

Automatic Billing System For Smart Trolley Using Raspberry Pi

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Abstract:

In recent years, the retail industry has grown rapidly, and customer expectations have also increased. One of the major problems faced by customers in supermarkets and shopping malls is the long waiting time at billing counters. Traditional billing systems require manual scanning and processing by a cashier, which leads to delays, especially during peak hours. This not only wastes time but also reduces customer satisfaction. To solve this problem, many researchers and industries are focusing on automation in retail systems. Smart retail solutions aim to reduce human effort and improve efficiency using modern technologies. In this paper, we propose a Smart Retail Automation system using Raspberry Pi, which helps in automatic billing through a simple and user-friendly approach. The proposed system uses a barcode scanner to scan products placed in the trolley. Each product has a unique barcode that is read by the scanner. The scanned data is sent to the Raspberry Pi, which acts as the main controller of the system. A Python-based program processes the data and retrieves product details such as name and price from a database. The total bill is automatically updated and displayed on a touchscreen. In addition to this, a buzzer and LED are used to provide feedback to the user whenever a product is scanned successfully. This helps the user to confirm that the item has been added to the bill. The system eliminates the need for manual billing at the counter, thereby reducing waiting time and improving the overall shopping experience. The main objective of this project is to design a low-cost and efficient system that can be easily implemented in retail stores. Unlike complex systems, this solution uses simple components like Raspberry Pi, barcode scanner, and display, making it affordable and practical.

Keywords — Smart Retail, Raspberry Pi, Barcode Scanner, Automatic Billing, QR Code Payment, IoT

I. INTRODUCTION

In today's fast-paced world, customers expect quick and efficient service in retail stores. However, one of the major challenges in supermarkets is the delay at billing counters. Customers often have to wait in long queues, especially during peak hours, which leads to frustration and poor shopping experience. This problem also increases the workload on staff and reduces overall efficiency in store operations. With the advancement of technology, there is a growing need to automate traditional systems and improve performance. Smart retail solutions are being developed to make shopping more convenient by reducing manual work and saving time. Automation in billing systems can play a key role in solving these issues. In this paper, a Smart Retail Automation system using Raspberry Pi is proposed. The system focuses on automatic billing by scanning product barcodes and calculating the total cost instantly. Unlike traditional systems, this approach allows customers to view their bill in real time while shop. The system is designed using simple and cost-effective components such as a barcode scanner, Raspberry Pi, touchscreen display, buzzer, and LED. It also includes a digital payment feature using QR code, which makes the checkout process faster and contactless.

The objective of this work is to develop an efficient and user-friendly billing system that can be easily implemented in retail environments. This solution aims to reduce waiting time, improve accuracy, and enhance the overall shopping experience for customers.

II. METHODOLOGY

The proposed Smart Retail Automation system works by automating the billing process using a barcode scanner and Raspberry Pi. The system is designed to make shopping faster and more convenient for customers. When a customer selects a product and places it in the trolley, the barcode of the product is scanned using a barcode scanner. Each product has a unique barcode that contains its identification details. Once the barcode is scanned, the data is sent to the Raspberry Pi, which acts as the main controller of the system. The Raspberry Pi processes the scanned data using a Python program. It checks the product information from a predefined database and retrieves details such as the product name and price. After retrieving the information, the system adds the product price to the total bill automatically.

The updated bill is displayed in real time on a 3.5-inch touchscreen display attached to the trolley. This allows the customer to see the list of selected items and the total cost at any moment. A buzzer and LED are also used to give confirmation feedback whenever a product is successfully scanned.

Once the customer finishes shopping, the final bill is generated by the system. A QR code is then displayed on the touchscreen for payment. The customer can scan this QR code using a mobile payment application to complete the transaction.

This method eliminates the need for traditional billing counters and reduces waiting time. It provides a simple, fast, and efficient solution for modern retail environments.

