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Versatile Smart Carts: Redefining the Retail Experience

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Abstract: ***This paper presents a smart shopping cart module that can be fastened on any traditional cart to make it smart cart. In this era of rapid urbanization and the expansion of automation and smart technologies this module proves to be invaluable. Traditional billing involves manual scanning of each product, which is more prone to errors. Misidentified items, incorrect labelling, and price discrepancies are very common issues. This research paper delves into the innovative concept of Smart Billing Cart module and their potential to revolutionize the way of shopping. The study ventures into the design and functionality of Smart Shopping Cart module, which could be used with any traditional cart to make it smart cart. This accelerates billing process and would also reduce time which is wasted in long queues for billing. Customers can complete their shopping faster and more conveniently.***
Keywords: Smart Cart Module, RFID, Keypad

I. INTRODUCTION

In this era of rapid urbanization and the expansion of automation and smart technologies, one such innovation that promises to revolutionize the traditional shopping experience is the "Smart Shopping cart". Shopping for groceries and other items is a common aspect of daily life, but the process of selecting items, adding them to a cart, and then standing in long queues for billing has not changed for decades. This smart shopping cart module seeks to change that by introducing a completely new experience of shopping.

We can convert any traditional shopping cart to smart shopping cart by fastening this smart module with traditional cart. This system is equipped with RFID reader, a LCD display Keypad and a Battery. This system ensures transparency and accuracy in the billing process, eliminating the need for manual calculations and price checks.

II. RELATED WORKS

This paper discusses the implementation of a centralized and automated billing system for shopping malls and supermarkets using Radio Frequency Identification (RFID) and ZigBee communication technology. It addresses the problem of long queues at cashier desks in these establishments by providing a more efficient and automated way to calculate and generate bills for customers [1].

This paper states the importance of RFID tags ,which helps in fast billing and how can we use it in other systems. The core method used in the paper is the implementation of RFID technology. RFID tags or cards are attached to each product, and RFID readers are installed in shopping carts. This method is designed to streamline the shopping process and reduce the time customers spend where RFID system is used to automatically capture product data without the need for manual scanning or barcode systems [2]. The paper mentions the use of cryptographic algorithms such as AES and DES for securing the data stored in the cloud server, enhancing the security of the billing information [3].

This paper discusses the development of a novel product called "A Novel Low-Cost Intelligent Shopping Cart (NLISC)". The system is designed to reduce the time spent on shopping and help users find the best prices for products. NLISC has four components, LDC (location detection component) detects and tracks cart in shopping area with help of infrared sensor and dynamic location detection. SCC (Server communication component) is a medium between cart and main server, it retrieves product data and sends to server. UIDC(user interface and display component) shows pricing of product on display. Automatic billing adds up price of product purchased and deletes the one which are removed [4].

This paper is about intelligent cart being designed which has key features like detecting objects placed in cart, user authentication [5].

This paper highlights a problem regarding keeping track on payments , difficulty in choosing product etc. The key feature of this smart cart is budget setting, here we can set a budget which on exceeding notifies the user [6].

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This research paper discusses the design and implementation of a smart shopping system based on RFID (Radio Frequency Identification) technology and Internet of Things (IoT). The objective of the research is to create a system that simplifies the shopping process for consumers and provides various benefits to both shoppers and retailers. The system involves the use of RFID technology in shopping carts, mobile applications, and a central server. It offers features like product location assistance, automatic billing, and real-time inventory management [7].

The focus of the paper is on the implementation of a smart shopping system using RFID technology. In this system, RFID tags are attached to products in a store, and RFID readers are installed in shopping carts and on shelves. When a product with an RFID tag is placed in a smart shopping cart, it is automatically read, and billing information is generated on the cart itself, reducing the need for customers to wait in long checkout lines. Smart shelves equipped with RFID readers monitor stock and can update a central server, making inventory management more efficient. The paper introduces the use of elliptic curve cryptography (ECC) for securing communications in the smart shopping system. ECC is chosen for its smaller key size and efficiency [8].

It introduces LiFi, a technology that uses visible light communication to transmit data. Each product in the supermarket is equipped with a LiFi transmitter that stores information like product ID, cost, and quantity. Customers' mobile phones are integrated with LiFi receivers, allowing them to read product information by simply pointing their mobile devices at the products they choose. This information is used for billing. The text suggests that LiFi technology offers advantages over traditional RF-based systems, such as high bandwidth, efficiency, and security. It also mentions that it can work well in indoor environments [9].

The proposed solution involves integrating technology, such as barcode scanning, weight sensors, and a mobile application, into the shopping process to automate billing and enhance the overall shopping experience.

