Smart Cart with Automatic Billing, Product Information and Product Recommendation System

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Abstract— In the 21st century, shopping often involves navigating through stores and department outlets, where customers manually push carts and fill them with desired products, eventually waiting in long lines at the cashier. Our project aims to revolutionize this traditional shopping experience with the introduction of modern automatic carts. These innovative carts are equipped with RFID readers that allow customers to scan the RFID tags on products, automatically updating their total on an Android mobile screen. Additionally, the system can send messages to customers' mobile numbers, enhancing the shopping experience by reducing queue times, automating cart movement, and enabling customers to monitor and manage their expenditures. This advancement not only streamlines the shopping process but also provides significant business insights by analyzing customer spending patterns.

Keywords— Automatic Trolley, Recommendation System, RFID, Message notification, Product scanning, Shopping technology, Mobile app integration.

1. INTRODUCTION

Technology has a significant impact on how human nature and identity are formed. Due to technological tools and artifacts, humans have expanded and transformed themselves. People are constantly working to create technology that will enable them to more easily and quickly meet their basic needs. The worldwide market has changed significantly in recent years due to the rising economy, urbanization, and industrialization. Shopping and making purchases at large malls is now a regular occurrence in urban areas, particularly on weekends and holidays [1].Technology has always been a catalyst for innovation and fostering connections among people,and the advent of modern advancements such as the Internet of Things (IoT) and business automation has further streamlined these interactions.People from various walks of life can purchase their everyday needs in a shopping mall. There are some issues that the client is now dealing with. In the current situation, a person typically comes with a list of necessary products [2]. When shopping, he chooses a product from a variety of brands based on the information he learns from reading the packaging or customer reviews [3]. After adding all necessary items to the cart, the customer proceeds to the billing counter, where, depending on the volume of traffic in the mall, he might have to wait in a long line to pay the bill, wasting needless time. When there are discounts and special deals, there is an even greater rush, and many individuals decide not to purchase in this situation. Although some techniques are used to address the issues, much more has to be done to improve it. It is necessary to enhance and automate this on-going activity so that everyone can purchase in comfort and ease, especially during extremely busy times. The main goals of science and technology have been to simplify things and increase productivity ever since they were first developed. Shopping is a necessary activity in today's fast-paced society, and the introduction of smart stores is an example of this advancement [4].

The primary goal of this work is to advances the current shopping system and may lead to new innovations in the retail industry, namely in the area of clothing malls. Customers' shopping experiences are greatly improved by these smart businesses, which allow them to register goods and pay bills with ease using their mobile numbers. In addition to streamlining operations for businesses, this technology integration gives customers the ease of accessing their transaction history whenever they want, even after the store closes. Additionally, the technology makes sure that bills are transmitted to clients' mobile phones automatically, which streamlines record-keeping and adds a convenience factor that fits in with modern digital lifestyles. A new working paradigm is offered, taking into account the issues with the current retail system. The payment is processed through mobile banking or cash payment and the cart system will verify the products and complete the process successfully. A modified model for working is presented, considering the shortcomings of the existing retail system.

2. PUBLICATION SURVEY

[1] Paper Name -: Automated Billing Smart Cart

Author -: Chandrasekar Palanisamy, T. Sangita Publisher-: International Journal of Engineering Research & Technology, 2020.

Observation-: In this paper [1], they made a model of the system in which each car will be equipped with **RFID** reader and Zigbee transceiver. In addition, RFID tags will be affixed to all products in the store or market. Supermarkets are places where consumers buy and pay for products, they use every day. For this reason,In other terms, it is essential to compute the quantity of products sold and create prices according to customers. When we go shopping at the market, we should choose the right products carefully. And after that the delivery of the invoice for all the products is very hectic. Therefore, the proposed system which help user to do smart shopping. There is a RFID tag which user can swipe on the rfid scanner once swipe is done thanit will retrieve the product id. Product id will be matched in database based on that amount added in the bill. Recommendation is done based on product enter in the cart. This recommendationtake past purchased history of the users and based on that recommendation is given. Billing is also done by using rfid tag attached with trolley. Disadvantage was online payment cant be done so user have to wait in queue. high cost[8].

