

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ∺ Peer-reviewed & Refereed journal ∺ Vol. 12, Issue 5, May 2025 DOI: 10.17148/IARJSET.2025.125384

The Future of Shopping: Smart Trolley

SAHANA T B¹, SHALINI S², SUNITA SS³, VIDYA SHREE H⁴, Mrs. SANGEETHA V⁵

Dept. of ECE, KSIT, Bengaluru, India¹⁻⁴

Assistant Professor, Dept. Of ECE, KSIT, Bengaluru, India⁵

Abstract:- The Smart Shopping Trolley system is designed to enhance the customer shopping experience by integrating advanced technology. It features an automatic billing mechanism and is capable of following user commands through hand gesture recognition. A built-in barcode scanner enables customers to scan items as they shop, with product details and prices instantly updated to the digital cart via the internet. This bill is then automatically sent to the store's billing counter, reducing the time spent in queues and eliminating the need for manually pushing or pulling the trolley. This intelligent trolley incorporates components such as an ultrasonic sensor, ESP8266 microcontroller, Wi-Fi module, and a weight sensor. When a customer scans a product, it is recorded in the cart, and a running total is maintained, allowing for seamless billing while concluding the shopping session. All elements are integrated within an Internet of Things (IoT) framework and have undergone testing to ensure optimal performance. After the shopping and payment process is completed, the trolley autonomously returns to its docking station.

Keywords: IoT, Bluetooth, Barcode Scanners, Obstacle avoidance, Android application

I. INTRODUCTION

Shopping has turned into an essential part of modern life, especially with the growing footfall in malls and supermarkets during weekends, holidays, and special sales. A frequent challenge encountered by customers is the long wait at billing counters. Often, these extended queues discourage shoppers, leading some to abandon their purchases entirely-resulting in a loss for store owners. To address this, a Smart Shopping Trolley has been developed, incorporating a barcode scanner along with a touchscreen interface, allowing customers to scan and make payments for items directly from the cart, eliminating the requirement for a sales associate. Each product in the store is labeled with a barcode. As shoppers pick their items, they can scan the codes using the onboard scanner, and all the information-including product details and prices—is shown on the touchscreen. The design essentially brings a compact self-checkout system to each trolley, complete with a user-friendly interface for payment processing. This greatly reduces congestion during peak shopping hours. In addition to core functions such as scanning and price checking, the Smart Trolley includes advanced features such as in-store item location tracking—users can search for products by name and receive on-screen directions—and budget management tools. Security is also a key consideration. The trolley is fitted with safeguards to avoid unauthorized removal from store premises and ensures secure card-based transactions, safeguarding customer payment data. Payments are accepted exclusively through cards for added security and convenience.. The system displays each scanned product along with the running total on the screen, making it easier for customers to monitor their spending. This is particularly beneficial for those shopping within a set budget. Overall, this Smart Trolley reduces checkout time, cuts down on the manpower needed at billing counters, and improves the shopping experience. This project introduces the concept of the "Intelligent Shopping Basket," aimed at minimizing, or even eliminating, waiting times, reducing staffing costs, and boosting operational efficiency. As technology continues to transform daily activities, automation in the retail sector is becoming increasingly important. Through this system, customers can view up-to-date pricing and product details, make quick payments, and enjoy a more efficient, hassle-free shopping experience.

II. LITERATURE SURVEY

AI-Powered Smart Shopping Trolley: The AI-Powered Smart Shopping Trolley brings a transformative approach to retail by utilizing artificial intelligence to make shopping seamless and highly efficient. This trolley is designed with next-generation features such as AI-enabled barcode scanners that instantly capture and identify product data. An Arduino-based microcontroller processes this data and updates it on an LCD display, showing real-time billing and detailed product information. Voice-command capability allows shoppers to interact hands-free, giving instructions such as adding or removing items from the billing list. Furthermore, the trolley incorporates a smart payment system, enabling users to complete their purchases directly at the trolley without visiting traditional checkout counters. Inventory management is improved through dynamic stock updates and predictive maintenance that ensures the trolley operates reliably.



