Auto Billing Shopping Cart

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ABSTRACT - This paper presents the design and implementation of an RFID technology-based smart shopping system that aims to improve the shopping experience for customers and retailers. The system consists of smart shopping carts that can automatically identify the products placed inside them using RFID readers and tags, and calculate the total bill. The system also displays the cart information on a webpage that can be accessed by customers and retailers. The paper discusses the benefits of the system, such as reducing the waiting time and hassle of billing, enhancing customer satisfaction and loyalty, and increasing sales and inventory management efficiency. The paper also addresses some of the challenges and limitations of the system, such as the cost and maintenance of RFID equipment, the security and privacy of customer data, and the compatibility and interoperability of different RFID standards.

Key Words: RFID, smart shopping system, IoT, customer experience, retail management.

INTRODUCTION - Shopping is one of the most common and essential activities in people's lives. However, shopping can also be a frustrating and time-consuming experience, especially when customers have to wait in long queues at the checkout counters or deal with errors and losses in their purchases. Therefore, there is a need for a system that can improve the shopping process efficiency and enhance the customer satisfaction and loyalty. One of the promising technologies that can achieve this goal is Radio Frequency Identification (RFID).

RFID is a wireless technology that uses radio waves to identify and track objects. RFID consists of two main components: RFID tags and RFID readers. RFID tags are small devices that can be attached to any object and store information about it. RFID readers are devices that can read the information from the RFID tags by emitting radio signals and receiving the responses from the tags. RFID can be used for various applications, such as inventory management, asset tracking, access control, identification and authentication.

However, RFID alone is not enough to provide a complete solution for the shopping process. There are some limitations and challenges of using RFID, such as interference, collision, privacy, security and cost. Therefore, RFID needs to be integrated with other technologies, such as sensors, mobile devices and wireless communication. One of the possible ways to integrate RFID with these technologies is to use smart shopping carts.

Smart shopping carts are shopping carts that are equipped with RFID sensors, proximity sensors, Node MCU microcontroller, WiFi module and webpage. The RFID sensors can read the RFID tags attached to each product and display the product information on the mobile application. The proximity sensors can detect when a product is removed from the shopping cart without pressing the remove item button and ring a buzzer for unlawful product removal. The Arduino microcontroller can control the logic and functionality of the system. The WiFi module can communicate with the recipient device wirelessly. The webpage can show the shopping list, total amount and items in cart for the customer. The server and device can store and process the RFID data and generate billing for each customer.

The main objective of this research paper is to propose a system that consists of smart shopping carts with RFID and proximity sensors that can improve the checkout process efficiency and enhance the customer experience in supermarkets. The paper will also discuss the advantages and disadvantages of using this system, as well as the challenges and solutions for implementing it. The paper will also present some test cases to demonstrate the functionality and performance of the system under various scenarios.

LITERATURE SURVEY

a) IoT Application Based Advanced Shopping Trolley by Hiba Sadia & et. al.:

The paper proposes a smart shopping system that uses RFID tags and readers embedded with the shopping carts to automate the billing process and reduce the waiting time of customers in supermarkets. The system also maintains an inventory list of all the products in the mall using smart shelves with RFID readers. The system displays the product details and the total price on an LCD screen installed in the cart and allows the customer to make the payment using a mobile point of sale. The system also stores all the processed information in a database for future analysis.

The paper claims that the proposed system can improve the shopping experience of customers and retailers by saving time, reducing human errors, enhancing security, and providing analytical insights. However, the paper also has some drawbacks, such as:

- The paper does not provide any experimental results or evaluation metrics to validate the performance and feasibility of the proposed system.
- The paper does not address the challenges and limitations of using RFID technology, such as interference, collision, security, and privacy issues.
- The paper does not compare or contrast the proposed system with other existing or related systems that use different technologies or approaches to solve the same problem.
- The paper does not discuss the scalability, reliability, or cost-effectiveness of the proposed system for large-scale deployment and maintenance.

b) Iot Based Smart Shopping Cart Using Radio Frequency Identification by Mobeen Shahroz & et. al.:

The paper proposes a smart shopping cart system that uses RFID tags and readers to scan the products and display the total price on an LCD screen installed in the trolley. The system also allows the customer to pay digitally through a mobile app without waiting in a queue. The system uses a Bluetooth module and an Arduino microcontroller to communicate with the RFID devices and the app. The system also uses a web server and a database to store and process the shopping information.