[2] Paper Name-: Smart trolley and billing system

Author-: Dr. Subburam, Anitha R

Publisher-: Science Direct

Observation-: This article presents a smart car that can track purchases and pay using RFID tags. It will scan the cutting and payment process in the cart. In today's world, shopping has become a daily activity. We can see long queues waiting to pay in many stores. The aim of our project is to overcome errors and prevent loss of time. To overcome the above problems, we propose a smart car that will scan products and pay online using RFID tags. It automatically identifies and identifies the product and the final checkout is done by the shopping cart itself Thus, customers do not have to wait in long queues. It also has an RFID-based energy management system. This model is necessary and useful in smart car for the new operation of IoT. The main purpose is to provide technological tools, save time and develop business-oriented products. The system will also offer product recommendations

based on the customer's purchasing history. In our project, we will give all the product with rfid tag attached to each shopping cart. These features will save time and make shopping easier. We can have the best shopping experience overall[2].

[3] Paper Name-: Collaborative Product Recommendation System for E-commerce Websites

Author-: S. Ganesh Sundaram

Publisher-: IEEE

Observation-: Product information is an important factor in convincing customers to buy products correctly on any e-commerce site. Online user reviews are all based on each user's actual experience, which will have increasingly important information for people. Recommendations will be important in terms of price, performance, previous purchase indications and much more. In this article, we aim to beautify the service provider by comparing the popularity scores across all rankings for a particular product on various e-commerce sites. Ultimately, the number of products can be reduced by up to a third of the total product to reach the group where people like to buy the product. Finally, only a few products are recommended to users through a five-point scale that allows users to filter and guide[3].

[4] Paper Name-: The supermarket's automatic shopping cart billing system

Author-:Sainath (2014)

Observation: Customers scan products using barcodes while employing barcode technology for product billing. The created bill is then forwarded to a central billing system, where clients can pay by producing a special ID. It's crucial to remember that there is a limitation to barcode scanning: it needs a clean line of sight and needs to stay inside its defined area[5].

[5] Paper Name-: RFID-based cash register line optimisation solution

Author-:Budic (2014)

Observation: An RFID-based retail system was developed. Products are scanned using RFID, and the data collected is kept in a database. Online or at a central billing site are the two options for payment. All shopping information is also managed by a web application, which necessitates routine web application server maintenance. Precautionary steps, however, are lacking for goods that consumers may unintentionally put in their shopping carts[4].

[6] Paper Name-: IOT based intelligent trolley for shopping mall

Author-:Dhavale Shraddha (2016)

Observation: In order to streamline bill management, this project integrates IoT via an ESP module and uses RFID technology for billing in shopping centres. Payment information is sent to the server, where client payments are processed by the central billing unit. By acting as a short-range Wi-Fi chip, the ESP module makes wireless communication possible. Limitations are mentioned, though, such as possible interference and distance restrictions. Furthermore, during periods of high consumer activity, server congestion may happen, making a steady internet connection necessary for efficient processing[11].

[7] **Paper Name-:** Smart shopping trolley using RFID

Author: Komal Ambekar (2015)

Observation: This study presents an effective RFID and ZigBee technology integration strategy

for shopping carts. By scanning products on the reader, the system creates bills, which it then sends to the central billing division. At the counter, paying the bill presents a big challenge for customers[9].

[8] Paper Name-: An intelligent shopping cart with attentive customer service
Author: Hsin-Han Chiang (2016),

Observation: This study successfully implemented an automated shopping cart with an automated billing system, incorporating face recognition for customer authentication. However, it is acknowledged that the process is complex, especially during peak shopping hours when face recognition may face challenges in accuracy due to crowded mall conditions. Numerous errors are anticipated in the authentication process when relying on facial recognition[7].