International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 $\,\,st\,$ Peer-reviewed & Refereed journal $\,\,st\,$ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125384

By integrating AI, the trolley provides personalized shopping suggestions based on customer history, enhancing user interaction and overall pleasure. Overall, this solution elevates both customer experience and store efficiency, setting new standards in the retail industry. [1]

Smart Trolley System: Created by Mayuresh M. Kodape and his team, this intelligent cart system aims to streamline the checkout process and improve user convenience. Each item in the store is equipped with an RFID tag, which is identified by the EM-18 RFID scanner installed on the trolley as products are placed inside. A digital display shows customers their running total, listing the product name, amount, and cost of each product. A GSM module further facilitates billing by sending a detailed invoice to the customer's mobile phone, allowing quick payments and minimizing waiting time. A unique feature is the trolley's ability to follow the customer autonomously using ultrasonic and infrared sensors. This not only eases the physical burden of pushing a heavy trolley but also ensures a more relaxed shopping experience. The trolley's real-time tracking and autonomous movement demonstrate practical applications of robotics and automation in everyday retail settings. [2]

Research on Smart Shopping Cart: The research paper shared by Prof. Roopa C and Nivas Chandra Reddy presents an innovative and practical approach to overcoming common challenges in supermarkets and shopping malls, particularly the issue of long queues at billing counters. This smart cart system leverages **RFID (Radio Frequency Identification)** technology to simplify the checkout procedure and elevate the overall shopping experience. In this system, all items in the store is installed with an RFID tag, meanwhile every shopping trolley is fitted with an RFID reader, an LCD display, and a microcontroller. As shoppers place items into the cart, the RFID reader detects the tags, and the microcontroller processes the information to identify each product. The item names and prices are displayed on the LCD screen, and the total cost is updated automatically in real time. If an item is removed, the system adjusts the bill accordingly by deducting that product's cost, once the shopping activity is finished all collected data is wirelessly transmitted to a central billing system using a **ZigBee communication module**. This allows customers to proceed with payment without needing to rescan items in-store operations but also elevates the customer experience by minimizing human effort and wait time. It represents a step forward in blending traditional retail with smart technology, addressing the increasing demand for convenience and digital integration in shopping environments. [3]

The IoT-Based Smart Shopping Trolley System: This IoT-based system integrates RFID readers, weight sensors, and a microcontroller to offer a comprehensive shopping solution. The trolley connects wirelessly via Wi-Fi to the store's server, ensuring that every product added or removed is tracked accurately and instantly. A built-in LCD screen displays all item details, including names, prices, and weights, while maintaining a running total. The system provides real-time synchronization between the trolley and the store's central database, ensuring accurate billing and up-to-date inventory records. In addition to simplifying checkout, the system assists store management by identifying stock shortages, predicting demand trends, and automating restocking alerts. Its modular design allows easy customization, making it adaptable to stores of various sizes and types. The combination of precise item tracking, real-time updates, and backend inventory coordination makes it a robust tool for modernizing the retail experience. [4]

Smart Shopping Trolley for Automated Billing and Theft Detection Using IoT: The Smart Shopping Trolley integrates IoT technology for automated billing and enhanced security, using RFID tags and weight sensors to detect theft and billing errors in real-time. It continuously displays an itemized list and total amount on an LCD interface, allowing customers to monitor their spending as they shop. The trolley communicates with the store's inventory system via Wi-Fi, updating stock levels and alerting staff to discrepancies. Advanced algorithms analyze shopping patterns to detect suspicious behavior, while integration with store security systems allows for immediate response to theft attempts. The system offers seamless, contactless checkout and generates valuable data insights for retailers to optimize operations and customer experience. Designed with sustainability and privacy in mind, it aims to upgrade the buyer's journey by ensuring accuracy, security, and efficiency.[5]

Iot Application Based Advanced Shopping Trolley: One of the key goals in enhancing the retail shopping experience is to reduce the customers time. IoT Application Based Advanced Shopping Trolley: This advanced model seamlessly blends trolley-based RFID scanning with smart shelving units to create an ecosystem where both the trolley and store shelves communicate in real time. When an item is placed into the cart, the trolley's RFID reader captures and logs the product, instantly updating the bill. The smart shelving units assist by updating stock levels automatically when items are removed. The system's mobile Point of Sale (mPOS) feature allows shoppers to complete their purchases at the trolley, bypassing checkout counters. Centralized data storage supports analytics for customer purchasing behavior, helping stores make data-driven decisions about promotions and stock management. Additional features include shopping list tracking and in-app notifications, offering a full-service smart shopping experience that is efficient and personalized. [6]



International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 $\,st\,$ Peer-reviewed & Refereed journal $\,st\,$ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125384

