Smart Shopping Trolley Based On Radio Frequence Identification(Rfid)

VENKATESAN.R[1], LATHA.R[2], PREETHI.A[3], THARANI.S[4], SELVA RAJAN.B[5]

1, 2 ASSISTANT PROFESSOR, 3,4,5 UG SCHOLAR

ELECTRONICS AND COMMUNICATION ENGINEERING

MUTHAYAMMAL ENGINEERING COLLEGE, TAMIL NADU, INDIA

ABSTRACT

In the present scenario, shopping in supermarkets and shopping malls has become a routine activity in everyday life. However, the traditional shopping system still follows a manual billing process which creates several difficulties for customers. Customers are required to select products, place them in a trolley, and finally wait in long queues at the billing counter for scanning, billing, and payment. This process is time consuming and causes inconvenience, especially during weekends and festival seasons. In addition, customers often find it difficult to keep track of their total expenditure while shopping, which may lead to budget mismanagement. To overcome these limitations, a Smart Shopping Trolley based on RFID technology is proposed. The main objective of this system is to automate the billing process and provide a smooth, efficient, and user-friendly shopping experience. When a customer places a product into the trolley, the RFID reader automatically scans the RFID tag without requiring line-of-sight. The scanned data is processed by the microcontroller, which retrieves the product details such as product name and price from its internal memory. These details are immediately displayed on the LCD screen mounted on the trolley. The final bill information, including product details and total cost, is stored in the microcontroller memory and wirelessly transmitted to the central billing system using ZigBee technology. This wireless data transfer eliminates the need for manual scanning at the billing counter and significantly reduces waiting time. As a result, customers can complete their shopping and payment process much faster compared to the conventional system. The proposed smart shopping trolley system not only reduces human effort and billing time but also improves accuracy and transparency in the shopping process. It helps customers manage their budget effectively and enhances overall customer satisfaction.

Keywords: RFID Technology, Smart Shopping Trolley, Automated Billing, Microcontroller, LCD Display, ZigBee Communication, Wireless Transmission, Retail Automation

1. INTRODUCTION

In the era of the Internet of Things (IoT), interactions among physical objects have become a reality. Everyday objects can now be equipped with computing power and communication functionalities, allowing objects everywhere to be connected. This has brought a new revolution in industrial, financial and environmental systems and triggered great challenges in data management, wireless communications, and real-time decision making. Additionally, many security and privacy issues have emerged and lightweight cryptographic methods are in high demand to fit in with IoT applications. There has been a great deal of IoT research on different applications, such as smart homes, e-health systems, wearable devices, etc. In this paper, we focus on a smart shopping system based on Radio

Frequency Identification (RFID) technology, which has not been well-studied in the past. In such a system, all items for sale are attached with an RFID tag, so that they can be tracked by any device equipped with an RFID reader in the store - for example, a smart shelf. Items put into a smart shopping cart (with RFID reading capability) can be automatically read and the billing information can also be generated on the smart cart. As a result, customers do not need to wait in long queues at checkout.

Smart shelves that are also equipped with RFID readers are able to monitor all stocked items and send item status updates to the server. When items become sold out, the server can notify employees to restock. It becomes easy for the store to do inventory management as all items can be automatically read and easily logged. In our proposed system, each smart cart is equipped with a UHF RFID reader, a micro controller, an LCD touchscreen, a Zig-Bee adapter, and a weight sensor. The smart cart is able to automatically read the items put into a cart via the RFID reader.

A micro controller is installed on the cart for data processing and an LCD touchscreen is equipped as the user interface. In order for the smart cart to communicate with the server, we have chosen Zig-Bee technology as it is low-power and inexpensive. We also have a weight scanner installed on the smart cart for weighting items. The weight scanner can also help do a security check, for example, if a malicious user peels off one item's RFID tag and puts it into the cart, extra unaccounted weight will be added. When a customer finishes shopping, they pay at the checkout point using the generated billing information on the smart cart. We also set a RFID reader before the exit door to check that all the items in the cart have been paid for.

2.LITERATURE SURVEY

A. Sharma et al., Smart Shopping Cart Using RFID and IoT," International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2021. This paper presents the design and implementation of a smart shopping trolley using Radio Frequency Identification (RFID) technology integrated with Internet of Things (IoT). Each product is equipped with an RFID tag, and an RFID reader mounted on the trolley scans the items as they are added. A microcontroller processes the scanned data and displays the product details and total bill amount on an LCD screen. The system also supports wireless communication to update billing information on a centralized server, reducing checkout time and human intervention.

