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Smart Shopping Card with Automated Invoice Mechanism

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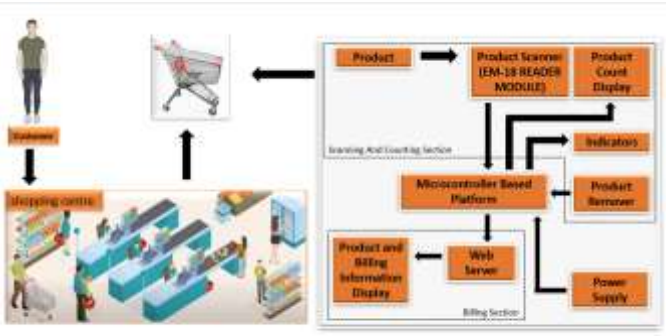
Abstract - The rapid growth of technology has transformed many sectors, including retail shopping. Traditional billing systems in supermarkets require customers to wait in long queues while items are manually scanned at checkout counters. This process consumes time and often leads to customer dissatisfaction. The Smart Shopping Cart with Automated Invoice System is designed to simplify and speed up the billing process using Internet of Things (IoT) and RFID technology. In this system, RFID tags attached to products are scanned automatically when placed in the shopping cart. The cart contains an RFID reader, microcontroller, and LCD display that identify products and calculate the total bill in real time. The customer can view the selected items and the total amount directly on the cart display. After completing shopping, the system generates an automatic invoice and sends the information to the central billing system. This approach eliminates long queues, reduces manual errors, and improves the overall shopping experience. The proposed system provides faster billing, improved inventory management, and enhanced customer satisfaction in modern retail environments.

Key Words: Smart shopping cart, RFID technology, IoT, automated billing, retail automation, NodeMCU.

1.INTRODUCTION

In today's fast-paced world, technology plays a crucial role in enhancing various aspects of daily life, including shopping experiences. Traditional shopping carts have been a staple in retail environments for decades, but advancements in technology offer opportunities to revolutionize the shopping experience.

The introduction of smart shopping carts with automated invoice mechanisms aims to streamline the checkout process, improve efficiency, and enhance customer satisfaction. This system integrates technologies such as RFID, microcontrollers, and IoT to automate the identification of products and generate invoices directly within the cart. By reducing dependency on manual billing counters, the system minimizes waiting time and improves operational efficiency in retail stores.



Architecture design of smart shopping cart.

2.NEED STATEMENT

Traditional checkout processes in retail stores often involve long queues, manual scanning of items, and manual generation of invoices. This leads to inefficiencies and customer dissatisfaction. Additionally, errors in manual data entry can cause billing discrepancies and inventory mismanagement.

Therefore, there is a need for an automated solution that simplifies the billing process, reduces waiting time, and ensures accurate billing. A smart shopping cart system with RFID technology can address these challenges by automatically detecting items and generating bills in real time.

3.OBJECTIVES

The primary objective of this project is to design and develop a smart shopping cart equipped with advanced technology to automate the checkout process and invoice generation.

The specific objectives include:

1. Implementing IoT technology to create a connected shopping cart capable of tracking items in real time.

2. Integrating RFID (Radio Frequency Identification) technology for automatic item identification and pricing.
3. Developing a user-friendly interface that allows customers to view cart contents and total cost.
4. Implementing automated invoice generation and payment mechanisms to eliminate manual billing.
5. Enhancing security features to prevent product theft or tampering.

4. LITERATURE REVIEW

4.1 Overview of Existing Systems

Several research studies have proposed automated shopping systems using technologies such as barcode scanners, RFID, and IoT.

Sainath (2014) proposed an automated shopping trolley using barcode scanning technology. However, barcode scanning requires line-of-sight and precise positioning, which limits its efficiency.

Budic (2014) introduced an RFID-based shopping system where product information is stored in a database and payments are processed through a central billing system. Although this method improves efficiency, it requires constant internet connectivity and server maintenance.

Dhavale Shraddha (2016) developed an IoT-based intelligent trolley using RFID and ESP modules for wireless communication. However, the system depends heavily on stable internet connectivity, which may cause delays in high-traffic environments.

Other systems have used technologies such as ZigBee, Bluetooth, and Android applications for billing processes. While these systems provide automation, they often introduce additional complexities such as network dependency, device compatibility, and server management.

4.2 Comparison of Existing Systems

Various systems have been developed using different platforms and sensors.

Author	Year	Platform	Sensors
Pavan Kumar et al.	2018	Raspberry Pi	Barcode scanner, touchscreen
Kowshika et al.	2021	Raspberry Pi	RFID reader, QR scanner
Akshay Kumar et al.	2017	Arduino Uno	RFID reader, LCD
Ruchi Gupte et al.	2020	Raspberry Pi	RFID reader
Tapan Kumar Das et al.	2021	Arduino Uno	RFID reader, keypad

These systems improve billing automation but still depend on external servers, internet connectivity, or centralized payment counters.

5. SYSTEM DEVELOPMENT

5.1 Proposed System Overview

The proposed system is a **Smart Shopping Cart with Automated Invoice Generation** designed to enhance retail shopping experiences. The system uses RFID technology to automatically identify products placed in the cart and update the total bill in real time.

The cart includes an RFID reader, NodeMCU microcontroller, LCD display, and push buttons. When a customer scans an RFID-tagged product, the system retrieves the product information from a database and updates the total amount. The customer can view the bill on the LCD display and complete the payment directly.

5.2 Components of Proposed System

5.2.1 RFID Technology

Radio Frequency Identification (RFID) is a wireless communication technology used for automatic identification and tracking of objects using tags.

