International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-779

IOT BASED INTELLIGENT AND USER-FRIENDLY TROLLEY SYSTEMS IN MALLS

DHARUN E D, KAVIYA M,JANANI R S,DAKSHATA K

[1]Studuent, Dept. of Electrical and Electronics Engineering, Anna University, IN
[2]Studuent, Dept. of Electrical and Electronics Engineering, Anna University, IN
[3]*Studuent, Dept. of Electrical and Electronics Engineering, Anna University, IN*
[4]*Studuent, Dept. of Electrical and Electronics Engineering, Anna University, IN*

Abstract –*In today's fast-paced world, shopping malls are seeking ways to enhance customer convenience and streamline the shopping experience. The proposed project focuses on the design and implementation of an IoT-enabled intelligent and user-friendly trolley system using the ESP32 microcontroller, RFID technology, Blynk app, and GSM module. This system automates the process of adding products to the shopping cart, calculating the total bill, and notifying customers of their total costs through a mobile app and SMS.Each product in the store is tagged with an RFID card, and as a customer adds a product to the trolley, the RFID reader integrated into the trolley scans the product's tag. The system instantly fetches the product details, including the price, and updates the total bill in real-time through the Blynk app on the customer's smartphone. A buzzer provides audio feedback for each successful scan. At the end of the shopping experience, the final total is sent to the customer's phone via SMS, using the GSM module.This intelligent system eliminates the need for traditional checkout counters, making the shopping process quicker and more efficient for both customers and store management. The integration of IoT and RFID technology ensures seamless operation, while the use of the Blynk app offers a user-friendly interface for real-time monitoring of purchased products. This solution is not only cost-effective but also scalable, making it adaptable to various retail environments. The integration of IoT and RFID technology ensures seamless operation, while the use of the Blynk app offers a user-friendly interface for real-time monitoring of purchased products. This solution is not only cost-effective but also scalable, making it adaptable to various retail environments.*

Keywords-ESP32 microcontroller, RFID technology, Blynk app, and GSM module.

1. INTRODUCTION

The Shopping technology has advanced as a result of the retail industry's explosive growth and consumer needs for efficiency and convenience. The Internet of Things (IoT)-enabled smart trolley is one example of this new technology. Even though they work, traditional shopping trolleys don't speed up the checkout process or offer real-time information about products, prices, or availability. This gap gives IoT-enabled smart trolleys the chance to boost operational efficiency for shops, lower labor costs, and dramatically enhance the shopping experience.. Among the many functions offered by these IoT enabled trolleys include the ability to scan products automatically as they are added to the basket, track product details, alert customers to applicable discounts, and facilitate a quick, contactless checkout procedure. By combining RFID technology, IoT connectivity, and user-friendly mobile interfaces, this system offers a practical solution to enhance the shopping experience while reducing the time spent on manual tasks such as scanning and billing at checkout. This project aims to bridge the gap between traditional retail and smart shopping, providing a scalable and efficient solution for modern shopping environments. This project proposes the design and implementation of an IoT-enabled intelligent trolley system for shopping malls. The system integrates ESP32, RFID technology, Blynk app, and GSM module to automate product scanning and billing, providing a seamless and user-friendly shopping experience. In this system, each product is tagged with an RFID card, and when a customer places an item in the trolley, an RFID reader identifies the product, adding its cost to the total bill. The Blynk app allows customers to monitor their purchases in real-time, displaying a running total of the items added to the trolley. Moreover, the use of a GSM module allows the system to send the final bill via SMS to the customer's phone, eliminating the need for manual checkout at counters.

1.1 Background of the Work

In order to enhance consumer satisfaction, optimize operations, and maintain competitiveness, the retail sector

has been investigating cutting-edge technology in recent years. New approaches to inventory management, improving customer interaction, and maximizing the in-store shopping experience have been made possible by the deployment of the Internet of Things (IoT) in retail settings. Some of the main issues that both retailers and customers experience can be resolved by implementing the idea of a "smart trolley" with Internet of Things connectivity. Despite being functional, traditional trolleys lack intelligent capabilities that may help customers or automate chores. This presents chances for IoT innovation to address inefficiencies in conventional retail systems. By linking devices to a network, the Internet of Things framework in retail enables data transfer between digital and physical systems. Numerous retail procedures, including inventory management, tailored marketing, and customer support, can be automated thanks to this network. Retail IoT applications have been developing, with RFID (Radio Frequency Identification), sensors, and wireless communication systems being used to track product movements, control inventory, and collect consumer information for targeted advertising.

