

Smart Retail Management System using RFID

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Abstract: The proposed system, “Smart Retail Management System using RFID and Data Analytics,” is designed to improve the operation of retail businesses through automation and the application of intelligent decision-making. The proposed system utilizes the benefits of RFID technology to automatically identify products, which can be used to speed up the billing and inventory management process. A web application is also proposed to track the sales and inventory level. Data analytics is proposed to analyse the sales trend and generate insights to efficiently manage the inventory level.

Key Words: RFID Technology, Smart Retail System, Inventory Management, Data Analytics, Automated Billing, Retail Automation

1.INTRODUCTION

The retail industry is using automation technology more and more for efficient and accurate business operations. Smart Retail Management System using Radio Frequency Identification (RFID) technology helps in the automation of products, billing, and inventory control. It reduces manual effort and minimizes errors in the process, thereby facilitating efficient decision-making for the business.

2. METHODOLOGY

2.1 RFID Technology in Retail

Radio Frequency Identification (RFID) is a wireless communication technology used for automatic identification of objects using radio waves for communication. In this technology, a unique identification number is allocated to each object in the form of a tag. An RFID reader reads these tags and sends information to software for further processing. In comparison to a barcode system, in this technology, multiple objects can be scanned at a time for billing purpose.

2.2 System Architecture

System architecture refers to the hardware and software components used in a system. In this project, in the hardware part of the system architecture, a unique ID is allocated to each object in the form of a tag. An RFID reader module (MFRC522) reads these tags and sends information about object tags to the software part of the system architecture. In this project, a microcontroller (Arduino Uno) is used in the hardware part of the system architecture.

The overall architecture of the proposed system is shown in Fig. 1

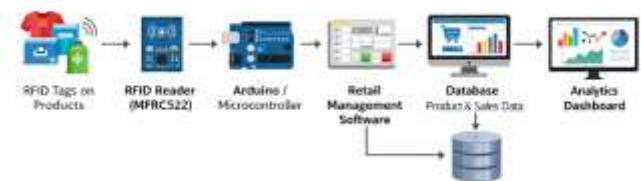


Fig -1: Architecture

2.3 System Workflow

The workflow starts with the registration of the product information into the database and assigning the RFID tag to the product. Once the customer selects the product and brings it to the counter, the RFID reader reads all the tags and sends the ID to the system. The system then displays the product information and generates the bill automatically.

The working process of the system is illustrated in Fig. 2

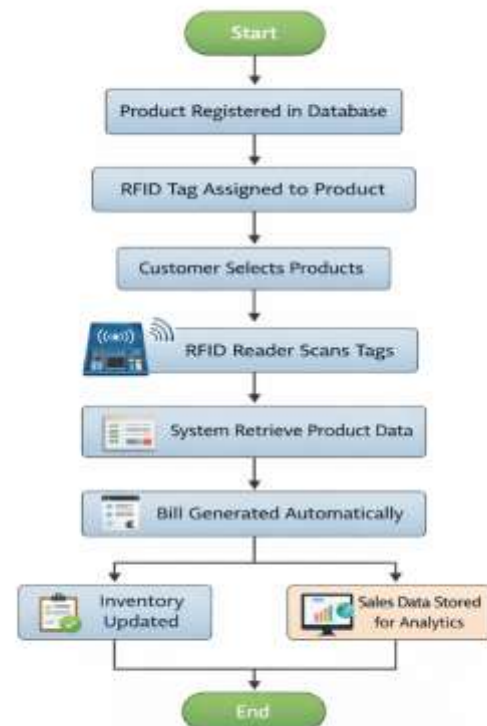


Fig -2: Workflow

2.4 System Implementation

The application is developed using various technologies such as Django, CSS, and Bootstrap as the user interface, and the backend is developed using the Django framework. The database is implemented using the MySQL database management system to store the product information, sales transactions, and inventory information. In the checkout process, the RFID reader reads all the tags and sends the ID to the system, and the system displays the product information and generates the bill automatically.

2.5 Data Analytics Module

The Data Analytics Module analyzes the data collected from the retail system regarding the sales and finds trends and patterns in the data. It uses Python libraries Pandas and Matplotlib to process the data regarding the sales transaction and generate visual reports. This will be helpful for the store managers to understand the sales of the products and efficiently manage the inventory.

The sales analysis generated by the analytics module is shown in Fig. 3



Fig -3: Data Analytics Module

Hardware Components Used:

1. **Arduino Uno** – Used as the main microcontroller to control the RFID reader and send scanned data to the system.
2. **MFRC522 RFID Reader** – Used to read RFID tags attached to products and detect their unique identification numbers.
3. **RFID Tags (13.56 MHz Passive Tags)** – Attached to each product to store a unique ID for product identification.
4. **USB Serial Communication** – Used to transfer RFID tag data from the Arduino to the computer system.
5. **Computer / Laptop** – Used to run the Django web application, manage the database, and generate billing and inventory records.

3. CONCLUSIONS

The Smart Retail Management System using RFID and Data Analytics is a system designed to improve retail business operations through the automation of billing and inventory management systems. The system utilizes RFID technology to identify products quickly and eliminate human error in transactions. Additionally, the system offers valuable information on sales and product performance through the data analytics module. Overall, the system improves business operations and offers customers a more satisfying shopping experience.

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