The proposed paper describes the development of a smart shopping cart system that integrates hardware components like Raspberry Pi, Intel Neural Compute Stick 2, a touchscreen display, and a camera with a software stack that includes TensorFlow, Open VINO, and a web-based graphical interface. The system aims to improve the shopping experience and streamline the checkout process for customers [10].

III. SYSTEM DESIGN AND IMPLEMENTATION

A. System Architecture

The system architecture comprises of an Arduino Uno microcontroller, a RFID reader, a LCD display, and a keypad. Interconnections are established via SPI (Serial Peripheral Interface) and I2C (Inter-Integrated Circuit) communication protocols. The RFID reader communicates with the microcontroller using the SPI protocol, while the LCD display is interfaced using I2C protocol.

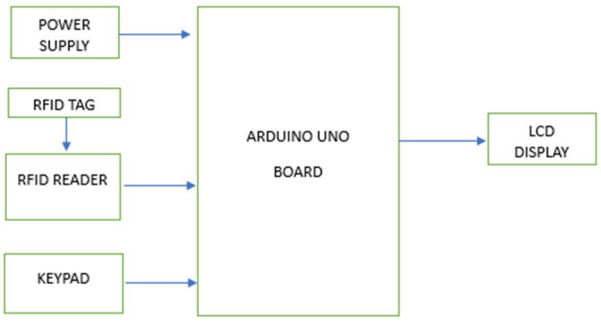


Fig. 1: Block Diagram

B. Hardware Setup

For Hardware setup, this module is equipped with Arduino UNO microcontroller. It has GPIO (General Purpose Input/Output) pins for interfacing with RFID reader. It uses MFRC522 RFID reader for reading product information from the associated RFID tags attached to an item. It uses 16*2 I2C-enabled LCD display to display the items added, total price and payment information. A matrix keypad is attached to it for giving inputs to the smart shopping cart module. All these components are interfaced according to their datasheets.

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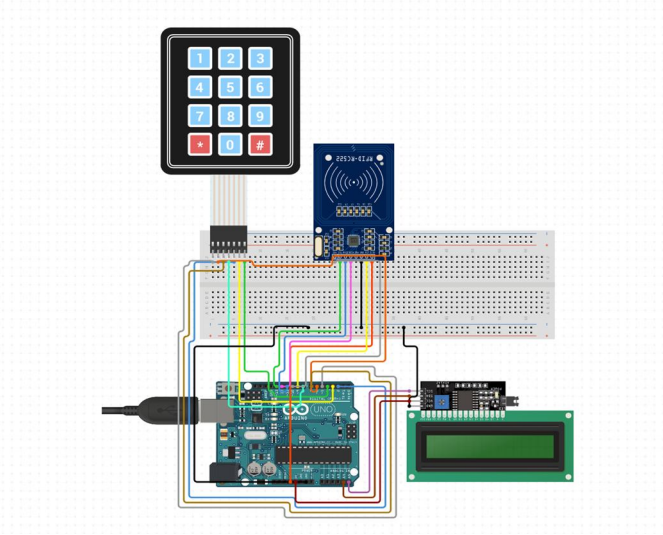


Fig. 2: Circuit Diagram

C. System Operation

System starts with a 'Welcome' message and then prompt to initiate the shopping cart by pressing '1'. Now user can add items to cart by scanning RFID tags attached with the items. To remove item from the cart, user needs to press '2' on keypad and then remove the product from the cart by just scanning the RFID tag attached to it. After done with shopping we just need to press '3' then system will display total items added and total amount, then after it will prompt user to scan the billing card for payment. If the balance is sufficient in billing card, then payment will take place, otherwise it would display 'Insufficient balance'. After completing the transaction, the system resets to the initial state for the next use.

IV. RESULTS AND DISCUSSION

We conducted a various experiment to validate system user ability and functionality. We also tested with valid/invalid RFID tags, addition/removal of items and also tested different payment scenarios. Test results indicated accurate RFID tag identification, proper item handling and successful payment transactions. The system exhibited unwavering efficiency and accuracy during shopping process, thereby enhancing the overall shopping experience for users. The proposed billing process improved the user convince during checkout and made it faster and efficient. The integration of this billing process resulted in a notable reduction in average checkout time.

V. FUTURE SCOPE

Introduce user authentication for secure transactions. Implementing user-specific profiles with RFID cards or pass codes can enhance security and personalize the shopping experience. We can also connect the system to a database or external storage to manage a larger inventory of items, their details (such as price, description), and possibly maintain user transaction histories. We can enhance the user interface on the LCD display by incorporating graphics, better formatting, or additional information during various stages of shopping. We can also include a feedback system to gather user input or ratings after the shopping experience, enabling improvements based on customer feedback. These future scopes aim to enhance the functionality, security, user experience, and analytical capabilities of the Smart Cart system, making it more efficient, secure, and adaptable to evolving user needs and market trends.