1.2 Motivation and Scope of the Proposed Work

It is obvious that innovation beyond conventional retail techniques is required as customer expectations continue to climb. In addition to providing increased convenience, speed, and interaction, smart trolleys can revolutionize in-store shopping by giving retailers real-time data access and more accurate inventory control. By putting in place a smart trolley system with IoT integration, this project seeks to close the gap between traditional shopping practices and contemporary technological developments, satisfying the demands of today's hectic retail settings. The goal of this project is to solve the shortcomings of conventional shopping carts and show how IoT may transform the in-store shopping experience for patrons and store owners alike.

2. METHODOLOGY

The proposed IoT-enabled intelligent trolley system is designed and implemented using ESP32, RFID technology, the Blynk app, and a GSM module to automate product scanning and real-time billing. The system workflow begins with each product being tagged with an RFID card. As a customer adds products to the trolley, an RFID reader attached to the trolley detects the RFID tag and sends the product information to the ESP32 microcontroller. The microcontroller processes this data, retrieves the product's price, and adds it to the total bill. The Blynk app is used to provide a real-time interface on the customer's smartphone, displaying the list of products scanned and the running total of the bill. A buzzer gives audio feedback for each successful product scan, ensuring that customers are aware when an item is successfully added. If a product needs to be removed, it can be rescanned or an option in the app can handle the removal. Once the shopping is complete, the system calculates the final bill and sends it via SMS to the customer's mobile phone using the GSM module, providing a convenient and contactless payment method.

2.1 System Architecture

Developed and tested the firmware for the ESP32, managing RFID data processing, communication protocols, and system logic. Writing code that operates directly on the microcontroller, managing its peripherals, and communicating with external devices is known as ESP32 firmware programming. This calls for a thorough comprehension of the communication protocols, peripherals, and architecture of the ESP32. Designed and implemented the user interface on the Blynk app, providing real-time updates and ensuring seamless interaction with the hardware. One well-known IoT platform is Blynk, which lets users make unique mobile apps for managing and keeping an eye on IoT devices. Installing the Blynk library for ESP32, establishing a project, and registering a Blynk account are all necessary steps in integrating Blynk with ESP32. In order to communicate with Blynk's API and send and receive data, developers write code and setup widgets and layouts in the Blynk app.

2.2 Component Selection and Integration

When developing a smart trolley with IoT connectivity, choosing the appropriate components is essential to guaranteeing the system's usability, effectiveness, and usefulness. In order to detect and track the things placed in the trolley, this selection procedure entails selecting appropriate hardware, such as RFID readers, barcode scanners, sensors, and microcontrollers. The selection of communication modules, such as Wi-Fi, Bluetooth, or NFC, is similarly crucial since they allow the trolley to communicate with backend systems, facilitating connectivity and real-time data transfer. Data communication between the trolley and server applications is made possible by techniques like API integration, and middleware organizes and handles data from various devices to create a single, effective system that can process real-time data.

2.3 Automated Bill Calculation:

One of the main features of a smart trolley project with IoT integration is automated bill computation, which is intended to make shopping more efficient. Usually, barcode scanning

or RFID (Radio Frequency Identification) methods are used to accomplish this, automatically detecting and recording each item placed to the cart. The device continuously updates the cart's total bill in real time without the need for manual scanning thanks to RFID readers built into the trolley that scan product RFID tags. As an alternative, barcode scanning can be utilized to track things as they are placed in the cart using cameras or sensors. By instantly computing the amount when products are added or withdrawn, these methods eliminate the need for manual checkout and enable customers to pay either directly on the cart or via a mobile app that is connected. This method increases overall customer satisfaction by streamlining checkout, cutting down on lengthy lines, and offering a precise and transparent billing process

2.4 Real-time data processing using the ESP32:

Real-time data processing using the ESP32 microcontroller is crucial for handling and evaluating data as soon as it is gathered in an IoT-integrated smart trolley. The ESP32's dual-core processor and ample memory allow it to process inputs from a variety of sensors, including load sensors for weight verification and RFID readers for product identification, quickly. This enables the trolley to handle user interactions, identify unauthorized item removal, and rapidly update item counts—all of which give the shopper instant feedback. The ESP32's real-time data processing also enables the quick transfer of pertinent data to a central server, where data analytics can help with price computations, inventory control, and customized consumer insights. A smooth, effective shopping experience is supported by the ESP32, which enhances system responsiveness by guaranteeing timely data handling and communication.