IOT Based Intelligent Trolley for Shopping Mall: In today's metropolitan lifestyle, shopping at large malls has become a routine activity. These shopping centers often experience heavy foot traffic, especially during weekends, holidays, and discount sales. Shoppers typically collect various items in a trolley and proceed to billing counters, where cashiers manually generate bills using barcode scanners. This often results in long queues and delays. Designed for busy shopping malls, this intelligent trolley incorporates RFID readers that detect tagged products as they are added. It displays product information, prices, and real-time totals on a user-friendly LCD screen. Wireless data transmission to the billing counter enables staff to prepare bills in advance, reducing waiting times for customers. The use of Embedded Serial Protocol (ESP) enhances data security and system stability, making it reliable even during high-traffic periods. The system includes a tracking module to monitor trolley location and usage patterns, assisting store managers in optimizing store layouts and managing customer flow. With its real-time monitoring and detailed tracking, this solution brings efficiency and convenience to both customers and store operators. [7]

Smart Shopping Trolley Using RFID Based on IoT: Shopping at large malls has become a regular activity in many urban areas, often resulting in overcrowded conditions, especially during weekends and holidays. Shoppers typically collect products in a trolley and move towards the cashier, where cashiers generate bills using barcode scanners. This procedure is often slow and leads to long queues, causing inconvenience for customers. To tackle this problem, the proposed project introduces an **automated goods carrier with integrated navigation and billing system** tailored for shopping malls. The system features a robotic trolley equipped with a keypad interface, which allows users to input movement commands. This enables the robotic trolley to navigate along specified paths within the store. The keypad also incorporates a built-in **product code scanner**, which reads the barcodes of items placed in the trolley. Based on the data received from the scanner, the controller identifies and displays each product's name and price on an **LCD screen**. For billing, the system uses a **Wi-Fi communication module**, enabling wireless transmission of cart details to the central billing system. Additionally, a **load cell sensor** is integrated into the trolley to check the weight of items. This serves as a validation layer if an item is placed in the trolley without being scanned, the discrepancy in weight will trigger an alert or error notification, preventing billing errors and enhancing system accuracy. This groundbreaking solution enhances the shopping experience by minimizing wait times while ensuring precise billing and more efficient inventory management. [8]

IoT Based Smart Automatic Shopping Cart with Overload Indicator: Within an **IoT-based framework**, a low-cost **RFID tag** can be affixed to every product. When a tagged item is placed into a **smart shopping trolley**, it is automatically detected by an onboard **RFID reader**. Additionally, the system can be enhanced with **smart shelves** that also contain RFID readers. These shelves can monitor stock levels in real time and send updates to a centralized server. A key benefit of such a setup is the simplification of **inventory management**. All items can be automatically scanned and tracked, reducing the need for manual checks. The system can also detect product expiry dates, alerting the store if any item is no longer valid for sale. All relevant information—such as product availability, expiry status, and billing data—can be updated and accessed via an **IoT-based web interface**, providing a streamlined, efficient, and intelligent retail management system. [9]

Smart Trolley System for Automated Billing using RFID and IoT: An automated smart shopping system is created by integrating Internet of Things (IoT) technology technologies to connect all products within a grocery store. Each item is embedded with a cost-effective **RFID tag**, enabling automatic detection when placed into an automated trolly fitted with an **RFID reader**. As a result, billing is processed directly from the cart itself, significantly reducing or eliminating the requirement for customers to wait in long checkout queues. The system also displays the **expiry date** of each product and uses **weight sensors** to help identify potentially **damaged items**. Products that are expired or deemed damaged based on weight discrepancies are excluded from the billing process to ensure quality and accuracy. Furthermore, the integration of **smart shelving**—featuring RFID readers—allows for real-time **inventory monitoring**, with data continuously synced to a central server. This enhances stock management and reduces the need for manual inventory checks. Lastly, **checkout points** are designed to validate and confirm customer purchases, adding an additional layer of accuracy and security. A functional **prototype** of this smart shopping system is also presented to demonstrate its practicality and effectiveness in real-world retail environments. [10]

An IOT Based Smart Shopping Trolly for Smart Shopping: In today's rapidly growing world, with an ever-expanding population and diverse needs, customers shopping at large retail stores like Walmart or supermarkets often face significant challenges in coordinating their shopping activities. Shopping can be time-consuming and requires patience, particularly when navigating long queues at checkout. To address this, technology can play a crucial part in improving the shopping experience. This paper introduces a **cost-effective and practical Smart Shopping Trolly** system powered by **Internet of Things (IoT)** technology, designed to enhance shopping efficiency. This system is particularly suitable for large retail environments such as **Walmart** and supermarkets, where it can reduce the need for manual labor and streamline the