The paper claims that the proposed system can improve the shopping experience of customers and retailers by saving time, reducing human errors, enhancing security, and providing analytical insights. However, the paper also has some drawbacks, such as:

- The paper does not provide any experimental results or evaluation metrics to validate the performance and feasibility of the proposed system.
- The paper does not address the challenges and limitations of using RFID technology, such as interference, collision, security, and privacy issues.
- The paper does not discuss the scalability, reliability, or cost-effectiveness of the proposed system for large-scale deployment and maintenance.
- The paper does not compare or contrast the proposed system with other existing or related systems that use different technologies or approaches to solve the same problem.

c) RFID Based Smart Shopping Cart by Bala Krishnan & et. al.:

The paper proposes a smart shopping cart system that uses RFID tags and readers to scan the products and display the total price on an LCD screen installed in the cart. The system also allows the customer to pay digitally through a mobile app without waiting in a queue. The system uses a ZigBee module and an Arduino microcontroller to communicate with the RFID devices and the app. The system also uses a web server and a database to store and process the shopping information.

The paper claims that the proposed system can improve the shopping experience of customers and retailers by saving time, reducing human errors, enhancing security, and providing convenience. However, the paper also has some drawbacks, such as:

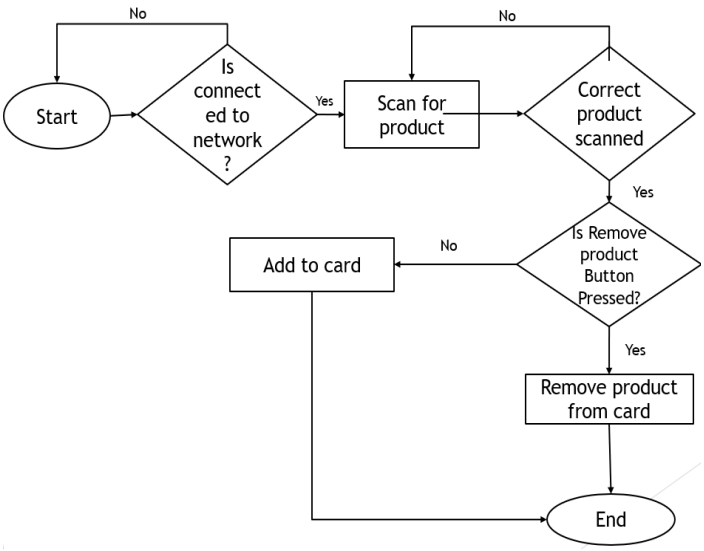
- The paper does not compare or contrast the proposed system with other existing or related systems that use different technologies or approaches to solve the same problem.
- The paper does not provide any experimental results or evaluation metrics to validate the performance and feasibility of the proposed system.

- The paper does not address the challenges and limitations of using RFID technology, such as interference, collision, security, and privacy issues.
- The paper does not discuss the scalability, reliability, or cost-effectiveness of the proposed system for large-scale deployment and maintenance.