VI. CONCLUSION

The integration of Smart Shopping Cart module presents a promising solution to improve the traditional shopping experience. This not only improves workflow but also offers transparency and efficiency. The versatility of the smart module , capable of integrating easily with any traditional shopping cart, emphasizes its adaptability and potential to revolutionize the shopping experience. By upgrading existing infrastructure with this smart technology, retailers can unlock a new realm of efficiency and customer satisfaction without the need of waiting in long queues for checkout. This flexibility not only reduces implementation costs but also ensures accessibility for businesses of varying scales.

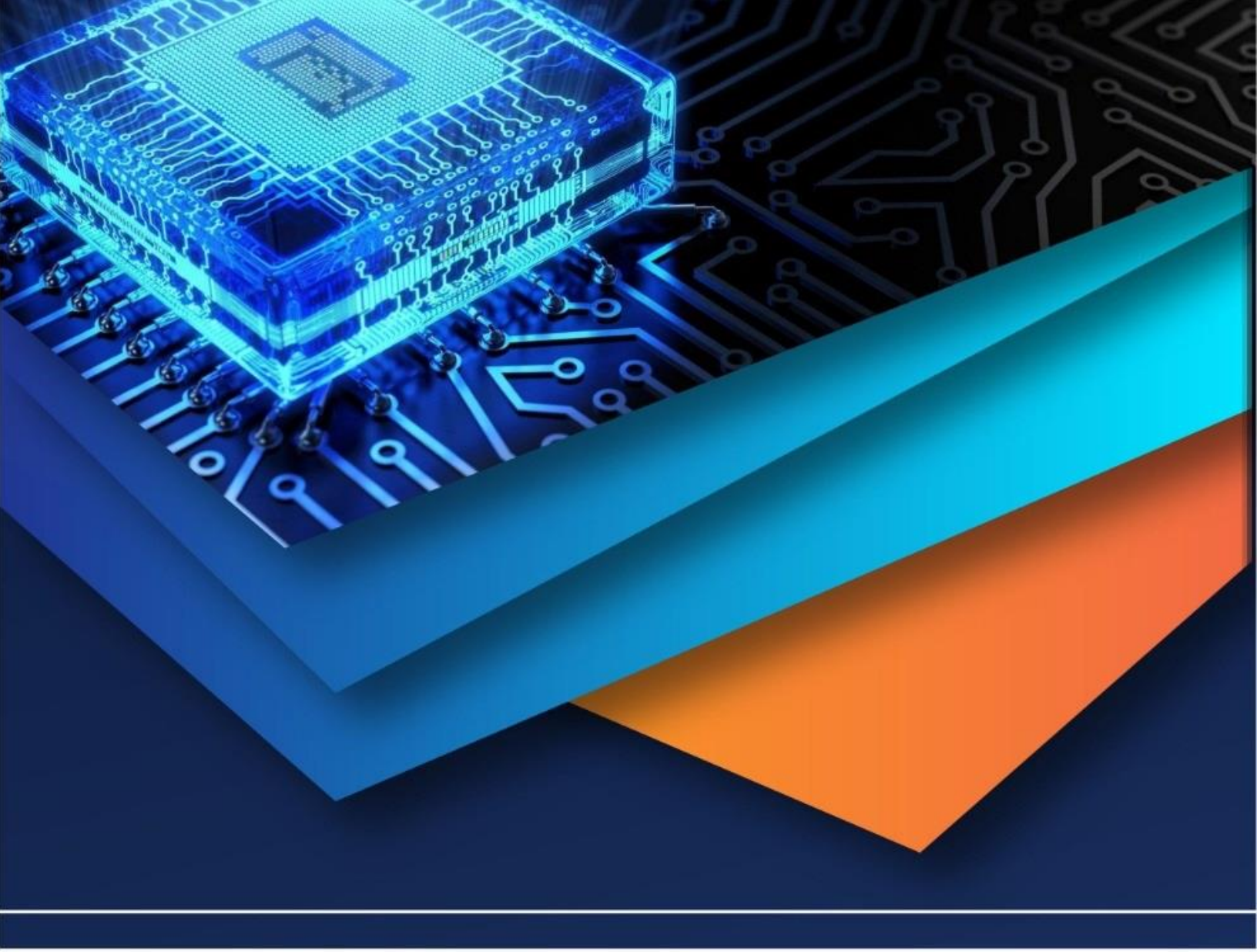
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In addition, the Smart Shopping Cart's convenient payment method simplifies the checkout process by allowing users to effortlessly scan their payment cards. This hassle-free approach eliminates the need for cash or traditional card swiping, making transactions quick and secure.

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