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Revamping the Retail Experience with Smart Carts

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Abstract: *In metropolitan areas, the issue of overcrowding due to a high number of shoppers at malls during peak hours, such as holidays and weekends, is a common occurrence. To address the problem of long billing queues in shopping malls, this project proposes an innovative solution that utilizes RFID technology and the Internet of Things (IoT) to enable automatic billing within shopping trolleys. The system involves equipping all mall products with RFID tags and outfitting the trolleys with an RFID reader and an LCD screen.As customers place products in their trolleys, the system automatically detects the RFID tags, displaying the item name and cost on the LCD screen, and adding them to the total bill. If a customer decides to remove a product, the system deducts the cost from the bill and sends the information to the central billing unit. By allowing customers to complete their billing directly in the trolley, this proposed system significantly reduces waiting times and enhances the overall shopping experience.The objective of our project is to develop an IoT-based shopping system that leverages RFID technology. Unlike barcodes, which have limitations such as line-of-sight requirement, limited range, and lower security, RFID provides unique identification for products and offers more extensive information. Each supermarket product is attached with an RFID tag containing details such as the product ID, brand name, price, manufacturing date, and expiry date. The shopping trolleys are equipped with RFID reader modules.When a registered user arrives at the supermarket, they log in to their designated trolley using a mobile application installed on their phone. As items are placed in the trolley, the RFID reader automatically reads the tags and adds the products to the shopping cart. Consequently, the billing process can be directly conducted from the shopping cart itself. In summary, this project aims to implement a technology-driven and scalable system to facilitate in-person shopping. By utilizing RFID technology, automatic billing within shopping trolleys offers a streamlined and efficient shopping experience for customers, alleviating the issues caused by long queues and reducing waiting times.*

Keywords: RFID, Reader, tags, shopping cart, IOT.

I. INTRODUCTION

Throughout history, individuals have continuously developed innovations to meet their needs. The main purpose of technology is to make it useful and easy to use. One significant task that consumes a considerable amount of time for individuals is shopping. Shopping malls serve as a hub where people fulfill their daily necessities, including food items, clothing, and electrical appliances. However, customers often encounter issues related to insufficient information about discounted products and time wasted at the checkout counters. In today's technological era, supermarkets and grocery stores provide shopping trolleys to assist customers in selecting and storing their intended purchases. However, the payment process at the counters remains troublesome and time-consuming, leading to heavy crowds.

According to a survey, individuals spend an average of 1.4 hours per day on shopping. Many customers tend to abandon a line if it is excessively long. The current shopping environment can be categorized into two main types: in-person shopping and remote shopping. Remote shopping includes online shopping and other forms that do not require customers to physically be present at the counters. In-person shopping involves visiting the location and manually selecting items based on various factors such as necessity and brand preference. The proposed smart shopping cart system aims to streamline the in-person shopping experience and reduce the time spent in stores. There is a need for continuous improvement in the traditional checkout process to enhance the quality of the shopping experience for customers. To address the aforementioned issues and improve the existing system, we have designed a shopping cart that incorporates RFID tags on the products and an LCD reader in the cart.With this system, customers can easily

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access information about the prices of items within the cart and the total cost. This saves time for both customers and the shopping center staff. The main objective of this system is to present a design and implementation of an innovative system for product acquisition in markets. This cart utilizes emerging technologies such as RFID to improve the quality of services provided by retailers, enhance the value for customers, and save time and money. By displaying the product catalog and respective costs, this cart provides a convenient and intuitive shopping experience while also assisting inventory management. It aims to make shopping more relaxed, comfortable, and systematic for customers while easing the workload for store management.

In reality, markets are frequented by a significant number of individuals seeking various items. The process of product acquisition involves time spent in aisles, locating products, and waiting in checkout lines. Consumers often encounter difficulties, such as concerns about having sufficient funds for their purchases or spending excessive time at the cashier. These issues can be addressed by replacing the ubiquitous Universal Product Code (UPC) barcode with smart labels known as radio frequency identification (RFID) tags. To overcome these problems, we propose the implementation of an RFID-based smart shopping cart system in the retail industry.The main goal of this initiative is to introduce a smart shopping cart that utilizes RFID technology to enhance the purchasing process. The plan involves implementing RFID-based monitoring in the shopping cart to improve shopping experiences. In this plan, an RFID card is used as a security measure for acquiring items in shopping malls. When a product is placed in the cart, its price is displayed, and the total amount is calculated accordingly. If a customer decides to remove a product from the trolley, the specific product's amount is deducted from the total. This technology streamlines the process of acquiring products, enhancing security, efficiency, and speed in shopping complexes.

