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Automatic Billing Smart Trolley

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Abstract: The conventional retail billing system involves manual barcode scanning and long queues, resulting in time delays and customer dissatisfaction. This paper presents a Smart Billing Automation Trolley that integrates embedded systems and IoT for real-time billing. The system uses an ESP32 microcontroller, barcode scanner, and load cell sensor to identify products and verify them using weight measurement. The scanned product information is displayed on an LCD screen, and the bill is updated in real time. A QR code and SMS-based payment system ensures a fast and secure checkout process. The system significantly reduces billing time and improves accuracy, providing a user-friendly and efficient shopping experience.

Index Terms - Smart Trolley, Barcode Scanner, Embedded Systems, IoT, Automated Billing, Retail System

I. INTRODUCTION

In modern supermarkets, traditional billing systems based on barcode scanning cause long queues and increase waiting time. These systems are time-consuming and may lead to human errors, reducing customer satisfaction. To solve this problem, a Smart Billing Automation Trolley is proposed. The system uses a barcode scanner for product identification, a weight sensor for verification, and an ESP32 microcontroller for processing. When a product is placed in the trolley, it is scanned and automatically added to the bill in real time. The system displays product details and total cost on an LCD screen and generates a QR code for quick digital payment. This reduces billing time, improves accuracy, and provides a faster and more convenient shopping experience. The integration of sensors and embedded systems enables real-time bill updates, reducing waiting time and enhancing customer experience. The system also supports digital payment through QR code and SMS confirmation, ensuring a seamless checkout process.

II.METHODOLOGY

1. Hardware Integration

- ESP32 used as the main controller
- Barcode scanner for product identification
- Load cell for weight verification
- LCD for display

2. Software Implementation

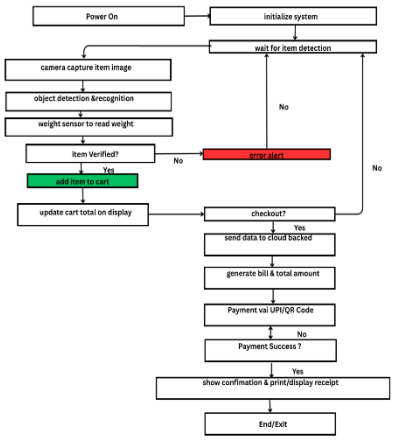
- Barcode data reading and processing
- Product details retrieval from database

- Real-time data processing

3. System Testing

- Barcode scanning testing
- Billing accuracy testing
- Performance evaluation

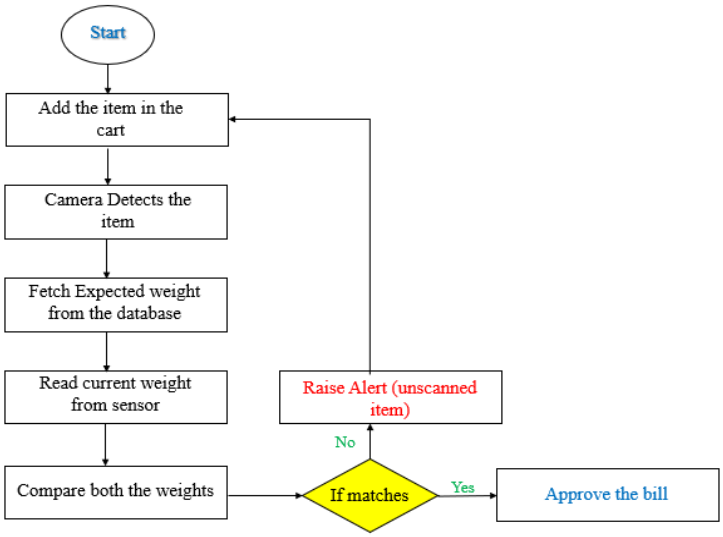
- **System Workflow**



System Workflow Fig 1

1. The system starts by initializing all components. When a product is placed in the trolley, the barcode scanner scans the item and retrieves its details from the database, while the weight sensor verifies it. If the item is verified successfully, it is added to the cart and the total bill is updated on the display.
2. If verification fails, an error alert is generated to prevent incorrect billing. During checkout, the system generates the final bill and displays a QR code for payment. Once the payment is successful, a confirmation message and receipt are displayed, completing the process.

- **Weight Verification Process**



Weight Verification Process Fig 2

1. The process starts when an item is placed in the trolley. The camera detects the item and retrieves its expected weight from the database. The load sensor measures the actual weight of the item, and both values are compared.
2. If the weights match, the item is approved and added to the bill. If they do not match, an alert is generated to indicate an unscanned or incorrect item. This ensures accurate billing and prevents errors.

- **System Prototype Design**

System Prototype Design Fig 3

1. The prototype design of the Smart Billing Automation Trolley is shown in Fig. 3. It includes a camera module, barcode scanner, load sensor, and ESP32 controller.
2. The camera is placed at the top of the trolley, where object detection takes place by capturing product images. A barcode scanner is also used as an alternative method for product identification. The load sensor at the base measures weight for verification.
3. This setup helps in accurate product detection and efficient billing.

IV. RESULTS AND DISCUSSION

- **Results**

The Smart Billing Automation Trolley system was successfully developed and tested under different conditions. The following results were observed:

1. Products were successfully scanned using the barcode scanner
2. Product details were displayed correctly on the LCD screen
3. Weight verification helped in preventing incorrect or duplicate billing
4. Real-time billing updates were achieved during shopping
5. QR code-based payment system worked effectively
6. Overall billing time was significantly reduced compared to the manual system.

- **Analysis**

The performance of the system shows that it improves the efficiency of the retail billing process. The barcode-based billing system reduces manual effort, leading to a faster checkout process. The integration of a weight sensor increases the accuracy of the system by verifying the scanned product, thereby reducing billing errors.

Real-time updates allow customers to track their expenses while shopping, improving transparency and user experience.

Compared to traditional billing systems, the proposed system provides:

1. Faster checkout process due to automation
2. Improved accuracy with reduced human errors
3. Better customer satisfaction through convenience and reduced waiting time .

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