[9] Paper Name-: Smart RFID based Interactive Kiosk Cart using wireless sensor node
Author: Narayana Swamy (2016)

Observation:Implemented RFID technology for automated shopping, utilizing a dedicated website for billing management and user interaction. Each user accesses the web server with a unique ID for bill payment and invoice details. The success of this service relies on a stable internet connection, and potential challenges include failures due to internet instability and server errors arising from high loads.

[10] Paper Name-: Shopping and automatic billing using RFID technology
Author: Vinutha (2014)

Observation: The research introduces an automatic billing system with a server-side component. Products are scanned using radio frequency identification, and the billing process is conducted at the server end, with the generated bill then communicated to the customer. The effective functioning of this system necessitates regular server maintenance and relies on stable internet connectivity for both customers and shopkeepers [5].

3. RECOMMENDED SYSTEM DESIGN

I. RFID and Ultrasonic Sensor:

- RFID: Radio Frequency Identification (RFID) tags are likely attached to products. The RFID reader on the trolley scans these tags to identify items placed in the trolley.
- Ultrasonic Sensor: This sensor is used for measuring distances, possibly to detect if items are placed in or removed from the trolley.

II. Central Microcontroller:

This component (likely an ESP8266 or a similar microcontroller) processes data from the RFID and ultrasonic sensors. It acts as the central unit of the smart trolley.

III. **Buzzer:**

Connected to the microcontroller, the buzzer provides auditory feedback or alerts to the user, potentially for actions such as successful item scanning or errors.

IV. **Database (SQL):**

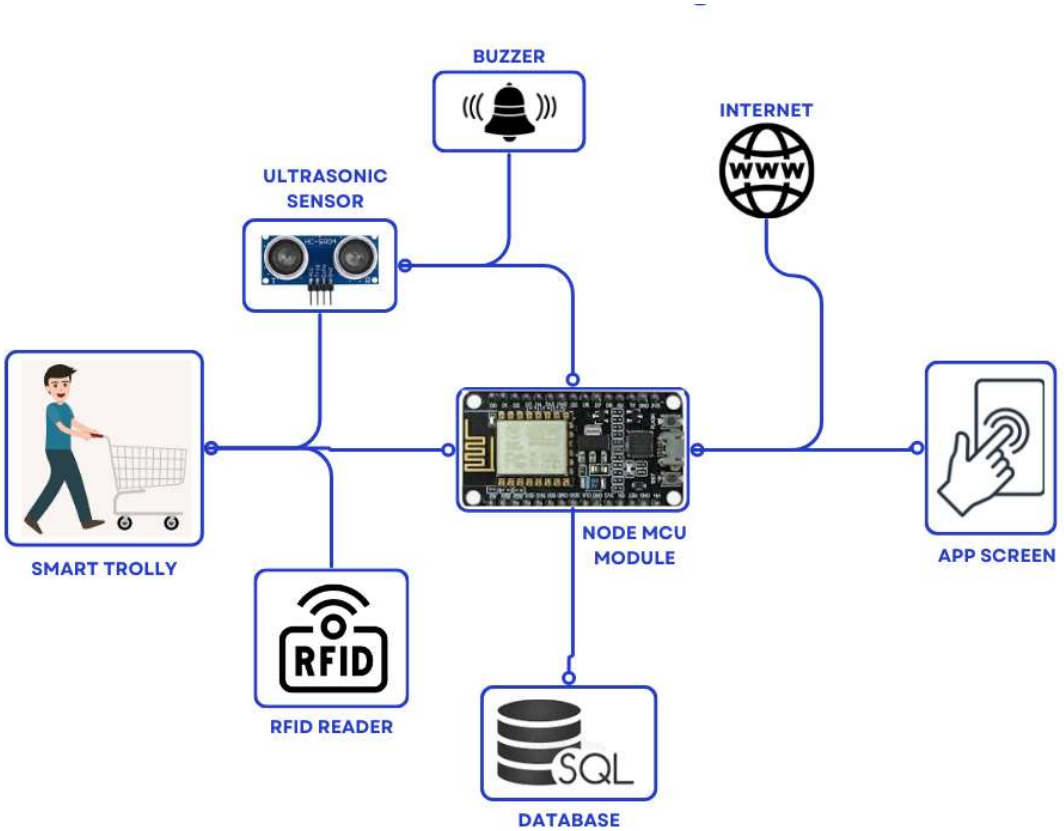
- The system uses a SQL database to store and manage data. This could include inventory information, user data, transaction logs, etc.
- The microcontroller communicates with the SQL database to update and retrieve data as necessary.

