



REAL-TIME CART CHECKOUT USING RFID AND IOT

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Abstract: In this fast-paced world, shopping malls and retail shops play a crucial role in enhancing human comfort. However, traditional billing systems create inconvenience by causing long queues during the checkout process, leading to significant time consumption. To address this issue, a new system called Real-Time Cart Checkout Using RFID and IoT has been developed. This system integrates the Internet of Things (IoT) and RFID technology, where an Arduino microcontroller works with an RFID reader to scan products equipped with unique RFID tags. Upon scanning, the product data is sent to a mobile application via a Bluetooth module. The app then retrieves matching details from a web server or database, automatically updating the pricing and product list in real-time. Users can manage their selected items efficiently, and the cart enables them to view the total amount directly in the app. By streamlining and automating the shopping experience, this IoT-based smart shopping cart significantly reduces checkout time, enhances convenience, and improves the overall retail experience.

Index Terms - Internet of Things, RFID, Bluetooth, ArduinoUno, RFID Tag

I. INTRODUCTION

The Internet of Things (IoT) has revolutionized various industries, including retail, by enabling seamless connectivity between physical devices. IoT refers to a network of interconnected objects embedded with electronics, software, sensors, and actuators that facilitate data exchange and automation. In the modern era, everyday objects are increasingly being integrated with the internet, making interactions between devices more efficient. One significant application of IoT is in smart shopping systems, particularly through the use of Ultra-High-Frequency (UHF) RFID tags, which have not been widely implemented in the past.

Traditional shopping experiences often involve long queues for billing, causing inconvenience to customers. To address this, the Real-Time cart checkout using RFID and IoT introduces an intelligent solution by combining RFID technology with a mobile application. The system utilizes an Arduino microcontroller connected to an RFID reader, which scans unique RFID-tagged products and transmits their details, such as name and price, to a mobile app via Bluetooth.

This allows shoppers to manage their purchases in real-time, track product details, and instantly view the total bill at the push of a button. Additionally, LCD touch panels provide an interactive user interface, enhancing accessibility. By automating the checkout process, reducing wait times, and improving overall shopping efficiency, this smart cart system offers a seamless and convenient retail experience for both customers and retailers.

Objectives of Real – Time Cart Checkout Using RFID and IoT

1. Understand and implement RFID technology for product identification and tracking.

Objective: Learn how to use ultra-high-frequency RFID tags and readers to automatically identify products and track their details, including name and price.

2. Integrate Arduino microcontroller with RFID and Bluetooth modules for communication.

Objective: Design and develop an Arduino-based system that connects an RFID reader and Bluetooth module, enabling seamless data transfer between the smart cart and a mobile app.

3. Develop a mobile app for real-time tracking of items and total amount calculation.

Objective: Create a mobile application that receives product data via Bluetooth from the Arduino, displays selected items, and calculates the total cost in real-time.

4. Implement Bluetooth communication between the Arduino and the mobile app for seamless interaction.

Objective: Program Bluetooth communication to enable smooth data transfer between the smart shopping cart and a mobile app, allowing users to monitor their purchases instantly.

5. Design a user-friendly interface on the mobile app to display shopping cart details.

Objective: Develop a mobile app interface that visually presents the list of items, prices, and total amount, providing a convenient shopping experience.

6. Optimize the system to reduce checkout time and minimize human error in billing.

Objective: Ensure the smart shopping cart system automates the checkout process, reduces manual calculations, and eliminates errors during the billing phase.

7. Enhance the shopping experience by automating product selection tracking and cost management.

Objective: Provide a seamless shopping experience where customers can automatically track the products they select and manage their spending without having to calculate totals manually.

8. Investigate and address power management for energy efficiency in IoT devices.

Objective: Implement power management strategies to ensure the Arduino and other connected devices consume minimal power, optimizing battery life during extended shopping sessions.

9. Ensure system reliability and scalability for potential real-world retail deployment.

Integrate a self-learning algorithm that allows the robot to improve its cleaning efficiency over time based on past performance data. Enable adaptability to different panel tilt angles and surface types.