R. Kumar and S. Patel, RFID-Based Automatic Billing System for Supermarkets," International Journal of Engineering Research & Technology (IJERT), 2020. This work discusses an automatic billing system using RFID technology to replace conventional barcode-based checkout systems. The system consists of RFID readers, tagged products, and a billing controller that automatically generates the bill when items are placed inside the trolley. The design significantly reduces queue length and improves customer convenience by enabling faster billing and real-time product tracking.

M. Singh et al., Design of Smart Shopping Trolley for Automated Billing Using RFID, International Journal of Scientific & Technology Research (IJSTR), 2019. This paper describes a low-cost smart trolley system using RFID technology for automated billing in retail stores. The authors implemented a microcontroller-based system with an RFID reader and LCD display to show item information and total cost. The proposed design demonstrates the feasibility of using RFID for improving the shopping experience and minimizing manual billing operations

P. Verma and N. Gupta, IoT Enabled Smart Shopping Cart Using RFID," International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE), 2018. This research proposes an IoT-enabled smart shopping cart that combines RFID technology with wireless communication for real-time billing and inventory updates. The system allows customers to monitor their spending while shopping and enables store management to maintain accurate inventory records. The integration of IoT enhances data accessibility and automation.

3. EXISTING SYSTEM

The Smart Shopping Trolley based on RFID (Radio Frequency Identification) is an advanced retail automation system developed to reduce billing time and improve the shopping experience in supermarkets and malls. In the traditional shopping system, customers select products and wait in long queues at the billing counter where each item is scanned using a barcode reader. This process consumes more time, especially during peak hours, and requires additional manpower. To overcome these problems, the RFID-based smart trolley system was introduced. In this existing system, every product in the supermarket is attached with an RFID tag that contains unique information such as product ID, name, and price. Unlike barcode technology, RFID does not require direct line-of-sight scanning, making the process faster and more efficient. Each shopping trolley is equipped with an RFID reader, a microcontroller, and an LCD display. When a customer places a product inside the trolley, the RFID reader automatically detects the tag and sends the information to the microcontroller. The microcontroller processes the data and retrieves the corresponding product details from the store's database. The product name, price, quantity, and total bill amount are then displayed on the LCD screen attached to the trolley. If the customer removes a product from the trolley, the system updates the total bill automatically. This real-time calculation helps customers keep track of their spending while shopping. At the end of the shopping process, the total bill is already generated in the trolley system, which significantly reduces the waiting time at checkout counters. The customer can proceed to a billing station where the final payment is made quickly, or in some advanced implementations, the bill is directly transferred to the central billing server through wireless communication such as Wi-Fi. This system not only reduces crowding at billing counters but also improves operational efficiency in retail stores. Additionally, the RFID system supports inventory management by automatically updating product data in the database whenever an item is scanned or removed. The existing smart trolley system offers several advantages including time saving, reduction in billing errors, decreased dependency on manpower, and enhanced customer satisfaction.

4. PROPOSED SYSTEM

The proposed Smart Shopping Trolley system based on RFID is an advanced retail automation solution designed to provide a faster, smarter, and more secure shopping experience. This system improves upon the traditional and existing RFID models by integrating wireless communication, digital payment options, real-time inventory management, and enhanced security features. The main objective of the proposed system is to eliminate long billing queues, reduce manual effort, and increase customer convenience. In this system, each product in the supermarket is embedded with an RFID tag containing unique information such as product ID, name, and price. Every shopping trolley is equipped with an RFID reader, a microcontroller, a display unit, and a Wi-Fi module. When a customer places an item into the trolley, the RFID reader automatically scans the tag and sends the data to the microcontroller. The product details are fetched from a centralized database and displayed on the screen along with the updated total bill amount. If the customer removes an item, the total is adjusted automatically. The proposed system also integrates a mobile application that connects to the trolley through user authentication. Customers can view their cart details, track spending, and receive notifications about offers and discounts. At the end of shopping, customers can complete the payment directly through digital methods such as UPI, debit or credit cards, eliminating the need to wait at billing counters.
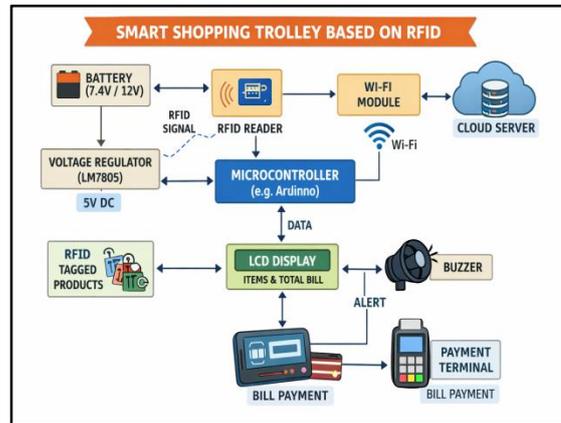
Fig 1: BLOCK DIAGRAM