V. **Internet Connectivity:**

The microcontroller connects to the internet, allowing it to sync data with the SQL database and possibly interact with other services.

VI. **Mobile Application (Android Mobile):**

- An Android mobile app interfaces with the system, allowing users to view their shopping lists, track expenses, receive notifications, and manage their account.
- The app communicates with the microcontroller and the database over the internet.



Architecture Diagram

The price will be updated and recommendations will be given via the Android app. we will inquire about the user's preferences when they register for the Android app, and we will then suggest products based on those preferences. Payment using Google Pay will be available when the user checks out.

4. SYSTEM FLOW

I. Item Scanning:

- As items are placed in the trolley, the RFID reader scans the tags.
- The ultrasonic sensor detects the presence or removal of items, providing additional context to the system.

II. Data Processing:

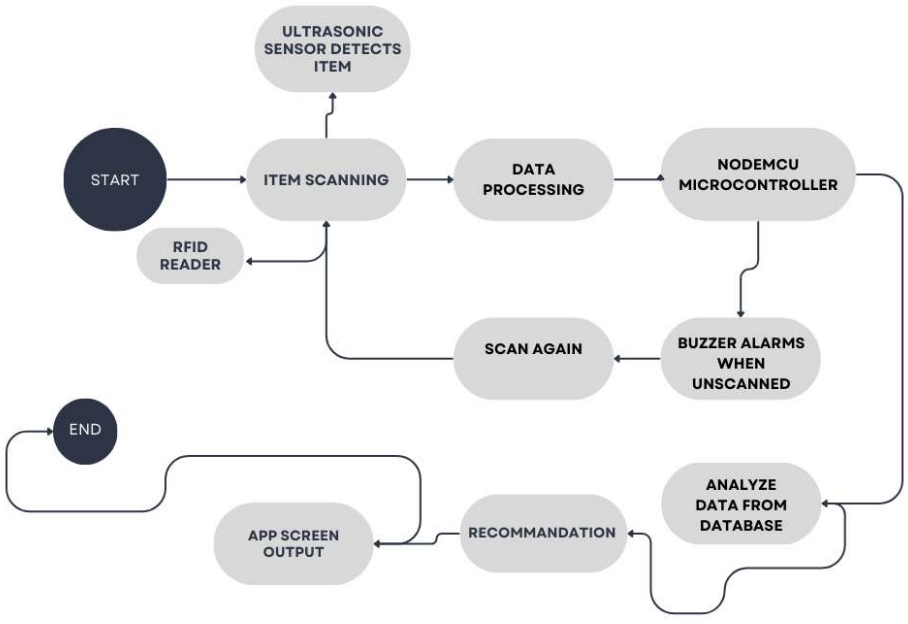
- The microcontroller processes the sensor data, updating the item list in the trolley.
- If an item is successfully added, the buzzer might beep to confirm the action.

III. Database Interaction:

- The microcontroller sends data to the SQL database, updating the inventory and user's shopping cart information.
- The database might also send data back to the microcontroller or directly to the user's mobile app.

IV. User Interaction:

- Users can view their current shopping cart, total cost, and other details via the Android mobile app.
- The app communicates with the SQL database and possibly the microcontroller to provide real-time updates.



