RFID BASED SMART TROLLEY FOR THEFT DETECTION

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Keywords:

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Introduction:

The retail industry is increasingly adopting automation to enhance customer experience and operational efficiency. Traditional checkout methods, which rely on manual scanning and cashier involvement, often lead to long queues, human errors, and customer dissatisfaction. To address these issues, self-checkout kiosks and mobile scanning apps have been introduced, but these still require customer effort at payment stations and supervision to prevent theft.

This project presents an RFID-Based Smart Trolley System that allows customers to scan products and complete payment directly at the trolley. The system uses RFID or barcode technology to scan items, while a load cell ensures that the weight of scanned products matches the expected value, preventing theft. A 2.8-inch TFT display shows real-time information about the cart's contents and total cost. For secure payment, the system includes NFC-based contactless payment.

The ESP32 microcontroller manages the system, ensuring smooth communication between components and providing Wi-Fi connectivity for mobile cart previews. This system aims to improve the shopping experience, reduce checkout time, and minimize labor costs, all while increasing operational efficiency.

Objectives:

- To enable customers to scan products using a barcode scanner.
- To automate the billing process, reducing the need for cashiers.

- To use a load cell to detect weight discrepancies and prevent theft.
- To display product details and quantity on a TFT display.
- To use ESP32 to manage data and enable Wi-Fi connectivity for cart previews.
- To enable real-time updates of quantity and price on the customer's mobile device.

Methodology:

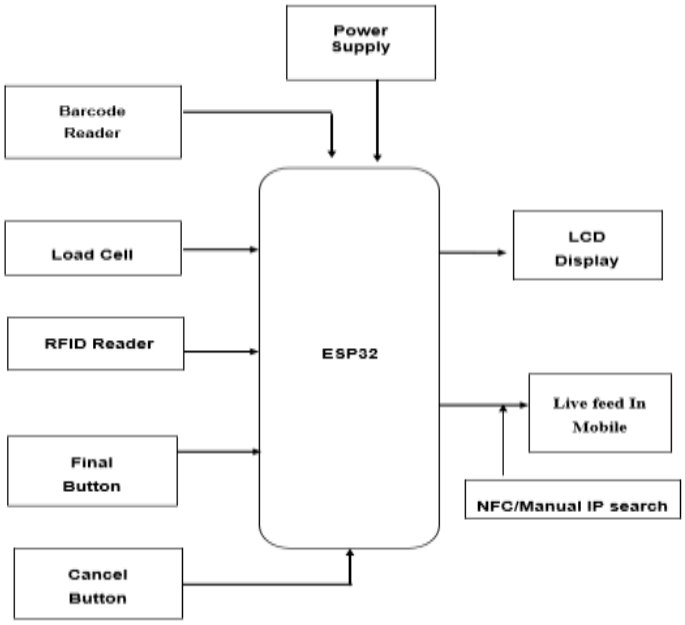

Figure 1: System Block Diagram of RFID-Based Smart Trolley

Working Mechanism, Techniques, and Materials Used:

The smart trolley system operates by allowing customers to manually scan product barcodes using a barcode reader to identify each item. A load cell is used to measure the total weight of the products in the trolley, which is then compared with the expected weight to detect any discrepancies and prevent theft. A 2.8-inch TFT display provides real-time updates showing scanned product details and alerts for any mismatches. For payment, a QR code is generated and displayed on the TFT screen, which the customer can scan using their mobile phone to complete a secure transaction. The system is powered by an ESP32 microcontroller that runs embedded software to manage all operations, including barcode scanning, weight verification, QR code generation, and display control. It handles the communication between all components and ensures accurate and real-time data flow throughout the system. The main materials used in this project include an ESP32 microcontroller, barcode scanner, load cell, 2.8-inch TFT display, and push buttons.

Result and Conclusion:

The RFID-Based Smart Trolley System was successfully developed to automate the shopping process and reduce checkout times. RFID technology enabled seamless item identification, while the load cell ensured accurate weight verification to detect theft or discrepancies. The system supported QR code-based contactless payments for secure transactions directly at the trolley. The TFT display provided real-time updates on scanned items and alerted for any weight mismatches. The system offered real-time updates of quantity and price on the customer's mobile device.

The system improved efficiency, minimized human involvement, and enhanced the customer experience. Future work could focus on optimizing the user interface, improving theft detection, and adding more features to the mobile app. This project demonstrated the potential of RFID and QR technologies to transform retail checkout systems.

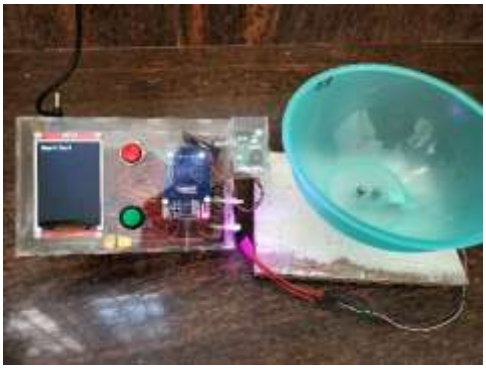

Figure 2: Assembled Prototype of Smart Trolley System

Future Scope:

The smart trolley system can be improved by adding mobile app support for real-time billing and shopping history. Voice guidance can help users navigate while shopping. Product suggestions based on previous purchases can enhance user experience. Camera-based theft detection and automatic lock systems can improve security. The system can support multiple languages and store data in the cloud for remote access. Using solar panels can make the system eco-friendly. QR code billing allows easy mobile payments. The trolley can also be adapted for use in places like clothing stores, libraries, and warehouses. These ideas open new areas for research and industrial use in smart retail systems.