An RFID system consists of three main components:

- RFID Tag
- RFID Reader
- Data Processing System

RFID technology offers advantages such as:

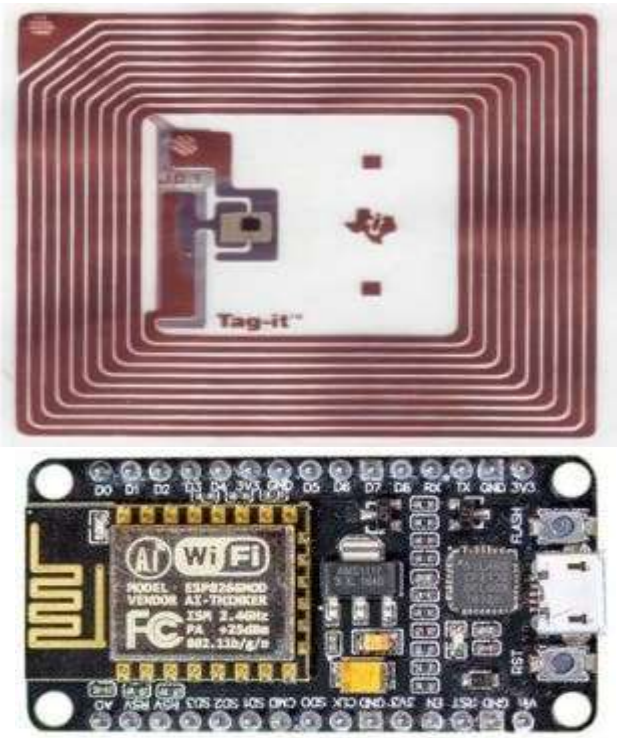
- No line-of-sight requirement
- Ability to scan multiple items simultaneously
- Faster and more accurate identification
- Improved data storage capabilities

5.2.2 NodeMCU (ESP8266)

NodeMCU is an open-source IoT platform based on the ESP8266 WiFi microcontroller. It provides built-in networking capabilities and supports various sensors and devices.

Key features include:

- 32-bit microcontroller
- Built-in WiFi module
- Low power consumption
- Easy programming through Arduino IDE



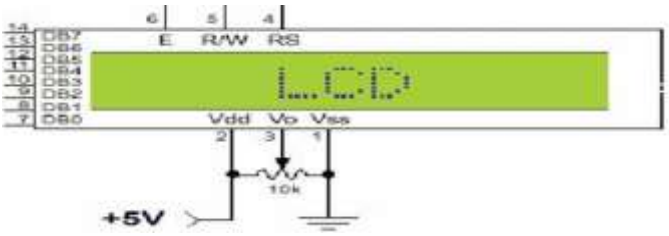
5.2.3 LCD Display

LCD (Liquid Crystal Display) is used to display product information and billing details. It shows the product name, quantity, and total price as items are scanned.

Features include:

- Low power consumption
- Clear visual output
- Compatible with microcontrollers

Pin Description:

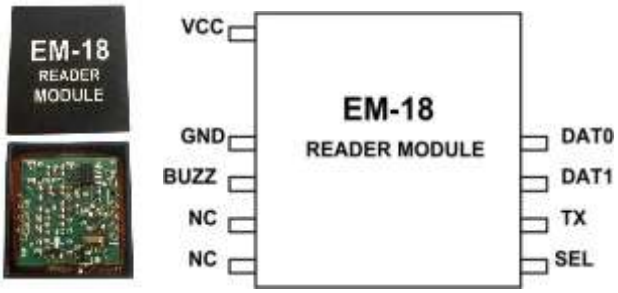


5.2.4 EM-18 RFID Reader

The EM-18 RFID reader operates at **125 kHz frequency** and is used to read RFID tags attached to products. It communicates with the microcontroller using serial communication.

Features include:

- Reading range up to 10 cm
- Low power consumption
- Easy integration with microcontrollers



5.2.5 RFID Tags

RFID tags contain a microchip and antenna that store unique identification information. When placed near the RFID reader, the tag transmits its data to the system.

6. WORKING PRINCIPLE

The system works through the following steps:

1. **Product Detection** – RFID reader detects tags attached to products placed in the cart.
2. **Identification** – The microcontroller identifies the product using its unique tag ID.
3. **Real-time Billing** – Product details and price are displayed on the LCD and added to the total bill.
4. **Payment Processing** – Customers can complete payment using smart cards or digital methods.
5. **Invoice Generation** – The system automatically generates an invoice and sends it to the central server.
6. **Inventory Update** – The inventory database updates automatically after purchase.

7.RESULTS AND DISCUSSION

The implementation of the smart shopping cart system demonstrates significant improvements in the retail billing process. Customers can scan products directly into the cart and monitor their expenses in real time. This reduces waiting time at billing counters and improves customer satisfaction.

The system also ensures better inventory management and minimizes billing errors. Overall, the smart shopping cart provides a faster, more efficient, and automated shopping experience.

Step :-01

Step :-02

Step :-03

Welcome To Smart Cart Trolly

ITEMS	QUANTITY	COST
Suger	0	0
Milk	0	0
Biscuits	0	0
Dairy Milk	1	5
Grand Total	1	5.00

Step :-04

Step :-05

Step :-06

8. CONCLUSIONS

The integration of smart shopping carts with automated invoice mechanisms represents a significant advancement in retail technology. The system simplifies the checkout process, reduces waiting time, and eliminates manual billing errors. Customers benefit from faster shopping experiences and instant billing information, while retailers gain better control over inventory and transaction data. The adoption of this technology can enhance operational efficiency and improve customer satisfaction in modern retail environments.

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