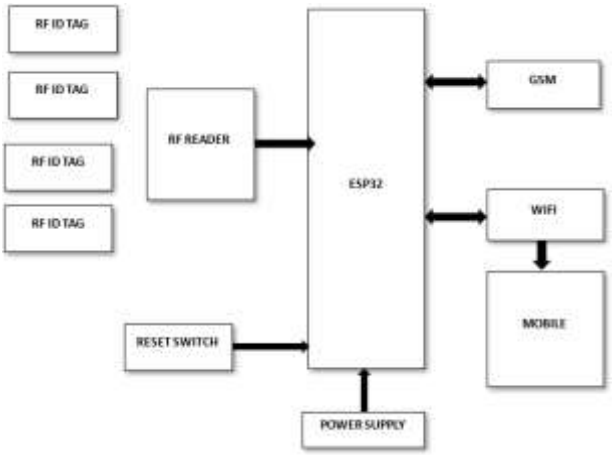

Fig -1- Block Diagram

3. CONCLUSIONS

The implementation of the IoT-enabled intelligent trolley system represents a significant advancement in modern retail technology, addressing key challenges associated with traditional shopping methods. By integrating RFID technology, ESP32 microcontroller, Blynk app, and GSM module, the system effectively automates product scanning, real-time cost calculation, and seamless billing. The results highlight a notable reduction in checkout times, enhanced accuracy in billing, and improved customer experience through real-time tracking and contactless payment options. While initial challenges such as RFID tag readability and connectivity were addressed, the overall benefits of the system—including increased efficiency, reduced manual errors, and enhanced user satisfaction—demonstrate its potential to revolutionize the shopping process. This innovative approach not only streamlines store operations but also offers a scalable solution adaptable to various retail environments, paving the way for a more efficient and customer-centric future in retail shopping.

4. SUGGESTIONS FOR FUTURE WORK

The future scope of the IoT-enabled intelligent trolley system extends beyond its current implementation, with several potential enhancements and applications that could further revolutionize the retail experience. Future developments could include integrating advanced AI algorithms for predictive analytics, enabling the system to offer personalized product recommendations based on shopping patterns and preferences. Additionally, incorporating machine learning could enhance RFID tag accuracy and reduce scanning errors. Expanding the system to support multiple languages and currency conversions could make it more accessible and user-friendly for international shoppers. Integration with store inventory management systems could provide real-time stock updates and automatic restocking alerts, optimizing store operations and reducing inventory issues. Moreover, the system could be adapted for use in other environments such as libraries or equipment rental services, showcasing its versatility and broad applicability. These advancements promise to further improve customer satisfaction, operational efficiency, and the overall shopping experience, positioning the system as a key player in the future of retail technology.

REFERENCES

[1] Khan, R., Zaheer, R., & Khan, S. (2012). "Future Internet: The Internet of Things Architecture, Technology, and Applications." 2012 10th International Conference on Frontiers of Information Technology, 257-260.

[2] Wang, Q., & Zhang, L. (2019). "Optimization of Smart Retail Systems: Integrating IoT and AI Technologies." IEEE Transactions on Automation Science and Engineering, 16(3), 1163-1173.

[3] Ali, M., & Maqsood, M. (2016). "RFID and IoT Technologies for Intelligent Retail Management Systems." 2016 IEEE International Conference on Internet of Things (things), 150-154.

[4] Cao, X., & Wu, S. (2020). "Smart Shopping Trolley System Based on IoT Technology." 2019 5th International Conference on Information Management (ICIM), 299-303.

[5] Suh, M., & Kim, H. (2021). "Intelligent Shopping Cart System Using IoT and RFID Technologies." 2021 10th International Conference on Information and Communication Technology (ICoICT), 217-222.