III. LITERATURE REVIEW

1. **Carsten D. Schultz and Patrick Zacheus (2024)** studied smart shopping carts and found that these systems improve customer satisfaction and reduce checkout time by using digital technologies like sensors and automatic billing systems.
2. **Omkar Santosh Shinde et al. (2025)** developed an IoT-based smart trolley using Raspberry Pi, barcode scanner, and touchscreen. Their system allowed automatic billing and digital receipts, which helped remove the need for manual billing counters.
3. **Prof. Shwetha M. et al. (2024)** proposed a smart trolley system with advanced billing features. Their work showed that such systems reduce long queues and are useful in maintaining smooth shopping, especially during busy hours.
4. **Gusvito Habiby et al. (2023)** introduced a smart trolley using both barcode scanning and computer vision. Their approach improved billing accuracy by combining multiple technologies.
5. **R. N. Jogekar et al. (2022)** designed an automated trolley using Raspberry Pi and barcode scanning. Their system reduced human errors and made the billing process faster.
6. **Nagaraja Bodravarva et al. (2022)** developed an RFID-based smart trolley. Their system identified products using RFID tags and displayed prices, helping to reduce billing time and improve efficiency.
7. **Savita C. Teli et al. (2020)** created an IoT-based smart trolley using Raspberry Pi and sensors. Their system helped in automatic billing and inventory management, reducing human involvement.
8. **Gunawan A. A. S. et al. (2023)** worked on item verification using sensors and computer vision. Their findings showed that this method improves billing accuracy and prevents incorrect item scanning.
9. **M. S. Wahab et al. (2021)** focused on RFID and cloud-based communication systems. Their work showed that IoT-based systems can reduce delays and improve data management.
10. **T. Raj (2023)** developed an IoT-based smart trolley using Raspberry Pi and Wi-Fi. Their system generated electronic bills and improved the overall shopping experience by making it more user-friendly.

IV. COMPONENTS

The Smart Retail Automation system is developed using the following hardware components:

1. **Raspberry Pi 4 Model B:** The Raspberry Pi acts as the main controller of the system. It processes the data received from the barcode scanner and controls all the operations of the system using a Python program.



4.1 Raspberry pi 4 Model

2. **Barcode Scanner:** The barcode scanner is used to scan the products. Each product has a unique barcode, and when scanned, the information is sent to the Raspberry Pi for processing and billing.



4.2 Barcode Scanner

3. **3.5-inch Touchscreen Display:** The touchscreen display is used to show product details and the total bill. It allows the customer to view items and interact with the system easily.



4.3 3.5-inch Touchscreen Display

4. **Buzzer:** The buzzer provides an audio signal whenever a product is scanned successfully. It helps in confirming that the product has been added to the bill.
5. **LED:** The LED is used as a visual indicator. It shows system status and gives confirmation during scanning operations.



4.4 LED

V. SOFTWARE

1. PHP-Based Billing System
 - Used to develop the backend of the smart trolley application.
 - Handles billing ,invoice generation and payment processing.
 - Connects the database with the user and admin interface.
2. Python Programming
 - Used for barcode scanner integration and system automation.
 - Control product scanning and real-time bill calculation
 - Handles communication between hardware and software modules .
3. MY SQL Database
 - Stores product details ,prices, invoices, and sales records.
 - Maintenance inventory and customer transaction history.
 - Supports fast and efficient data retrieval.