5. COMPARISION

A. Existing System:

Shopping centers currently use barcode scanners to scan products provided by suppliers, which is a laborious procedure that requires shoppers to wait in long lines. Shoppers who are impatient with the line-up frequently decide to leave the mall empty-handed [5]. The goal is to improve the shopping experience by implementing new technologies in order to address this problem.

The idea is to switch to smart shopping carts, which have individual identifiers installed. Customers can scan product RFID tags with these cutting-edge carts' RFID readers, which instantly update the total on an Android smartphone screen [6]. This strategy seeks to improve consumer happiness and shopping efficiency by streamlining the process, offering real-time tracking of purchases, and doing away with the need for lengthy line waits [7].

B. PROPOSED SYSTEM DESIGN

a. Customer Registration and Login

Customers must first create their own account in the application. Customer details will be stored on the web server.

b. Store Database Maintenance

The store database will have all the information about everything. This is where product-related information is stored and managed. Customer account information and billing information will be stored here.

c. Shopping cart selection

Once the user enters the mobile application, the system will ask you to scan the shopping cart. The carrier will be identified by the SSID with a unique pattern. The user can select a particular cart after reviewing all the carts. When selected, the phone will connect to the cart via Bluetooth, allowing them to communicate.

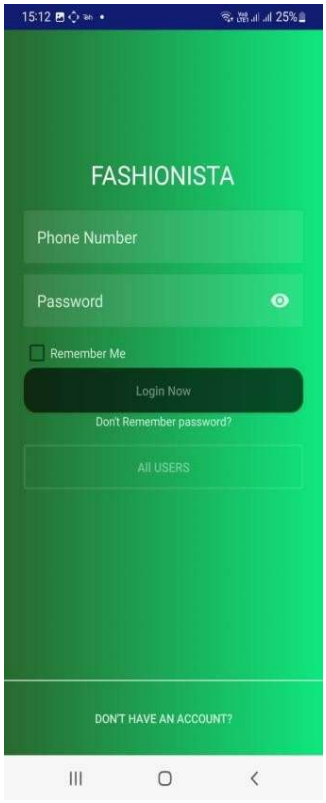
d. Shopping using the shopping cart and mobile application.

When the mobile application andthe shopping cart are connected via Bluetooth, the customer can start shopping.

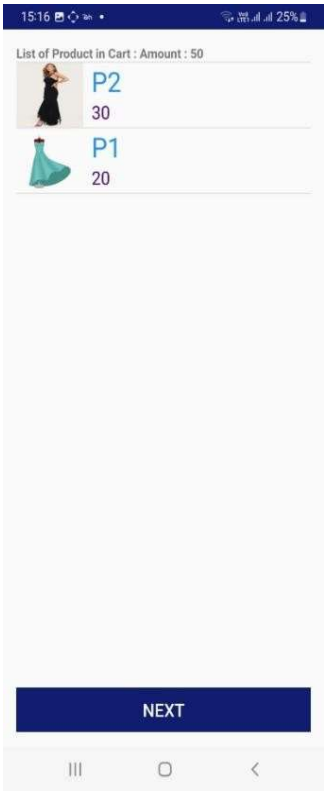
6. Testing and Result

After developing a hardware prototype and software this is how our project looks like .

Billing screen interface

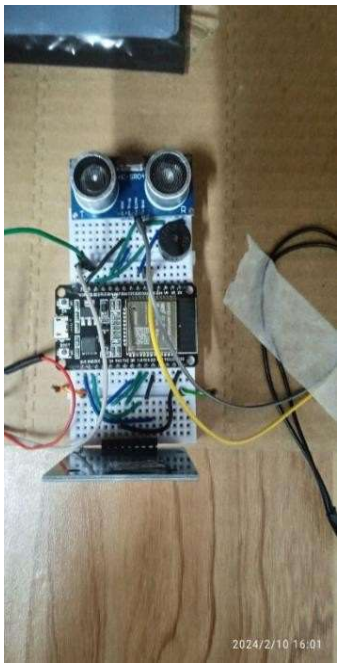


Login screen interface



Item screen interface

RFID Scanner



Node MCU Module

Integrated System

1. **System Performance**

Metric	Description	Value
Response Time	Time taken to scan and update the cart	3 seconds/item
WiFi Connection Time	Time taken to connect the mobile app to the cart via ESP8266 WiFi	5 seconds
Notification Delay	Time delay between adding an item and receiving a notification on the app	1 second
Battery Life	Operational time before needing a recharge	7 hours