10. Safety and Compliance

Incorporate features to prevent accidents, such as edge detection to avoid falling off tilted panels. Ensure compliance with safety standards and regulations for solar installations

Literature Review:

A detailed analysis of existing research on Real-Time cart checkout using RFID and IoT reveals a variety of novel approaches targeted at improving the retail experience. [2]Kowshika et al. proposed an IoT-based Smart Shopping Trolley that integrates with a mobile cart application to simplify the billing process. Their solution includes RFID tags and receivers for product scanning, a load cell for theft prevention, an LCD display, and a Raspberry Pi, which allows customers to log in via a mobile app and make payments quickly. Similarly, [3]The IoT-Based Smart Shopping Trolley System by S. Real-Time Cart Checkout Using RFID and IoT 3 Maurya et al. improves the shopping experience by incorporating sensors, RFID, and microcontrollers into a trolley. It tracks products, displays total costs, and delivers real time data to customers and supermarket management via a mobile app and cloud server.

Existing Method

Traditional shopping relies on manual product selection and checkout operations, in which customers load products into carts and then wait in line to scan each item individually at a POS system. This process is frequently slow, particularly during peak hours, and requires staff assistance to ensure accurate item scanning. Manual checkout also increases the likelihood of human error in item counts and prices, which can lead to billing issues and delays. Customers' ability to control their spending efficiently is further limited by the lack of real-time tracking when shopping, since they may need to calculate totals manually or rely on price tags, both of which can be time-consuming.

Draw backs:

- 1.Manual QR Scanning
- 2.Human Errors
- 3.Time consumption

Proposed Method is Real – Time Cart Checkout using RFID and IoT

The suggested Real-Time cart checkout using RFID and IoT uses an RFID reader coupled to an Arduino microcontroller to automatically scan products with RFID tags, resulting in a smoother and more automated shopping experience. Each item's details, such as name and price, are updated in a mobile app using a Bluetooth module, allowing customers to track their purchases and expenditures in real-time. A push button on the cart allows the consumer to see the entire cost in the app at any time, avoiding tedious computations and checkout delays. This automated solution not only makes shopping more convenient but also lowers human error and speeds up the checkout process, thereby improving the whole shopping experience.[1]

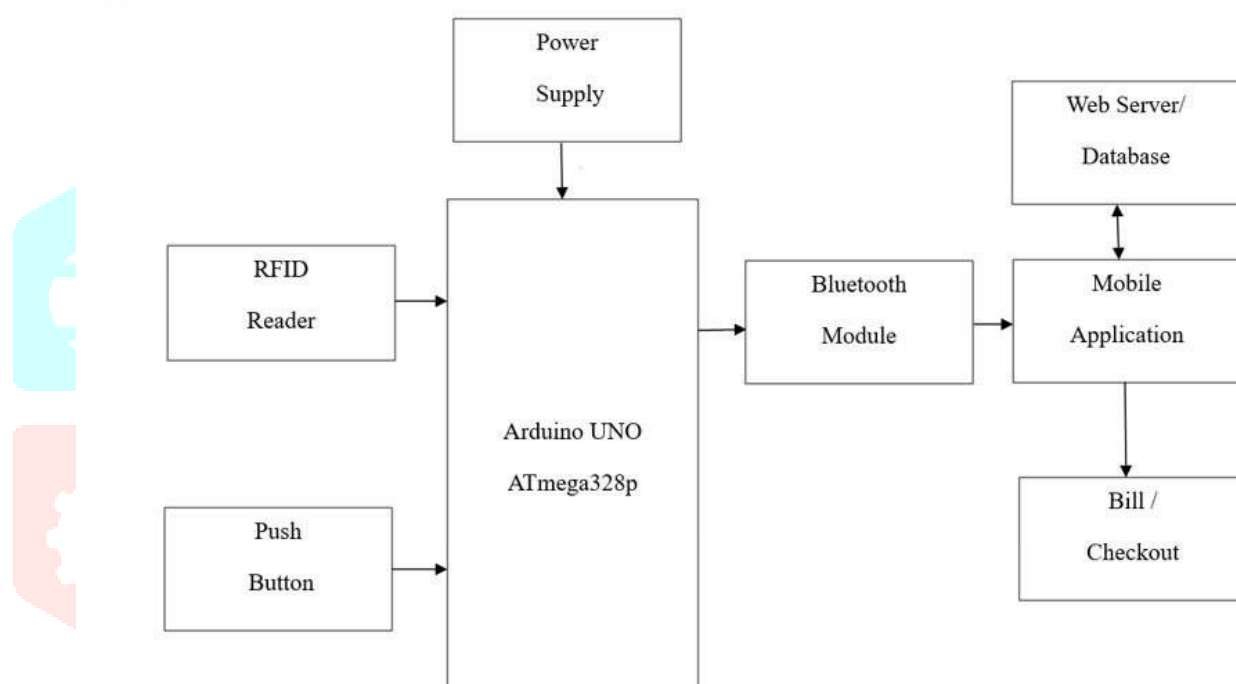
Block Diagram:

Fig. Block diagram of Real-Time Cart Checkout Using RFID and IoT

Hardware and Software Components**Hardware Components**

Sr.	Component	Specification
1.	RFID Reader MFRC522[4]	Workingfrequency:13.56MHz, Card reading distance: 0-60mm[1]
2.	RFID Tags	Passive Tags.[1]
3.	Arduino Uno ATmega328p[5]	Microcontroller:ATmega328p, WorkingFrequency:16MHz, Memory: 32 KB.[1]
4.	Bluetooth HC-06	Operating voltage: 3.3 to 5V Max, Working frequency: 2.4GHz, Supply Voltage: +3.3 VDC 50mA.[1]

Table1: Hardware Components Required

Software Components

Sr.	Components	Specification
1.	Mobile Application	Android Compitable
2.	Arduino IDE	For integrating the Arduino UNO

Table2:Software Components Required

Insights:

The components work together to build a Real-Time cart checkout using RFID and IoT

- RFID technology for identifying products.
- Arduino for managing hardware components.
- Bluetooth for communication with the mobile app.
- A mobile app and web system for user interaction and backend operations.

Advantages:

- Automated tracking
- Real-time updates
- Quick checkout
- Cost management
- Reduced human error

Applications:

- Supermarkets
- Retail stores
- Shopping malls
- Smart retail systems
- Inventory management

CONCLUSION

In conclusion, the Real-Time Cart Checkout Using RFID and IoT technologies provides an efficient and automated approach to current retail buying. The solution improves ease by integrating an Arduino microcontroller, RFID reader, Bluetooth connection, and a mobile application, allowing for real-time goods tracking and automated billing. This decreases checkout time, minimizes manual work, and increases overall shopping efficiency. With the ability to speed the purchasing process and improve the customer experience, this smart-cart offers a practical solution for optimizing retail operations and decreasing congestion at billing counters.

REFERENCES

- [1] M. Shahroz, M. F. Mushtaq, M. Ahmad, S. Ullah, A. Mehmood, and G. S. Choi, "IoT-Based Smart Shopping Cart Using Radio Frequency Identification," *IEEE Access*, vol. 8, pp. 68426–68438, 2020, doi: 10.1109/ACCESS.2020.2986681.
- [2] S. Kowshika, S. S. M. Mitha, G. M. Varshini, V. Megha, and K. Lakshmi, "IoT-based Smart Shopping Trolley with Mobile Cart Application," in *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)*, Coimbatore, India: IEEE, 2021.
- [3] S. Maurya, G. Sahu, A. Yadav, B. Shukla, G. Agrawal, and N. Kumar, "The IoT-Based Smart Shopping Trolley System," in *2023 International Conference on IoT, Communication and Automation Technology (ICICAT)*, 2023, pp. 1–6. doi: 10.1109/ICICAT57735.2023.10263687.
- [4] V. D. Hunt, M. Puglia, and A. Puglia, *A Guide to Radio Frequency Identification*. Hoboken, NJ: John Wiley & Sons, Inc., 2007.
- [5] S. Monk, *Programming Arduino™: Getting Started with Sketches*. New York: McGraw-Hill Education, 2016.