The primary technological objective of this plan is to utilize RFID technology for seamless recognition of products within the shopping cart, eliminating the need for shoppers to intervene during the purchase and payment process. The proposed framework aims to provide a cost-effective, easily adaptable, and efficient solution to facilitate individual shopping. By implementing this technology, significant time can be saved at the billing counters, improving overall efficiency and customer satisfaction.

II. LITERATURE REVIEW

The proposal of a system that comprises three main components: the user interface and display component, server communication component, and automatic billing component. In this system, RFID technology is employed for product identification instead of traditional barcodes.

In another paper titled "Smart shopping trolley using RFID," the authors present an automated billing system for malls. This system utilizes ZigBee to directly transmit product information to the billing system. Each shopping trolley is equipped with an RFID reader for the user, and each user has a corresponding RFID tag.

The integration has led to advancements in measuring and understanding various environmental indicators, ranging from sensitive ecosystems to urban environments. These technologies contribute to the development of the Internet of Things (IoT), where sensors and actuators seamlessly interact with the surrounding environment, enabling the sharing of information across platforms. This convergence of technologies, including RFID tags, readers, near field communication devices, and embedded sensor and actuator nodes, paves the way for the IoT to transform the Internet into a fully integrated Future Internet.

As the use of wide-area Wireless Sensor Networks (WSN) continues to expand in consumer applications, it becomes crucial to address concerns such as reliability, energy consumption, and cost-effectiveness. One such application is the implementation of smart shopping systems in places like supermarkets.

These systems aim to reduce labor and enhance the shopping experience for customers. Instead of having customers wait in long queues during the checkout process, the system automates the billing procedure. Additionally, customers can conveniently track the details of their purchased items and the current bill amount displayed on the screen attached to the shopping cart.

III. SYSTEM ARCHITECTURE

3.1 Block Diagram

The procedure that requires for store automation system is showed below and the components are that given below.

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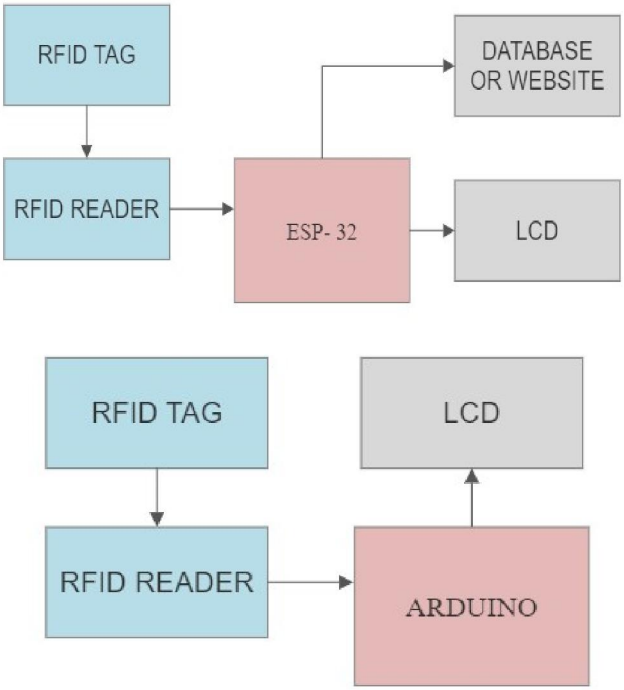

Fig 1. Shows how the Smart Cart works.

Description of the components

ARDUINO

The Arduino Uno, a microcontroller board, is built on the ATmega328 microcontroller chip. This chip serves as the core component and provides the necessary functionality for the Arduino Uno. It features a 16 MHz ceramic resonator, along with various essential components such as a USB port, power connection, ICSP header, reset button, and six analogue inputs. Additionally, six of the digital I/O pins can be configured to function as Pulse Width Modulation (PWM) outputs. To begin working with the Arduino Uno, you only need a few basic components. These include a USB cable for connecting to a computer, an AC-to-DC converter, or batteries to provide power. Fortunately, everything else you require is already included in the Arduino Uno package, making it convenient and easy to get started with your projects.

