AUTOMATED BILLING OF PRODUCT'S WITHIN THE SECURITY INTELLIGENT SHOPING CART RFID TECHNOLOGY

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ABSTRACT

In modern retail environments, the need for efficiency, enhanced customer experience, and loss prevention has led to innovations in shopping systems. This project presents the development of an Automated Billing System integrated into a Security Intelligent Shopping Cart using Radio Frequency Identification (RFID) Technology. The proposed system eliminates the need for traditional checkout queues by automatically detecting and billing items placed in the cart in real time. To enhance security and prevent theft, the cart communicates with the store's central server and exit security systems. If any unpaid item is detected at the exit, the system alerts staff and locks the cart's movement. This smart cart not only streamlines the billing process but also ensures a secure, seamless, and contactless shopping experience. Each product is tagged with an RFID tag that stores its unique identification and price. An RFID reader embedded in the smart cart detects the tags as items are added or removed. The system updates the virtual bill dynamically and displays it on an LCD or mobile interface for the customer's convenience. Upon completion of shopping, the final bill is paid through a self-checkout or mobile application, minimizing human interaction.

Keywords: AT89S52, IR Proximity Sensor, RFID READER Wireless TX-RX Module, etc.

Introduction

People have been producing innovation to meet their needs since the birth of civilization. We face this complexity on a daily basis. Shopping is one of the most important activities. To overcome these challenges, this project introduces an Automated Billing System integrated with a Security Intelligent Shopping Cart using RFID (Radio Frequency Identification) Technology**.** The core idea is to automate the entire shopping and billing process without human intervention. Each item in the store is embedded with an RFID tag containing product-specific information such as name, ID, and price. As the customer places items into the smart shopping cart, an RFID reader attached to the cart scans and records the items automatically. With the rapid growth of technology and evolving customer expectations, the retail industry is shifting towards automation and smart solution to improve the shopping experience. One of the major pain points in traditional shopping is the long

wait at checkout counters, especially during peak hours. Manual billing processes not only waste customers' time but also lead to inefficiencies in store operations. Furthermore, the smart cart is integrated with a security mechanism. If any item is taken out of the store without proper billing, the system triggers an alert and prevents unauthorized exit, ensuring both security and loss prevention.

Objective

- Very convenient to use for the customer.
- Saves lot of time for customer as well as the sales man on the billing counter.
- Avoids large queues on billing counters.
- Customer gets exact total bill amount before it actually goes to the billing counter.
- It consumes very less power.

Concept

The concept of Automated Billing of Products within a Security-Intelligent Shopping Cart using Integrated Circuit 89S52 Technology involves combining smart shopping cart technology, automatic billing systems, and security mechanism to provide a seamless, efficient, and secure shopping experience. This system is designed to automatically calculate the cost of the items in a shopping cart, ensure security, and assist the user in paying without needing manual intervention at check out. The89S52 microcontroller (a variant of the 8051 microcontroller) is the central technology that drives the system's logic and functionalities.

Product Detection: When the customer places a product into the cart the RFID tag barcode the product is scanned by the cart sensor.

Data Processing: The 89S52 microcontroller receives the product data and queries the central store database via wireless communication to retrieve the product details.

Security Check: If a product is removed from the cart if an error occurs (e.g., item was not scanned), the security system triggers alerts warn the user store personal.

Payment: Once the customer confirms the items in the cart, they can proceed with payment via NFC, QR code scanning, or other electronic payment methods.

Finalization: After payment is processed, a receipt is provided to the customer, and the store's inventory system is updated to reflect the transaction.

Key Components

Smart Shopping Cart with Embedded Sensors:

- The shopping cart is equipped with sensors (such as weight sensors, RFID scanners, or barcode scanners) that automatically. RFID (Radio Frequency Identification)QR codescanning can be used to identify products. Each product has an RFID tag or a QR code, and when it enters the cart, the sensor reads it.
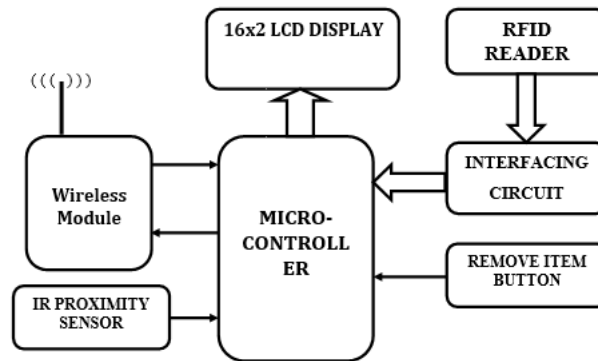
Block Diagram
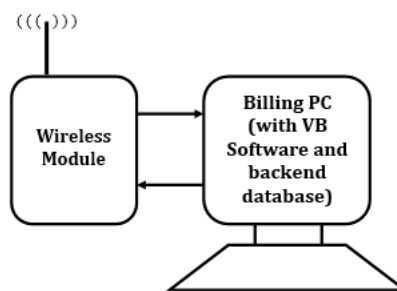

