

An Intelligent a IoT Framework for Automated Checkout and Real-Time Inventory Management in Smart Retail

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Abstract—The Smart Cart is an AI- and IoT-based intelligent shopping system designed to transform the conventional retail shopping experience by enabling automated billing, real-time inventory monitoring, and personalized customer assistance. Traditional shopping carts and manual checkout processes often result in long queues, increased billing time, and inefficient inventory management. The proposed system integrates IoT sensors/RFID technology, AI-based product identification, edge computing, and cloud connectivity to detect products, calculate bills, and update inventory in real time. An interactive display provides product information, cart status, recommendations, and navigation assistance to customers. The system also supports low-stock alerts, intelligent inventory tracking, and data-driven demand analysis, improving store management and operational efficiency. By reducing checkout time, minimizing manual errors, and enhancing customer interaction, the proposed AIoT-enabled Smart Cart provides a scalable and cost-effective solution for next-generation smart retail and autonomous checkout environments.

Index Terms—A IoT, Smart Cart, IoT, RFID, Artificial Intelligence, Automatic Billing, Real-Time Inventory, Edge Computing, Smart Retail, Personalized Recommendation, Autonomous

I. INTRODUCTION

Nowadays, shopping malls and supermarkets often have long billing queues, manual product scanning, and increased customer waiting time. The Smart E-Shopping Cart is designed to overcome these problems by automating the product identification and billing process. The system uses RFID technology to identify products placed in the cart. A microcontroller processes the product information, calculates the total amount, and displays the bill in real time. The system can also use IoT/wireless communication to send

billing information to the central system. This reduces manual effort, minimizes billing errors, and makes the shopping process faster and more convenient.

II. OBJECTIVES

- 1)To automate product identification using RFID technology.
- 2)To calculate the total bill in real time as products are added or removed.
- 3)To reduce customer waiting time at the billing counter.
- 4)To minimize human errors in product scan.
- 5)To reduce manual effort for customers and supermarket staff.
- 6)To display product details and total cost on the cart's display.
- 7)To use IoT/wireless communication for transmitting billing information.
- 8)To develop a low-cost and efficient smart shopping solution for supermarkets.

III. PROBLEM STATEMENT

Traditional shopping in supermarkets involves manual product scanning, repeated handling of products, long billing queues, and increased checkout time. Customers have to wait while each product is scanned and the final bill is prepared. Manual billing can also lead to human errors and increased workload for staff. Therefore, there is a need for a smart and automated shopping system that can identify products, calculate the bill in real time, and reduce the time and effort required during checkout. The proposed Smart E-Shopping Cart addresses this problem using RFID, a microcontroller, and IoT/wireless communication to provide faster, more accurate, and convenient shopping.

IV. PROPOSED METHODOLOGY

The Smart E-Shopping Cart uses RFID technology to automate product identification and billing. Each product is assigned a unique RFID tag, which is detected by the RFID reader when the product is placed in the cart.

The microcontroller processes the product information, retrieves its price, and calculates the total bill in real time. The product details and total amount are displayed on an LCD/OLED screen. Using IoT or wireless communication, the billing information can be transmitted to a central billing system.

This reduces manual scanning, minimizes billing errors, and helps customers complete the checkout process faster.

V. MAIN COMPONENTS

- RFID reader / barcode scanner – identifies product.
- RFID tags / product barcodes – store product identification information.
- Microcontroller – processes product and billing data.
- LCD/OLED display – shows cart contents and total cost.
- Weight or security sensors – optional verification of items.
- Wi-Fi/Bluetooth module – optional communication with a central server or mobile app.
- Battery and power circuit – supplies power to the cart electronics.

Battery maintenance is required for mobile carts. Network-based features depend on reliable connectivity.

VI. WORKING PRINCIPLE

When a customer places a product in the cart, its RFID tag or barcode is detected. The controller retrieves the product details from the stored database and adds the price to the running total.

If an item is removed, the system updates the cart and subtracts its price. The display continuously shows the updated shopping information. At the end, the final bill can be transferred to the store's billing or payment system.

VII. ADVANTAGES

- Faster checkout and shorter queues.
- Real-time bill visibility for customers.
- Reduces manual billing effort.
- Can improve inventory and shopping-data management.
- Provides a foundation for smart-store automation.

VIII. APPLICATIONS

- Supermarkets and shopping malls – for automated product scanning and billing.
- Retail Stores – to reduce manual billing and checkout time.
- Smart Retail Systems – for real-time product and billing management using IoT.

IX. FUTURE SCOPE

The system can be extended with a mobile shopping application, digital coupons, personalized recommendations, voice assistance, automatic payment, indoor navigation, AI-based shopping suggestions, and cloud-based services.

The Smart Shopping Cart combines embedded systems, product identification, and digital billing to create a modern retail experience. By automating product tracking and bill calculation, it can save time for customers and reduce operational effort for retailers.

The project is practical, scalable, and suitable as an IoT-based academic project.

X. CONCLUSION

The Smart E-Shopping Cart provides an efficient solution for automating product identification and billing using RFID, microcontroller, and IoT technology. It reduces manual effort, billing errors, and customer waiting time while providing real-time bill information.

The proposed system offers a faster, smarter, and more convenient shopping experience and can be further enhanced with mobile payments, automated checkout, and advanced IoT features.

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