VI. BLOCK DIAGRAM

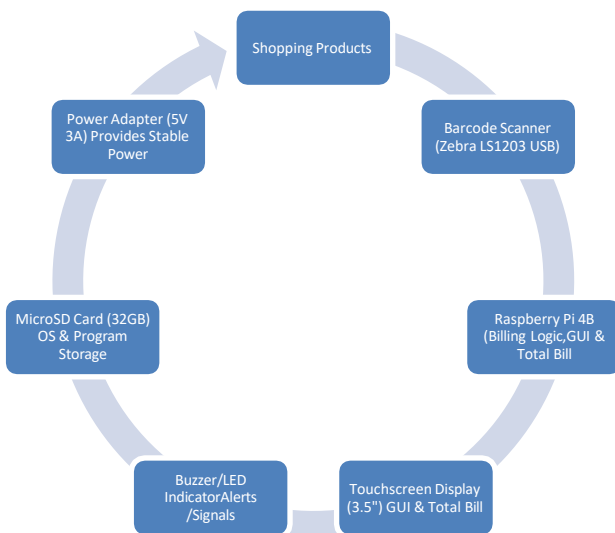


Fig5.1: Block Diagram of Automatic Billing system for smart Trolley

VII. FLOWCHART



1. Start
The system is powered ON and initialized for shopping operations.
2. Scan Product Barcode
The customer scans the product barcode using the barcode scanner attached to the smart trolley.
3. Barcode Data Sent to Raspberry Pi
The scanned barcode information is transferred to the Raspberry Pi 4Model B for processing.
4. Retrieve Product Details from Database
The Raspberry Pi searches the data base and retrieves product details such as product name, price, and quantity.
5. Display Product Details and Update Total Bill
The product information and updated bill amount are displayed on the touch screen display in real time.
6. Check Out
After completing shopping, the customer proceeds to the checkout stage for payment processing.
7. Select UPI Payment Option
The system displays the UPI payment option for digital payment.
8. Process and Verify UPI Payment
The payment transaction is processed and verified successfully through the payment module.
9. Send Payment Confirmation Message
After successful payment ,a confirmation message is displayed to the customer.
10. Store Invoice and Transaction Details
Invoice details, payment information, and transaction records stored in the database.
11. Update Admin Panel and Inventory Records
The admin panel automatically updates sales details, invoices, and inventory records.
12. Stop
The billing Process is completed successfully, and the system ends the transaction.

VIII. RESULT

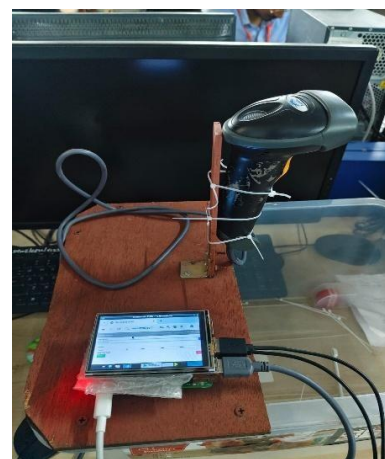
- The Automatic Billing System for Smart Trolley was successfully developed and tested using Raspberry Pi 4 Model B, barcode scanner, touchscreen display, Wi-Fi connectivity, database management, and UPI payment integration.
- The system efficiently performed barcode scanning and automatically retrieved product details from the database in real time.
- The touchscreen display successfully showed product information, quantity, price, and continuously updated total bill amount during shopping operations.
- The billing management system accurately calculated the total amount and minimized manual billing errors commonly found in traditional billing methods.
- The UPI payment module worked successfully and supported secure digital payment transactions with fast payment verification.
- Payment confirmation messages and transaction details were generated correctly after successful payment completion.
- The database system efficiently stored invoices, customer billing details, payment records, and sales information for future reference and analysis.
- The admin panel successfully managed product details, inventory records, invoices, and daily sales collection through a user-friendly interface.
- The integration testing results confirmed smooth communication between all hardware and software modules without major operational failures.
- Field testing demonstrated that the system reduced billing time, improved checkout speed, and enhanced customer shopping convenience.
- The system also reduced crowding at billing counters and supported self-check out shopping operations effectively. The overall system performance was stable, reliable, and suitable for implementation supermarkets, shopping malls, and smart retail environments.
- The project successfully achieved its objective of providing an automated, fast, secure, and user-friendly smart billing solution for modern retail applications.



7.1 Scan Product Barcode



7.2 Display Product Details and Update Total Bill on Touchscreen



7.3 Process of Billing system of Smart Trolley

IX. REFERENCE

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X. CONCLUSION

In this paper, a Smart Retail Automation system using Raspberry Pi has been successfully designed and implemented to improve the billing process in retail stores. The system uses a barcode scanner to identify products and automatically calculates the total bill in real time. The use of a touchscreen display allows customers to easily view their selected items and total cost while shopping.

The proposed system reduces the need for manual billing at checkout counters, thereby saving time and minimizing long queues. It also improves billing accuracy and provides a simple and user-friendly experience for customers. The integration of QR code-based payment further enhances the system by enabling fast and contactless transactions.

Overall the System is cost effective , efficient and easy to use, making it suitable for shopping malls, supermarkets and others retail environment .In the future system can be improved by adding features such as mobile application support , cloud based data storage and advanced product identification techniques . The work demonstrates how automation and embedded system can be effectively used to modernize traditional retail operations.

XI. FUTURE SCOPE

The proposed Smart Retail Automation system can be further improved by adding advanced features and technologies. In the future, the system can be integrated with a mobile application, allowing customers to view their shopping details and bills directly on their smartphones.

Cloud-based storage can also be implemented to store billing and product data, which will help in better data management and analysis. This can support inventory tracking and improve store management.

The system can be enhanced by using RFID or computer vision technology to automatically detect products without the need for manual scanning. This will make the shopping process even faster and more convenient.

Additionally, artificial intelligence can be used to provide product recommendations and personalized shopping experiences for customers. Security features can also be improved to ensure safe and reliable digital payments.

Overall, the future development of this system can make retail shopping fully automated, more efficient, and highly user-friendly.