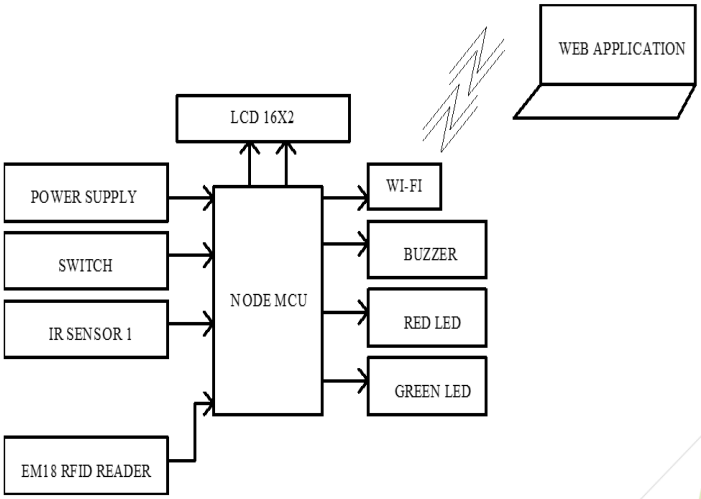
OBJECTIVE

- To improve the checkout process efficiency by allowing customers to do self-scanning of items and reducing the queue time.
- To enhance the customer experience by providing convenience, security and transparency.
- To reduce the operational costs for the supermarket by saving labor, paper and inventory management.
- To increase the sales and loyalty of the supermarket by offering personalized promotions, recommendations and rewards based on the customer's shopping history.
- To prevent theft and loss of products by alerting the staff when someone tries to remove a product without pressing the button.
- To provide real-time data on the stock levels, customer preferences and sales trends.
- To improve the product quality by monitoring the expiration dates, temperatures and freshness of the products.
- To reduce the environmental impact by eliminating the need for plastic bags, receipts and stickers.