Fig. (b) Customer Trolley Unit

Fig. (b) Billing Counter Unit

Fig. Block Diagram

Integrated Circuit 89S52:

- The **89S52 microcontroller** is the core of the system, controlling all the operations and processing the data received from the sensors.
- It interfaces with the RFID readers, weight sensors, and the display screen, processing the product information and calculating the total cost.
- The microcontroller performs essential functions such as
- o Scanning RFID tags to identify products.
- o Calculating the total bill.
- o Sending alerts or notifications to the user for any discrepancies (like product removal or addition).

Product Identification and Automated Billing:

- **RFID tags** or **barcodes** on the products are scanned by an integrated into the shopping cart.
- When the product is detected, its price, description, and other details are automatically retrieved from the store's central database (connected via Bluetooth or Wi-Fi) and displayed on the cart's **LCD screen**.
- The **89S52 microcontroller** processes the scanned data and calculates the total amount based on the prices of the identified products.
- **Real-time updating** of the cart's total is displayed as the customer adds or removes products.

Security Features:

- **Tamper Detection**: The cart can incorporate **motion sensors** or **weight sensors** to detect unauthorized access, ensuring that products are only scanned when placed in the cart.

- **Alert Mechanism**: If an attempt is made to bypass sensors, the system can trigger **audible alarms** or **visual warnings** (e.g., flashing lights) to deter theft.

- **Encryption and Data Protection**: Communication in cart and microcontroller should be **securely encrypted** to prevent unauthorized access or manipulation of pricing information or product details.

Payment System Integration:

- The system can integrate with **mobile payment platforms** directly embedded into the cart.

- The microcontroller (89S52) interfaces with the payment system to process payments, either by scanning a QR code displayed on the customer's phone or using NFC for contactless transactions.

- After payment confirmation, the system will provide a receipt and update the store's inventory system in real-time.

User Interface:

- A small **LCD display** or **touch screen** on the shopping cart displays real-time information such as products added to cart total cost, and security alerts.

- User can interact with the display for order confirmation, product removal, and final payment.

- **Buttons** or **touch inputs** can be used to perform additional actions like applying discounts, verifying product details, or selecting payment options.

Inventory Management System:

- The system is integrated with the inventory management system, updating stock level in real-time the products are added or removed from the cart.

- This helps prevent inventory discrepancies and ensures that stock levels are accurate at all times.

Cloud Integration and Data Sync:

- Data related to purchases, payment status, and inventory levels are synced with the cloud, enabling easy tracking, auditing, and data analysis by the store.

- Real-time synchronization also ensures that customer billing and payment information is safely stored and accessible to the store's back-end systems.

Project Benefits

1. Faster Checkout Process

- Products are automatically billed as they are placed in the cart.

2. Enhanced Security

- Prevents theft by ensuring products are billed before leaving the store.

- Uses RFID or barcode-based authentication with the **89S52 microcontroller** for secure transactions.

3. Improved Customer Experience

- Reduces waiting time, making shopping more convenient.

- Provides real-time billing updates on an LCD screen, allowing customers to track expenses.

4. Cost Efficiency

- Reduces the need for cashier employees, cutting labor costs.

- Lowers operational costs by streamlining the checkout process.

5. Smart Payment Integration

- Allows cashless transactions via digital wallets, credit/debit cards, or NFC payment systems.

- Ensures secure payment processing with minimal human intervention.

6. Enhanced Shopping Cart Intelligence

- Can provide suggestions or alerts (e.g., product offers, warnings for expired items).

- Can integrate with mobile apps for a seamless shopping experience.

7. Environmental Benefits

- Reduces paper usage by offering digital receipts.

- Promotes efficient store management, reducing waste and excess stock.

Application

1. Supermarkets & Retail Stores

- **Faster Checkout:** Reduces long queues and enhances the customer shopping experience.

- **Inventory Management:** Automatically updates stock levels, preventing overstocking or shortages.