2. **User Feedback**

Aspect	Description	Feedback (Scale: 1-5)
Ease of Registration	User-friendliness of the registration process	4.6
WiFi Connectivity	Reliability of WiFi connection between app and cart via ESP8266	4.4
Notification Accuracy	Accuracy of notifications for added products	4.7
Recommendation Relevance	Relevance of the product recommendations	4.3
Checkout Process	Ease and speed of the checkout process using Google Pay	4.8

3. **Shopping Experience: Clothing Shopping**

Scenario	Description	Outcome
Scenario 1: Adding Tops	User adds a top to the cart; receives recommendations for matching bottoms, accessories, and shoes.	90% of recommendations were relevant and accepted.
Scenario 2: Adding Jeans	User adds jeans; receives recommendations for matching tops, belts, and shoes.	85% of recommendations were relevant and accepted.
Scenario 3: Adding Dresses	User adds a dress; receives recommendations for accessories and shoes.	88% of recommendations were relevant and accepted.
Scenario 4: Adding Shoes	User adds shoes; receives recommendations for matching outfits (tops, bottoms).	83% of recommendations were relevant and accepted.
Scenario 5: Adding Jackets	User adds a jacket; receives recommendations for innerwear and accessories.	86% of recommendations were relevant and accepted.

4. **Cart and Product Statistics**

Metric	Description	Value
Total Products in Cart	Number of products added to the cart	6-7
Average Price per Product	Average price of products added to the cart	$50
Total Cart Value	Total value of all products in the cart	$300
Recommendation Acceptance Rate	Percentage of recommended products accepted by the user	87%

5. Challenges and Limitations

Challenge	Description	Impact	Mitigation
WiFi Interference	Issues with WiFi connectivity due to interference in crowded areas	Moderate	Implement stronger WiFi signal protocols and error-handling mechanisms
RFID Reader Accuracy	Inconsistent reading of RFID tags	High	Upgrade to higher quality RFID readers and improve tag placement
User Privacy Concerns	Concerns over data security and privacy	High	Implement robust encryption and anonymization techniques for data storage and transmission
Google Pay Integration	Occasional issues with Google Pay during checkout	Low	Regular updates and testing to ensure compatibility and functionality