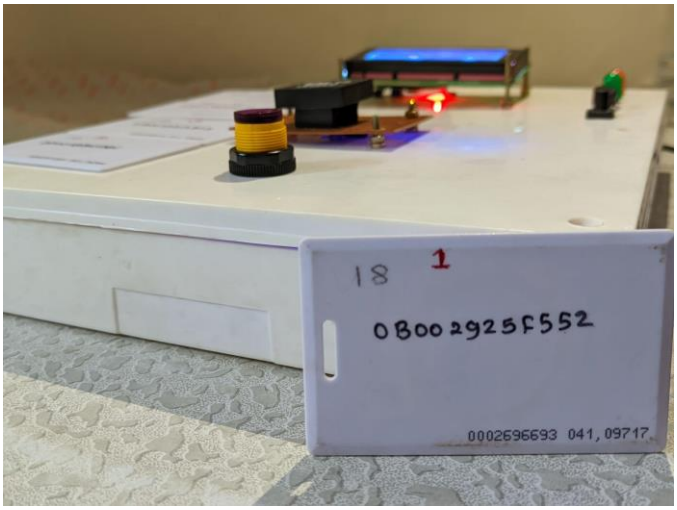
FLOWCHART

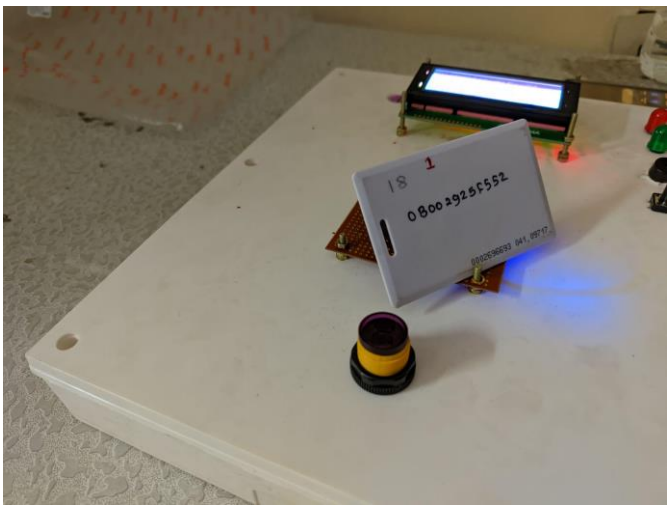


SYSTEM ARCHITECTURE



IMPLEMENTATION



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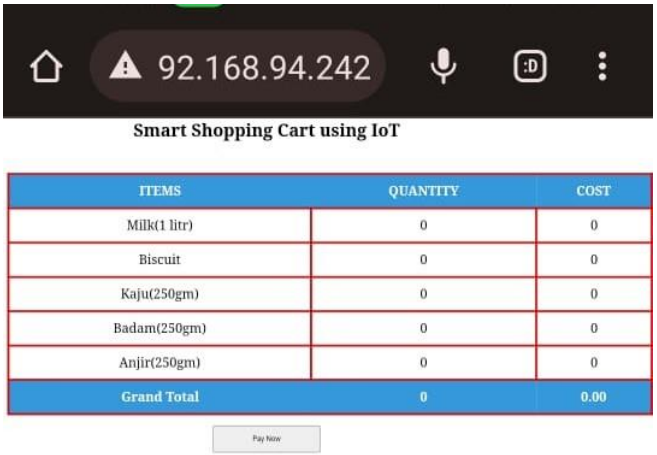
EM-18
READER
MODULE

TESTING & RESULT

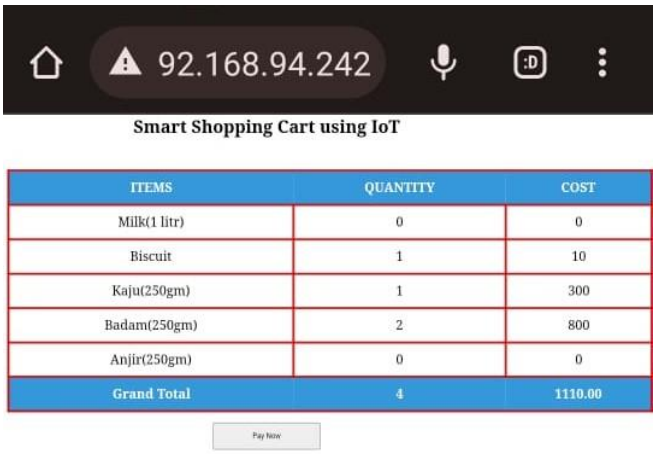
TC ID	Test Case Description	Expected Result	Actual Result	Status
TC-1	Verify that the RFID tag is attached to each product and contains the product information.	The RFID tag should be readable by the RFID reader and display the product information on the mobile app.	The RFID tag is readable by the RFID reader and displays the product information on the mobile app.	Pass
TC-2	Verify that the remove item button can delete a product from the shopping list.	The remove item button should remove the selected product from the shopping list and deduct its price from the total amount.	The remove item button removes the selected product from the shopping list and deducts its price from the total amount.	Pass
TC-3	Verify that the proximity sensor can detect an unlawful product removal and ring a buzzer.	The proximity sensor should sense when a product is taken out of the shopping cart without pressing the remove item button and trigger a buzzer alarm.	The proximity sensor senses when a product is taken out of the shopping cart without pressing the remove item button and triggers a buzzer alarm.	Pass
TC-4	Verify that the web page can show the shopping list and total amount.	The web page should display all the relevant information for the customer and allow them to manage their shopping preferences.	The webpage displays all the relevant information for the customer.	Pass
TC-5	Verify that the wireless communication between the RFID system and the receiving device is reliable.	The wireless communication should encrypt the RFID data and transmit it without errors or delays.	The wireless communication encrypts the RFID data and transmits it without errors or delays.	Pass