- **Cashless Payments:** Supports NFC, UPI, or digital wallet transactions for seamless payments.

2. Shopping Malls

- **Multi-store Integration:** Customers can shop from different stores within a mall and checkout in a single transaction.

3. Hypermarkets & Wholesale Outlets

- **Bulk Purchase Management:** Automates billing for large quantities of items.

- **Business Analytics:** Provides insights into customer buying patterns and product demand.

4. Airports & Duty-Free Shops

- **Quick Purchases for Travelers:** Reduces waiting time by enabling faster self-checkout.

- **Currency Adaptation:** Can integrate multi-currency payment options for international travelers.

5. Smart Grocery Stores (Amazon Go-like Stores)

- **Contactless Shopping:** Eliminates the need for manual scanning of products.

- **AI-Powered Integration:** Can be combined with AI to offer personalized shopping recommendations

6. Hospitals & Medical Stores

- **Automated Medicine Billing:** Helps in quick and accurate billing of medicines in hospital pharmacies.

- **Inventory Control:** Ensures medicines are well-stocked and prevents unauthorized removal.

7. Warehouses & Industrial Supply Chain

- **Automated Product Tracking:** Enhances logistics by tracking product movement in real time.

- **Reduces Human Error:** Prevents misplacement or miscounting of products in warehouses.

8. Libraries & Bookstores

- **Automated Book Checkout:** Allows users to borrow or buy books without standing in line.

- **Anti-Theft System:** Ensures books are registered before leaving the store.

9. Clothing & Fashion Stores

- **Smart Trial Rooms:** Customers can add items to their cart directly from smart trial rooms.

- **Automated Discounts:** Applies offers and membership discounts in real time.

10. Restaurants & Cafeterias 🎥

- **Self-Service Billing:** Customers can pick items, and the cart auto-generates the bill.
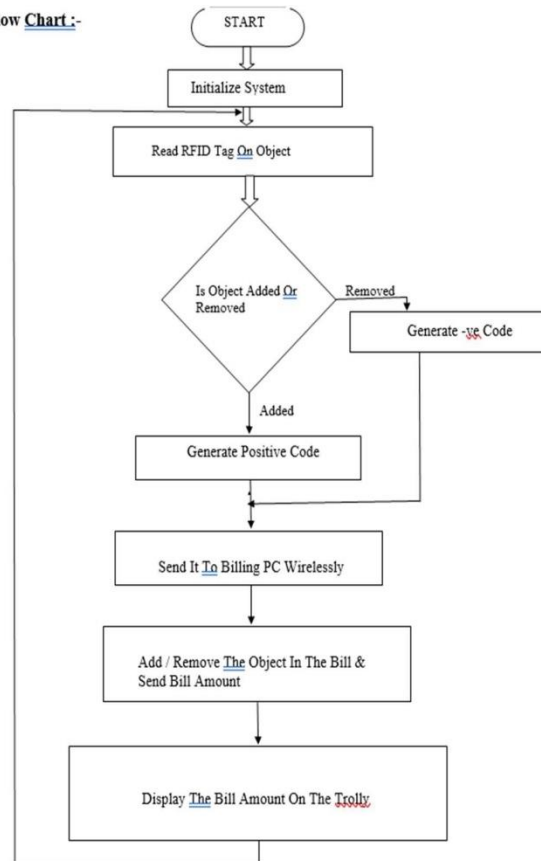
Flow chart

.2 Flow Chart :-

Fig. Flow Chart

Working

In this system there will be two units, one unit is placed at the billing counter & their other unit is placed on the customer's shopping cart. We will see working of each unit in detail. First we will see the billing counter unit. It compromises of a PC and a Wirelesstransreciver module.

The cart side unit will have a barcode scanner. The user can scan the product code using the scanner provided on the cart. The barcode number displayed on the display. Then the code number is transmitted using the Wireless trans-receiver module. All these things will be connected to a controller board. It consists of a microcontroller AT-89S52. The program code is stored inside the microcontroller and the system will work according to that program.

There will also be REMOVE ITEM BUTTON. The customer can use this button for remove a particular item from his/her cart. The customer simply needs to scan that product again on the barcode scanner and then press the remove item button. Then after that this product will be removed from their bill. The IR sensor will keep track of number of products present in the cart. This number can be tallied at the billing counter.

In the PC therewill be a database of all the itoms presentin super market for sale. The database consists of the product name, its barcode number and its cost. The database may be created using MS Access. The database is kept in the backend. There will also be a automatic billing software will take care of all the billing process.