5.HARDWARE DESCRIPTION

5.1 POWER SUPPLY

The power supply of a Smart Shopping Trolley based on RFID provides stable DC power to all electronic components. It usually uses a rechargeable battery such as 7.4V or 12V as the main power source. Since components require low voltage, a voltage regulator is used to control the output. A commonly used regulator is the LM7805 to provide a stable 5V supply. For 3.3V devices like Wi-Fi modules, the AMS1117 In advanced systems, a LM2596 buck converter improves efficiency. Capacitors are added to filter noise and maintain smooth voltage output. Diodes are included to protect against. A power switch allows easy ON/OFF control of the trolley system. This regulated power system ensures safe and reliable operation of the RFID trolley.

5.2 ARDUINO UNO R3 MICROCONTROLLER
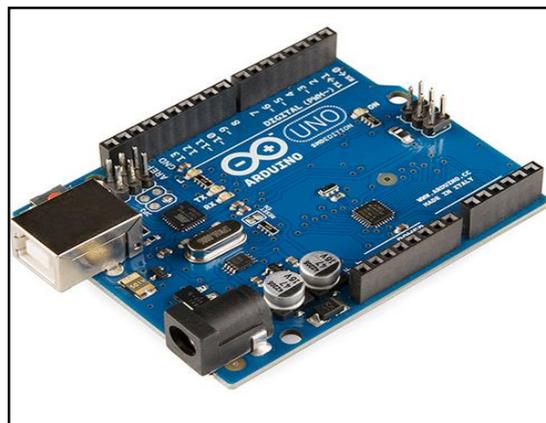
Arduino Uno R3 is an upgraded version of the Arduino Uno with improved features .It uses the ATmega16U2 chip instead of the older FTDI or ATmega8U2 for USB communication .This provides faster data transfer and better memory performance .No drivers are required for Linux or Mac ,and Windows drivers are included in the Arduino IDE .The board can also function as a keyboard ,mouse, or joystick when programmed .It includes additional SDA and SCL pins for I2C communication near the AREF pin. Two extra pins, IOREF and a reserved pin, are added near the RESET pin. It is based on the ATmega328 microcontroller and runs at 16 MHz. The board has 14 digital I/O pins (6 PWM),6 analog inputs, USB port, power jack, ICSP header, and reset button. "Uno" means "one" in Italian and marks an important release in the Arduino series.

5.3 RFID READER

RFID tags can be either passive, active or battery assisted passive. Passive RFID does not use a battery, while an active has an on-board battery that always broadcasts or beacons its signal. A battery assisted passive has a small battery on board that is activated when in the presence of a RFID reader. Most RFID tags contain at least two parts: one is an integrated circuit for storing and processing information, modulating and demodulating a radiofrequency (RF) signal, and other specialized functions; the other is an antenna for receiving and transmitting the signal.

5.4 LCD

LCD is used to display the results of the system operation such as sensed values, motor status etc…. A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The LCD standard requires 3 control lines and 8 I/O lines for the data bus. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character-based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application.

5.5 RFID TAG
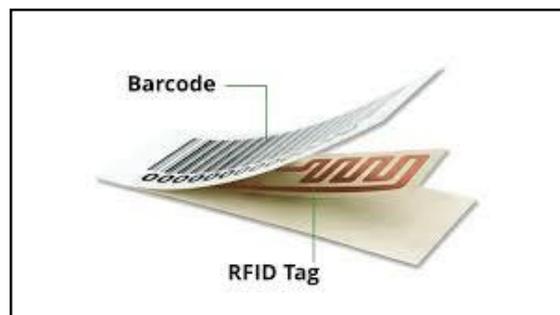
An RFID tag is comprised of an integrated circuit (called an IC or chip) attached to an antenna that has been printed, etched, stamped or vapor-deposited onto a mount which is often a paper substrate or Poly-Ethylene There phtalate (PET). The chip and antenna combo, called an inlay, is then converted or sandwiched between a printed label and its adhesive backing or inserted into a more durable structure.