The results of this research paper show that RFID and proximity sensors in shopping carts can offer many benefits for the customers and the supermarket, as well as for the society and the environment. The proposed system can improve the checkout process efficiency, enhance the customer experience, reduce the operational costs, increase the sales and loyalty, prevent theft and loss, provide real-time data, improve the product quality, facilitate better customer service and support sustainability initiatives. The test cases conducted on the system demonstrate its functionality and performance under various scenarios. The system can also overcome some of the challenges and drawbacks of implementing RFID technology, such as privacy and security, initial costs, technical difficulties, complex implementation and power availability. The system can provide a convenient and secure shopping experience for the customers and a profitable and competitive edge for the supermarket

Before Scanning Product -



After Scanning Product -



ADVANTAGES

- It can improve the checkout process efficiency by allowing customers to do self-scanning of items and reducing the queue time.
- It can enhance the customer experience by providing convenience, security and transparency.
- It can reduce the operational costs for the supermarket by saving labor, paper and inventory management.
- It can increase the sales and loyalty of the supermarket by offering personalized promotions, recommendations and rewards based on the customer's shopping history.
- It can prevent theft and loss of products by alerting the staff when someone tries to remove a product without pressing the button.
- It can provide real-time data on the stock levels, customer preferences and sales trends .
- It can improve the product quality by monitoring the expiration dates, temperatures and freshness of the products.
- It can reduce the environmental impact by eliminating the need for receipts.

DISADVANTAGES

- It can increase the initial costs of setting up and maintaining the RFID system, including the tags, readers, software and testing.
- It can face technical challenges such as interference, collision, compatibility and standardization issues.
- It can require complex implementation and integration with existing systems and processes.
- It can depend on power availability and battery life for the RFID tags and readers.

CONCLUSIONS

In conclusion, RFID and proximity sensors in shopping carts can offer many benefits for the customers and the supermarket, as well as for the society and the environment. By using this system, the customers can enjoy a more convenient and secure shopping experience, as they can scan and pay for their products without waiting in long queues or worrying about theft or loss. The supermarket can also benefit from this system by saving labor, paper and inventory costs, as well as by gaining more insights into the customer preferences and sales trends. Moreover, the system can help to increase the sales and loyalty of the supermarket by providing personalized promotions, recommendations and rewards based on the customer's shopping history. Furthermore, the system can improve the product quality and reduce the environmental impact by monitoring the expiration dates, temperatures and freshness of the products, as well as by eliminating the need for plastic bags, receipts and stickers. However, this system also poses some challenges and drawbacks that need to be carefully considered before implementing it. One of the main challenges is to ensure the privacy and security of the RFID data, as it can be easily tapped or intercepted by unauthorized or malicious readers. Another challenge is to cover the initial costs of setting up and maintaining the RFID system, including the tags, readers, software and testing. Additionally, the system can face technical difficulties such as interference, collision, compatibility and standardization issues that can affect its performance and reliability. Moreover, the system can require complex implementation and integration with existing systems and processes that can involve a high level of collaboration among the stakeholders, such as the supermarket, the suppliers, the customers and the regulators. Furthermore, the system can depend on power availability and battery life for the RFID tags and readers that can cause problems in case of power outages or malfunctions. Therefore, before implementing this system, the supermarket should carefully weigh the pros and cons and consider the best practices and solutions to overcome the potential barriers.

FUTURE SCOPE

The smart shopping cart system using RFID and proximity sensors has the potential to improve the shopping experience of customers and retailers in various ways. Some of the possible future enhancements are:

- Integrating the system with a payment gateway that allows customers to pay online using their mobile devices or credit cards without going to the cashier.
- Adding a voice assistant or a chatbot that can interact with customers and provide them with recommendations, feedback, or assistance based on their preferences and shopping history.
- Incorporating artificial intelligence and machine learning techniques to analyze the shopping patterns and behavior of customers and provide them with personalized offers, discounts, or coupons.
- Expanding the system to other domains such as libraries, warehouses, or museums where RFID and proximity sensors can be used to track and manage the inventory, books, or artifacts.
- Enhancing the security and privacy of the system by using encryption, authentication, and blockchain technologies to protect the data and transactions of customers and retailers.

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