It will take barcode number as a input. It will search the product name and price for which of this barcode number is assigned. It will add the item in the bill for that particular cart number. The product details will also transmitted back the cart where it will displayed on LCD along the Total Bill Amount.

Result

Additionally, if the customer wishes to remove a product from the cart, they can do so using a push button. By pressing the button and re-scanning the product's RFID tag, the system identifies the item and removes it from the bill accordingly.Whenever a customer using the smart shopping cart adds a product, the RFID tag attached to the product is scanned. The necessary details are then fetched and sent to the microcontroller. Based on the programmed logic, the microcontroller processes the information and generates an updated bill with all required fields. This bill is refreshed instantly as soon as a product is added and is displayed both on an LCD screen mounted on the cart and on a web server, allowing the customer to easily view and cross-check the list of added products

Fig. Image Of Circuit

Result And Analysis

ITEMS	QUANTITY	COST	WEIGHT(gm)
Biscuit	2	70	200
Soap	2	76	300
Rice	0	0	0
Tea	0	0	0
Grand Total	4	146.00	500.00

Pay Now

Advantages

- Reduced check out time
- Real-time billing information
- Improved customer experience

- Less staff is needed

- Reduced errors

- Reduced Labor Cost

- Data collection

- Easy Integration

Fig. Image Of Trolley

Features

Automated Product Detection:

- Products are identified automatically using RFID tags as they are added to or removed from the cart.

- No need for manual barcode scanning.

Real-Time Billing:

- The bill is updated instantly when a product is added or removed.

- Displays item name, quantity, price, and total cost.

LCD Display Interface:

- Provides a user-friendly display of the current bill inside the cart.

- Allows customers to track their shopping in real time.

Web Server Integration:

- Bill details are also synced and displayed on a connected web server or mobile app.

- Enables remote viewing and cross-checking of items before checkout.

Product Removal Option:

- Customers can remove items using a push button and re-scan method.

- The bill is adjusted automatically after product removal.

Secure Checkout System:

- Ensures that all items are billed before leaving the store.

- Prevents theft by alerting the system if any unpaid product is detected.

Wireless Communication:

- Communicates with a central server via Wi-Fi, Bluetooth, or IoT protocol.

- Keeps billing records synced and updated.

Future Scope

Over time, we can expect a rise in self-service and scan-it-yourself systems, with RFID playing a key role. If current challenges are effectively managed, RFID technology has the potential to become a powerful tool in everyday human life.As RFID systems evolve, the adoption of "scan-it-yourself" models is expected to grow, allowing users more control and efficiency in tracking and inventory processes. While the technology continues to face limitations, including infrastructure costs and privacy concerns, the demand for RFID systems is steadily increasing. This growth reflects the recognition of RFID's potential to transform how data is collected, shared, and utilized across numerous domains.In recent years, there have been notable improvements in the durability and life expectancy of RFID tags, further enhancing their practicality in various environments. Additionally, several international standards for RFID systems are currently under development, which will facilitate interoperability and streamline implementation across different sectors.Radio Frequency Identification (RFID) technology utilizes radio waves to automatically identify people or objects. After more than sixty years of development, RFID is now being applied across a wide range of industries, contributing significantly to the field of Automatic Identification and Data Capture (AIDC). Despite its growing adoption, RFID technology still faces several challenges that hinder its widespread global implementation. One of the primary obstacles is the high cost associated with RFID systems. However, as technology advances and design experience improves, the price of RFID tags is expected to decrease. These tags are anticipated to become not only more affordable but also more powerful, increasing their feasibility for mass deployment. Another significant concern is privacy, which remains a critical issue in many RFID applications. Ensuring data security and user privacy is essential for the technology to gain public trust and regulatory approval.

Conclusion

In the era of automation, such a system plays a crucial role in advancing technological innovation in the retail sector. Unlike the traditional barcode system currently in use, this RFID-based solution offers faster, more reliable, and contactless identification of products. As a result, it not only streamlines operations but also contributes to a more efficient and time-saving shopping experience for consumers. Ultimately, this technology has the potential to significantly improve both customer satisfaction and store productivity.This project utilizes RFID technology, specifically the EM-18 reader in conjunction with Arduino, to develop an automated billing system. The primary objective is to reduce billing time in long queues, thereby enhancing customer convenience while simultaneously simplifying inventory management. This system is particularly beneficial in high-traffic areas such as shopping malls, where large crowds often lead to delays and inefficiencies in the checkout process.

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