.

5.6 PULSE SENSOR:
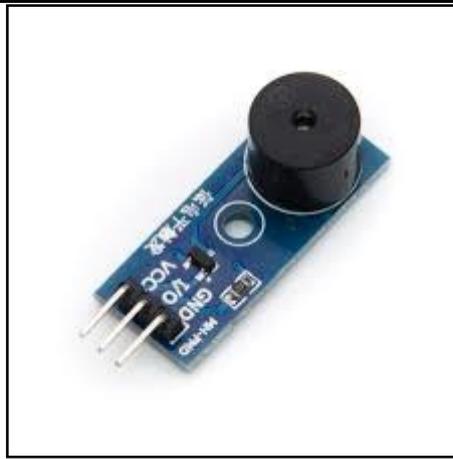
A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep. Some systems, such as the one used on Jeopardy! make no noise at all, instead using light.

.

6. CONCLUSION

The Smart Shopping Trolley System is an innovative solution designed to modernize the traditional shopping experience in supermarkets and shopping malls. Its primary objective is to reduce customer waiting time at billing counters and simplify the entire shopping process through automation. The system implements an Automated Central Billing System using Arduino-based product identification, which automatically records product details when items are added to the trolley. This eliminates the need for manual barcode scanning at checkout counters, thereby reducing congestion and long queues. Billing information is continuously updated and transferred to the central system, allowing customers to view their total purchase amount in real time. This transparency helps customers manage their budget effectively while shopping. At the end of the shopping process, payments can be completed quickly using digital methods such as credit or debit cards, making the process faster and more convenient. The proposed system is reliable, secure, and time-efficient, as automation reduces human errors during billing and minimizes labor costs for store management. Additionally, accurate product tracking reduces the chances of theft and billing manipulation. The integration of an Android application further enhances customer satisfaction by enabling users to search for and locate products easily within the store. This feature saves time, especially in large shopping malls, and makes the shopping experience smoother and more user-friendly. Overall, the Smart Shopping Trolley System provides an efficient, secure, and modern retail solution that benefits both customers and store owners.

7.REFERENCES

[1] F. Xia, L. T. Yang, L. Wang, and A. Vinel, ―Internet of things, ‖International Journal of Communication Systems, vol. 25, no. 9, p. 1101, 2012.

[2] P. Castillejo, J.-F. Martinez, J. Rodriguez-Molina, and A. Cuerva, ―Integration of wearable devices in a wireless sensor network for an e- health application, ‖ IEEE Wireless Communications, vol. 20, no. 4, pp. 38–49, 2013.

[3] N. Mitton, S. Papavassiliou, A. Puliafito, and K. S. Trivedi, ―Combining cloud and sensors in a smart city environment, ‖ EURASIP journal on Wireless Communications and Networking, vol. 2012, no. 1, p. 1, 2012.

[4] T. Song, R. Li, X. Xing, J. Yu, and X. Cheng, ―A privacy preserving communication protocol for iot applications in smart homes, ‖ in to appear in International Conference on Identification, Information and Knowledge in the Internet of Things (IIKI) 2016, 2016.

[5] D. Klabjan and J. Pei, ―In-store one-to-one marketing,‖ Journal of Retailing and Consumer

Services, vol. 18, no. 1, pp. 64–73, 2011.

[6] T. Shanmuga priyan, ―Smart cart to recognize objects based on user intention,‖ International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 5, 2013.

[7] P. Chandrasekar and T. Sangeetha, ―Smart shopping cart with automatic billing system through rfid and zigbee,‖ in Information Communication and Embedded Systems , 2014 International Conference on. IEEE, 2014, pp. 1–4.

[8] Z. Cai, Z. He, X. Guan, and Y. Li, ―Collective data-sanitization for preventing sensitive information inference attacks in social networks,‖ IEEE Transactions on Dependable and Secure Computing, 2016.

[9] www.schneiderelectric.com.hk/resources/access/text/rfidreader

[10] http://archive.computerhistory.org/resources/access Oral History Panel, retrieved 2011 June 28 page 4.