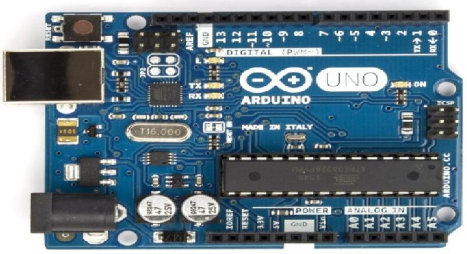

Fig2: Arduino UNO Rev 3.

ESP32

The ESP32 is a powerful microcontroller module that offers a wide range of features and capabilities. It is a popular choice among developers and hobbyists due to its versatility and performance. The ESP32 module is based on the Espressif Systems' ESP32 system-on-a-chip (SoC), which integrates a dual-core processor, Wi-Fi and Bluetooth connectivity, ample I/O pins, and various built-in peripherals.One of the key advantages of the ESP32 is its dual-core architecture, which enables multitasking and efficient handling of complex tasks. This makes it suitable for applications

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that require real-time processing and responsiveness. The Wi-Fi and Bluetooth capabilities provide seamless connectivity options, allowing the ESP32 to communicate with other devices and access the internet. This makes it ideal for Internet of Things (IoT) projects, home automation, and wireless communication applications.

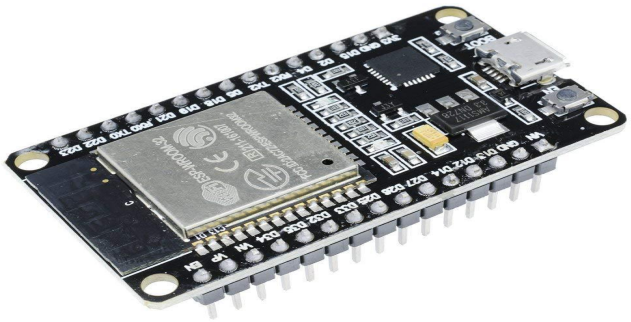

Fig 3. ESP32 Microcontroller (Wi-Fi Module)

LED

A light-emitting diode (LED) is a semiconductor component that emits light as electric current passes through it. When electrons within the semiconductor material recombine with electron holes, they release energy in the form of light particles called photons. The specific color of the emitted light is determined by the amount of energy needed for the electrons to traverse the band gap in the semiconductor material.

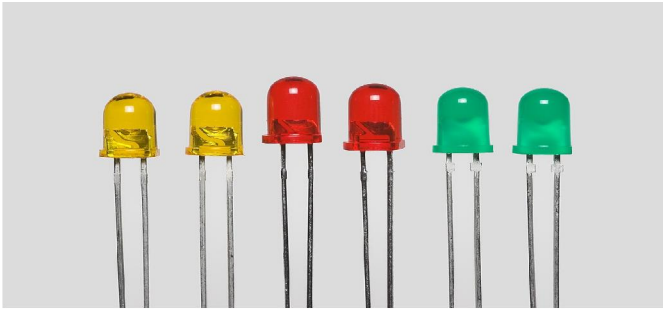

Fig4. Light Emitting Diode.

LCD Display

LCD (Liquid Crystal Display) screens are widely utilized as electronic display modules, offering a range of applications. When we mention an LCD display with the designation "16x2," it signifies that the display consists of two lines, with each line capable of showing 16 characters. These characters can be represented using a 5x7 pixel matrix, enabling the display of alphanumeric symbols and other characters.

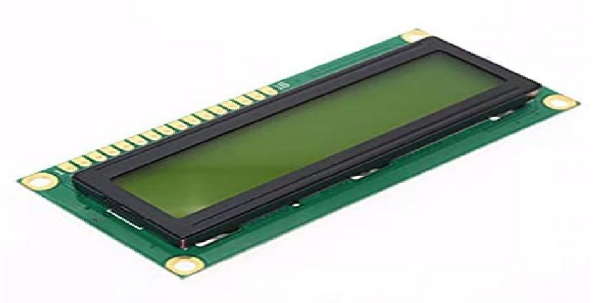

Fig5.Liquid Crystal Display

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RFID Reader

An RFID reader is a device specifically designed to establish communication with RFID tags or transponders. Its primary purpose is to retrieve and collect data stored on RFID tags by utilizing wireless transmission and reception of radio frequency signals. The fundamental components of RFID readers include an antenna or coil responsible for emitting radio waves, as well as a receiver that captures the signals sent back from RFID tags within its operational range.