6. Registration and Login Statistics

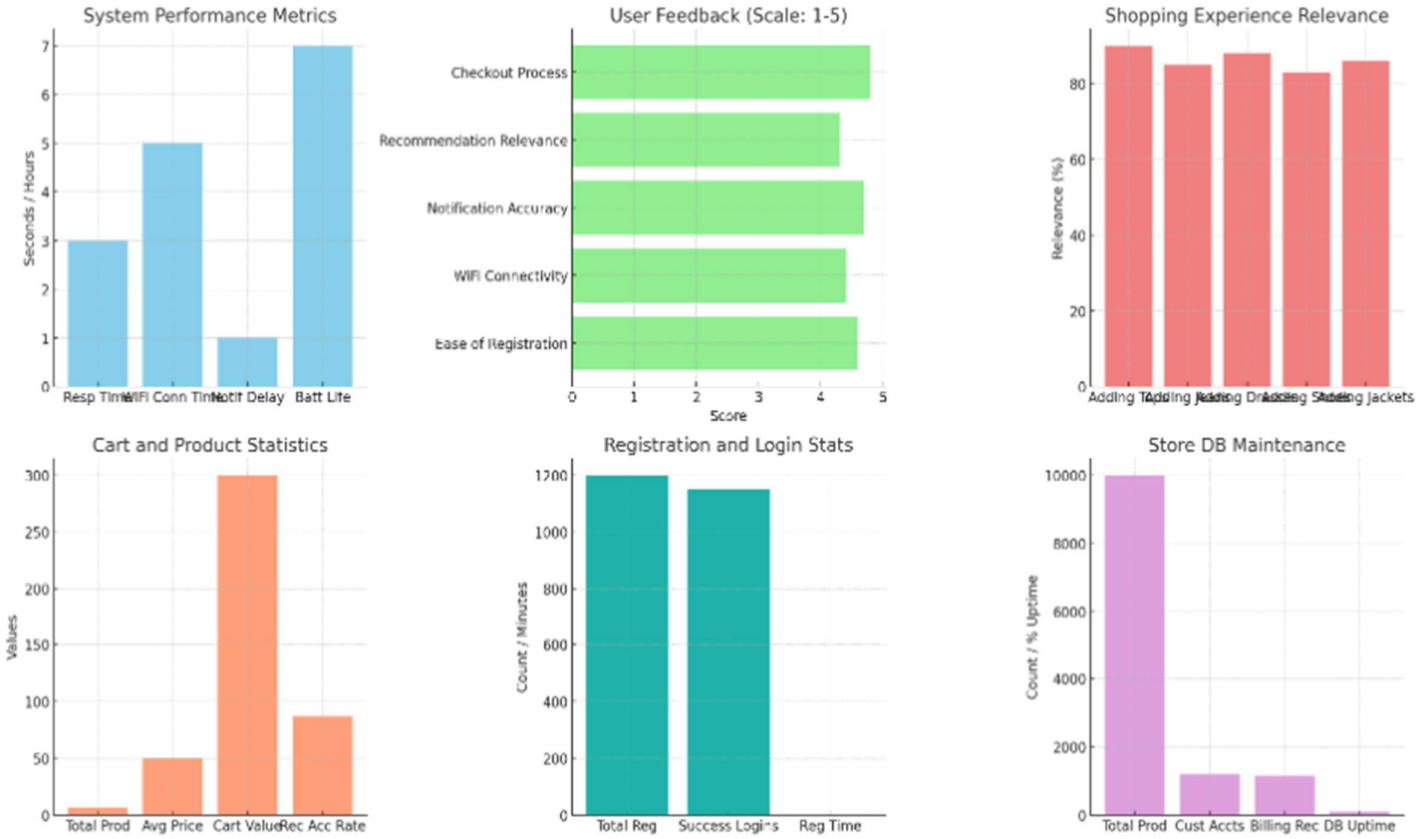
Metric	Description	Value
Total Registrations	Number of users registered in the system	1,200
Successful Logins	Number of successful logins	1,150
Average Registration Time	Time taken to complete registration	2 minutes

7. Store Database Maintenance

Database Metric	Description	Value
Total Products	Number of different products in the store database	10,000
Customer Accounts	Number of customer accounts stored	1,200
Billing Records	Number of billing records processed	1,150
Database Uptime	Percentage of time the database is available	99.9%

8. Shopping Cart Selection

Metric	Description	Value
Cart Identification Time	Time taken to scan and identify a cart	3 seconds
Cart Selection Success Rate	Percentage of successful cart selections	95%
Average Carts Connected	Average number of carts connected per session	50



7. CONCLUSION

In summary, the creation of this System represents a substantial advancement in the field of retail technology. This creative approach improves the customer purchasing experience by fusing the ease of automated invoicing with the strength of real-time item information and tailored product recommendations. Along with streamlining the checkout process to save customers time and minimize errors, it also offers an extensive range of information goods to help them make well-informed purchases. A more engaging and personalized shopping experience is provided by the product recommendation system, which also makes use of sophisticated algorithms and data analysis to accommodate individual tastes. The Smart Cart's amalgamation of these attributes renders it a propitious resolution for merchants and patrons alike, refining the retail ecology and elevating the customer experience.

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