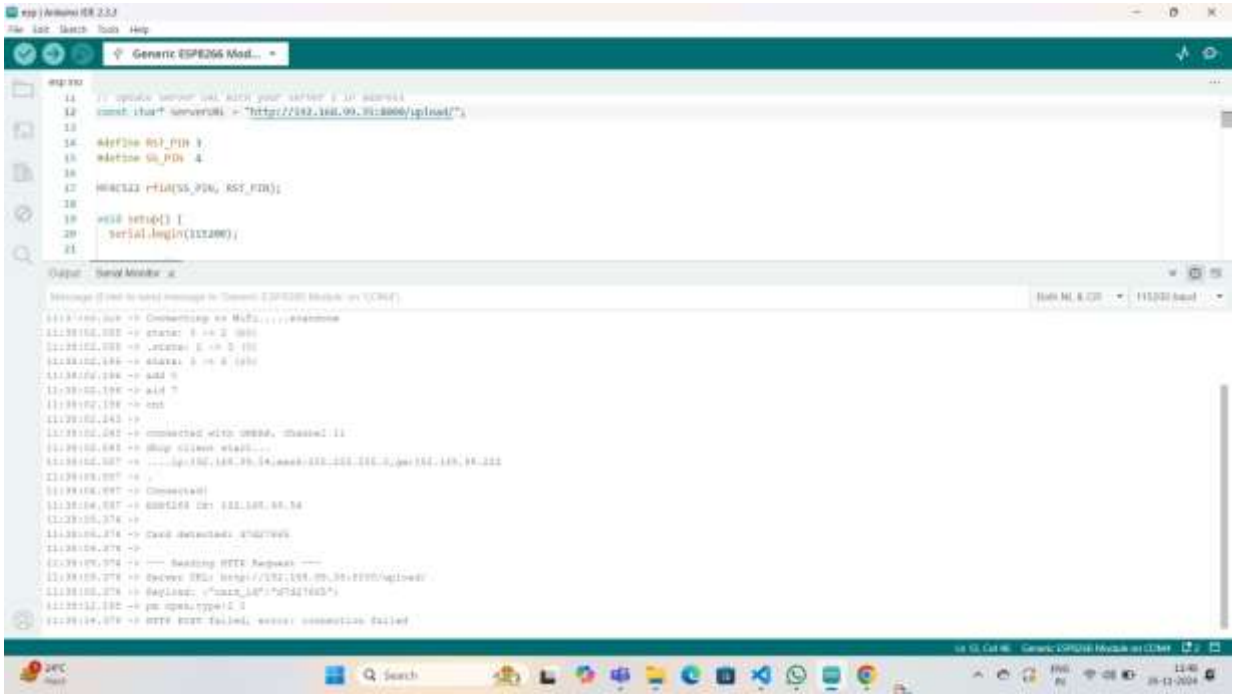


Fig 5.1- ESP8266 software implementation

The ESP8266 Wi-Fi module connects the Smart Trolley to a Wi-Fi network and transmits RFID data to the Django server via HTTP requests. Its firmware ensures real-time communication, confirmed by successful serial monitor output.

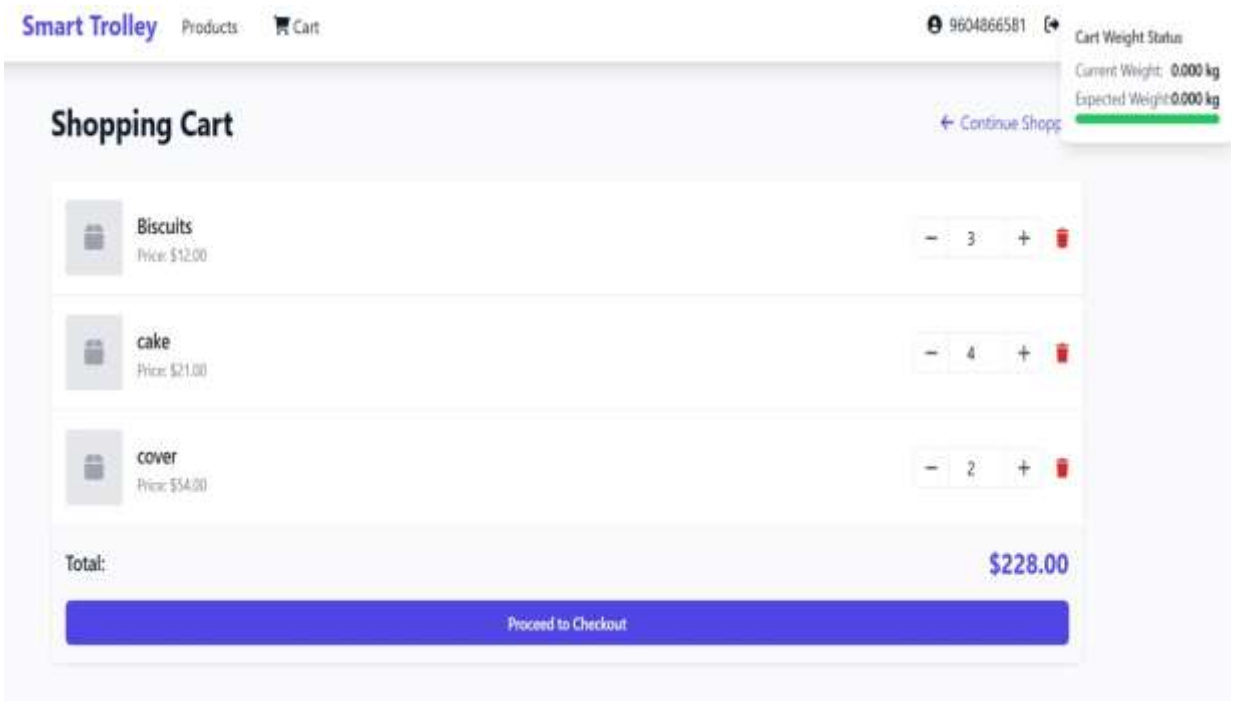


Fig 5.2 – web application output

The Smart Trolley web application, powered by Django, displays real-time product data—like name, price, weight, quantity, and RFID ID—in a structured table. It enables automated billing and inventory management, enhancing efficiency and reducing manual errors.

VI. Conclusion:

The smart trolley automation system has successfully integrated RFID tags and an RFID reader with the ESP8266 Wi-Fi module, enabling seamless communication with a Django based web application. This integration facilitates real-time cart tracking and the display of product details, significantly enhancing the shopping experience by automating billing and checkout processes. The system eliminates the need for manual product scanning, streamlining operations and reducing human effort. Looking ahead, the project has vast potential for improvement and scalability. Future developments could include incorporating weight sensors for fraud prevention, integrating advanced payment options such as digital wallets or contactless payments, and developing a dedicated mobile application to offer a more personalized and convenient user experience.

VI. References:

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