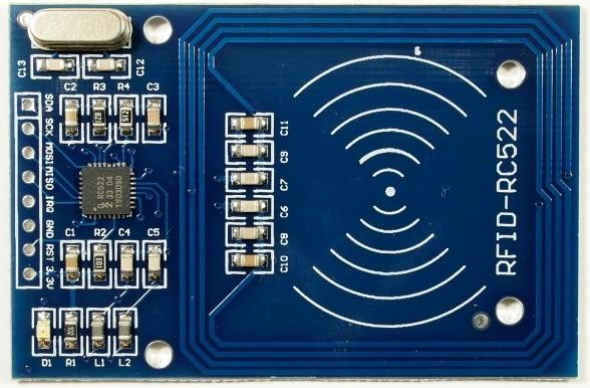

Fig6. RC522 RFID READER

IV. BASIC FUNCTION AND WORKING MODEL OF SMART SHOPPING CART

The smart shopping cart is specifically designed to improve the overall shopping experience and streamline the checkout process. By incorporating a range of advanced technologies and features, it aims to make shopping more convenient and efficient.At its core, the primary function of a smart shopping cart is to automate the billing process. This is achieved through the implementation of cutting-edge technologies like RFID (Radio Frequency Identification) or barcode scanning. These technologies enable the cart to swiftly identify the products as they are placed inside, allowing for seamless tracking and accurate calculation of the total bill.Ultimately, the introduction of smart shopping carts represents a significant revolution in the traditional shopping experience. It offers a hassle-free and efficient method for customers to shop and make payments for their desired products. The advantages of these innovative carts include time savings, reduced potential for human error in billing, and enhanced convenience for both customers and retailers alike.

Product Information:

Smart shopping carts with RFID technology transform product information management in the shopping experience. RFID tags on each item enable seamless tracking within the cart. When a customer places an item, the RFID tag is scanned by the cart's reader, instantly displaying the product details on a screen. This eliminates manual scanning, reduces errors, and speeds up checkout. RFID-equipped carts can show real-time promotions and aid inventory management. They also facilitate contactless payments, saving time. Overall, RFID in smart shopping carts revolutionizes product information, simplifies checkout, supports personalized offers, and enhances the shopping experience with accurate, real-time information.

Real-Time Display:

Real-time display in RFID-enabled smart shopping carts revolutionizes the customer experience by providing immediate access to vital product information. Equipped with RFID readers and screens, these carts retrieve and display details as customers add items. The RFID reader captures embedded information like name, price, and discounts, promptly showcased on the cart's display screen. Customers can verify selections, track items, and review pricing details effortlessly. Additionally, real-time display offers personalized recommendations, related items, promotions, and tailored advertisements. This technology eliminates manual price checks and signage reliance, ensuring accurate and

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up-to-date information. The integration of real-time display in RFID-enabled smart shopping carts enhances efficiency, convenience, decision-making, transparency, and personalization for an engaging shopping journey.

Automatic Billing:

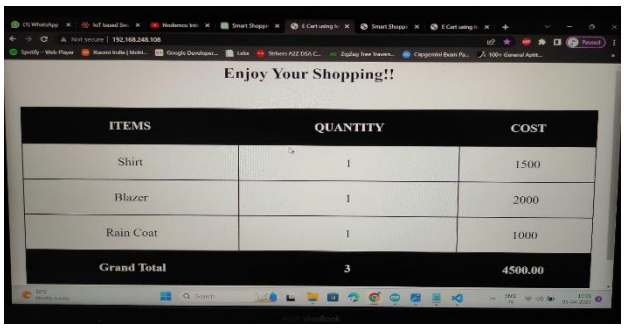

Fig.7 Webpage showing the cart details.

Automatic billing in RFID-enabled smart shopping carts streamlines the checkout process, providing a convenient and efficient experience. Each product is equipped with an RFID tag, enabling instant identification and tracking. As customers place items in the cart, the RFID reader captures the information and automatically calculates the total bill. This eliminates the need for manual scanning or barcode reading, saving time and reducing errors. With automatic billing in smart shopping carts using RFID, customers can enjoy a seamless payment process and a hassle-free shopping experience.