International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 🗧 Peer-reviewed & Refereed journal 😤 Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125384

overall shopping process. Instead of waiting in long checkout lines, customers can automatically process their purchases through an integrated, automated billing system. The proposed system operates in two primary modes: a **predefined shopping list** and **random shopping**. In the predefined list mode, the system helps customers navigate the store by providing the **shortest route** to pick up the items from various racks. Additionally, the system supports **Cart-to-Cart communication**, allowing customers to share shopping lists with others, enabling simultaneous or parallel shopping with multiple carts. This function not only saves time but also enhances efficiency. Moreover, the system includes theft detection functionalities, helping to identify potential shoplifting incidents. Retail administrators can also gain advantages from the system's data gathering, which provides valuable commercial insights into consumer purchasing patterns. These insights can assist store managers in predicting sales trends, ensuring optimal stock levels, and adapting to customer demand in real time. Overall, this intelligent retail system aims to deliver a more seamless and pleasant shopping experience for customers, while equipping retailers with the resources to enhance efficiency and boost customer satisfaction. [11]

III. FUTURE SCOPE

The future scope of smart shopping trolley systems is vast and promising, with potential for integration of AI and machine learning to enable personalized shopping experiences, predictive inventory management, and dynamic pricing strategies. Enhanced features such as voice-command interfaces, multilingual support, and mobile app integration can further improve usability and accessibility. Real-time indoor navigation using AR (Augmented Reality) or BLE (Bluetooth Low Energy) beacons can guide customers to products efficiently, while biometric authentication and advanced theft detection ensure secure transactions. Cloud-based data analytics can provide valuable insights into shopping behavior, optimize store operations, and support omnichannel retail models. Additionally, improved obstacle detection and autonomous navigation will enhance trolley mobility, while sustainable design practices can reduce environmental impact. Overall, these advancements aim to create a seamless, intelligent, and efficient retail experience that benefits both consumers and retailers.

IV. CONCLUSION

The **Smart Trolley system** marks a major advancement in modernizing the retail shopping experience by incorporating technologies such as **RFID**, **barcode scanners**, **IoT**, and **mobile payment solutions**. This creative approach not only enhance customer convenience by minimizing long checkout queues and saving time, but also streamlines the billing process, enhances inventory management, and reduces the reliance on manual labor. With real-time billing and a user-friendly interface, Smart Trolleys can significantly increase the operational efficiency of supermarkets while boosting customer satisfaction. As the retail industry increasingly shifts toward automation and digital solutions, Smart Trolleys are poised to become a key component of future shopping environments.

ACKNOWLEDGEMENT

Author is thankful to K S Institute of Technology Bangalore For providing necessary materials to prepare this paper.

REFERENCES

- [1]. https://www.researchgate.net/publication/390093384_AI-Powered_Smart_Shopping_Trolley
- [2]. https://www.ijraset.com/research-paper/smart-trolley-system.
- [3]. https://www.researchgate.net/publication/347094766_Research_on_Smart_Shopping_Cart
- [4]. https://ieeexplore.ieee.org/document/10263687//ISBN: 9781472475084,pp 256
- [5]. Kevin Boyle," The Human Rights Handbook", Publisheed in: Routledge, 2011, ISBN: 9780415229104, pp 336
- [6]. Hiba Sadia, Shubhansu Jee, Krishnendu Pal, Shikhar Singh, Mebansharai Marbaniang," Iot Application Based Advanced Shopping Trolley"
- [7]. Dhavale Shraddha D., 2DhokaneTrupti J., 3Shinde Priyanka S.," IOT Based Intelligent Trolley for Shopping Mall"
- [8]. K.Gogila Devi, T.A.Kaarthik, N.Kalai Selvi, K.Nandhini, S.Priya,:Smart Shopping TrolleyUsing RFID Based on IoT"
- [9]. 1Thangavel M 2Karthick N 3Karthikeyan D 4Karunakaran P 5Prasanth R,"IoT Based Smart Automatic Shopping Cart with Overload Indicator"
- [10]. PrithaN, SahanaS, SelvinStephy N, Shiny Rose S, Unnamalai S, "Smart Trolley System for Automated Billing using RFID and IoT"
- [11]. Srinidhi Karjol , Anusha K. Holla , and C. B. Abhilash, "An IOT Based Smart Shopping Cart for Smart Shopping"