V. RESULTS

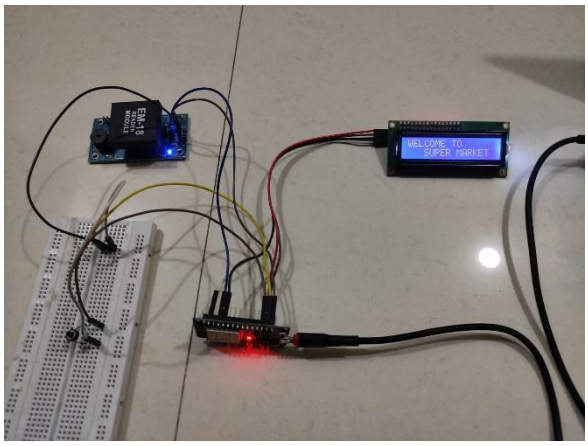

Fig.8Hardware structure after Complete Connections.

The utilization of RFID (Radio Frequency Identification) technology in smart shopping carts has yielded significant results in managing paper-based items during the shopping experience. By incorporating RFID tags on paper-based products such as coupons, receipts, or shopping lists, the smart shopping cart can automatically track and organize these items. This innovation eliminates the need for customers to manually manage and keep track of paper documents, reducing the risk of misplacement or loss. The RFID-enabled smart shopping carts provide a seamless and efficient solution for paper management, improving overall shopping convenience. Customers can easily access their digital coupons or receipts by simply scanning the RFID-tagged paper items. This technology-driven approach not only reduces paper waste but also enhances the customer experience by ensuring quick and hassle-free access to important documents, promoting a more eco-friendly and organized shopping journey.

VI. CONCLUSION

The objective has been effectively achieved in the developed prototype model, which is cost-effective, user-friendly, and requires no specific training. The decision-making ability is incorporated within the cart itself, providing a seamless

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and intelligent way for customers to purchase items, ultimately saving their energy, time, and money. The project has undergone evaluation through several trial cases, encompassing various practical scenarios and assessing different items. The tags used in this project are sensitive to water, necessitating the restriction of water-sensitive products within the trolley. Additionally, as the tags used in this project can only be detected from one side, circular attachment of the tags to products has been implemented to prevent non-detection. However, further research on more powerful tags could potentially overcome this limitation. The evaluation of a single shopping trolley with different items yielded an accuracy rate of 83% for all cases.

REFERENCES

[1]. Suraj.S, Vishal Guruprasad, Udayagiri R Pranava, Preetham S Nag, "RFID Based Wireless Intelligent Cart Using ARM7," International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 8, 2016.

[2]. Komal Ambekar, Vinayak Dhole, Supriya Sharma,"Smart Shopping Trolley Using RFID," International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), Volume 4 Issue 10, 2015.

[3]. Satish Kamble, Sachin Meshram, Rahul Thokal & Roshan Gakre, "Developing a Multitasking Shopping Trolley based on RFID Technology," International Journal of Soft Computing and Engineering (IJSCE), ISSN: 2231-2307, Volume-3, Issue-6, 2014.

[4]. Galande Jayshree, Rutuja Gholap, Preeti Yadav, "RFID Based Automatic Billing Trolley,"InternationalJournal of Emerging Technology & AdvancedEngineering 2014.

[5]. PaxalShah,Ms.JasmineJha,NiravKhetra,ManmitsinhZala"ALiteratureReviewImproving Error Accuracy and Range based on RFID for Smart Shopping," *InternationalJournal for Scientific Research &Development(IJSRD),2015.*

[6]. Amine Karmouche, Yassine Salih-Alj, "Aisle-level Scanning for Pervasive RFID based Shopping Applications ," IEEE.

[7]. Suryaprasad J, Praveen Kumar B O, Roopa D & Arjun A K, " A Novel Low-Cost Intelligent Shopping Cart," IEEE, 2014.

[8]. Lynn A. DeNoia , Anne L. Olsen , "RFID and Application Security,"Journal of Research and Practice in Information Technology, Vol. 41, No. 3, 2009. Mayur Subhash Chaudhari, "A Review on Electronic Shopping Cart Based RFID," International Journal & Magazine of Engineering, Technology Management & Research, ISSN No: 2348-4845.

[9]. K. Gogila Devi, T.A.Kaarthik, N.Kalai Selvi, K.Nandhini, S.Priya, "Smart Shopping Trolley Using RFID Based on IoT," International Journal of Innovative Research in Computer and Communication Engineering. Vol. 5, Issue 3, 2017.

[10]. Molnar, D. & Wagner, D. (2004). Library RFID privacy and security: Issues, practices, and architectures. 11th ACM Conference on Computer and Communications Security. ACM Press