



IoT-Enabled Smart Shopping Trolley with Automated Billing and Real Time Cost Tracking

E. Jothi^{1*}, R. Thenmozhi², S. Vidhyalaxmi³

¹Assistant Professor, Department of Computer Science and Engineering, IFET College of Engineering, Villupuram, India

^{2,3}UG Scholar, Department of Computer Science and Engineering, IFET College of Engineering, Villupuram, India
thenmolzhiramesh@gmail.com, vidhyalaxmi2003@gmail.com

Corresponding Author E-mail: rjothilaxme@gmail.com

ABSTRACT: In today's fast-growing world, with a rapidly increasing population and diverse demands across various sectors, customers often face challenges when shopping in supermarkets. The time spent and difficulties encountered while waiting in long queues for billing can be frustrating. Moreover, customers may end up purchasing unnecessary items, adding to their expenses. To address these issues and create a modern, efficient, and user-friendly shopping experience, this paper proposes a Smart Shopping Trolley with Automated Billing. The system is designed to enhance the shopping experience by minimizing common problems, such as long wait times at the checkout and difficulty in tracking the total cost of purchased items. The proposed system incorporates IoT components such as RFID tags, an RFID reader, an LCD display, and the Bolt ESP8266 module. As items are placed in the trolley, the RFID reader scans the RFID tags on each product, instantly displaying the item's details and the running total on the LCD screen. Once shopping is completed, the final bill is automatically sent to the checkout counter, reducing the need for manual scanning and significantly decreasing waiting times.

Keywords: RFID, LCD screen, Bolt ESP8266

1. Introduction

Nowadays, shopping is a common activity that occupies much of people's time. Malls are often crowded with individuals traveling to metropolitan areas for shopping. With the growing availability of products and the evolution of consumer tastes, the market is expanding daily. However, pushing or pulling a shopping cart in malls and retail establishments can be quite challenging due to the weight of the items. To address this problem, the Smart Trolley with Automated Billing System was developed. These smart shopping carts allow customers to shop.

Conveniently without worrying about maneuvering the cart. Similar to systems found in

supermarkets and shopping centers, smart trolleys streamline the shopping process by efficiently handling billing. Currently, RFID tags attached to each item are used to implement this system in shopping centers. The cart has a built-in scanner that utilizes RFID technology when items are placed inside. This helps avoid the long checkout lines typical of traditional shopping methods, which often irritate customers. Regarding efficiency and the number of objects it can scan, RFID technology is more advanced than barcodes. RFID readers can scan multiple items simultaneously without direct contact with the tagged objects, whereas barcodes must be scanned one at a time. Additionally, RFID technology has been in use for more than 20 years, demonstrating its efficacy across a range

of business sectors. In the Smart Trolley System, when a product is added to the cart, its details—such as name, price, and quantity—are displayed on an LCD screen integrated into the trolley. The system automatically calculates the total bill as items are added or removed. Customers no longer need to wait in line at conventional billing counters, as the automated billing process is completed within the trolley itself. RFID Tags Each product has an RFID tag attached for unique identification. RFID Reader Items placed in the trolley are scanned automatically by the RFID reader. LCD Display The customer can view product details, prices, and the running total. As products are placed in the trolley, the RFID reader scans them, and the LCD screen displays the product name, price, and quantity. The trolley also serves as an interactive shopping assistant, informing and advertising relevant details about the items. Shopping is one of the daily activities in which people spend a significant amount of time. According to a survey, individuals spend an average of one to two hours shopping, and many experience delays due to long checkout lines. Supermarkets and shopping centers that do not provide efficient shopping carts and baskets risk losing customers. After completing their purchases, customers must typically proceed to the billing counter, where the invoicing process can be time-consuming. This often necessitates hiring additional staff to handle transactions. The implementation of a Smart Trolley System based on RFID aims to address the problem of long queues and enhance the overall shopping experience. One of the daily activities in which people spend the majority of their time is consumption. People spend an average of one to two hours shopping, according to a survey, and the majority of them always have a habit of forming a big line behind them. A supermarket and shopping center that does not provide shopping carts and baskets to retain customers is existent. After completing their purchases, clients must proceed to the billing

point. The invoicing process is time consuming in this case, and hiring more staff is necessary for the transaction. A smart trolley system based on RFID will be implemented on the queue problems.

2. Existing Solution

Shankar et al, (2021) Supermarkets and shopping centers have nearly reached a state of technological development. Items such as glassware, toys, kitchenware, food, ornaments, and much more can be found in a shopping mall. Due of benefits like home delivery and savings, many people [1] enjoy shopping. Particularly on weekends, people must wait in lengthy lines, and customers must wait patiently for their turn. This is a time-consuming procedure since individuals have busy schedules, are bored, and are dissatisfied with the services they receive at the billing counter. In order to prevent these issues, we implemented a highly efficient system that also aids us during the COVID-19 pandemic.

A. Tripathy et al, (2020) While shopping can be incredibly captivating and seductive, it also entails getting exhausted from waiting in line to pay for bills. Therefore, the design of a smart trolley that can handle invoicing and shopping is suggested. As a result, the consumer can enter the store right away, use the smart trolley to buy items, and leave. In addition to viewing his purchase data on the shop's website, he receives the e-bill by mail. To do this, we need an Arduino board, an RFID reader, an RFID tag, an LCD display, an ESP8266 Wi-Fi module, a database manager, and a website that allows the administrator to access product and customer information from anywhere in the

Dr. Jeevanandham et al, (2021) Our paper's primary goal is to make customers' buying experiences simple. Avoiding standing in the billing section is the goal. To create a smart trolley, we therefore created an embedded system that combines RFID and IOT. All of the trolleys that have RFID readers will have the system

installed as part of the rollout. Every product at the mall will have an RFID tag attached to it [3]. The cart's simulated code will be recognized, and the product prices will be saved in memory. The invoicing will be completed within the trolley itself and shown on the LCD as we place the things. The total bill data will be finalized at the billing counter

K. Anjali et al, (2022) Shopping is a common but tiresome activity, particularly in supermarkets. Brick and mortar stores are not entirely replaced by online shopping, despite the fact that the internet has completely changed the way that people shop for goods. Large crowds at peak hours and on public holidays, however, typically result in longer billing [4] times, which irritates customers and detracts from their overall shopping experience. This work introduces a new and clever shopping cart design that uses RFID technology and Arduino to enable customers to scan the products independently. Additionally, the proposed system offers a web interface for bill generation and an automatic payment interface for the client. Following then, it is anticipated that the suggested model will ease off-queue

Lakshmiprabha et al, (2021) The advancement of the wireless generation There are many areas where we may use the generation, and using Wi-Fi technology is advantageous at the moment. We present our thoughts on an automated shopping cart in this paper [5] that combines an LCD display, bar code scanner, and Raspberry Pi tool. As we all know, during income and vacations, we tend to rush to the grocery store. As a result, the billing process becomes more time-consuming, and customers are unable to wait in line for very long. In this situation, we can use the automatic purchasing trolley, which has an LCD display, Pi device, and barcode reader. The customer will selftest the merchandise with the help of this trolley.

B. Mahalakshmi et al, (2020) The intelligent shopping trolley system facilitates customers' shopping experiences. Using an Android application that was put on the customer's phone, the trolley features an automated billing system and responds to movement instructions from the user [6]. Through the use of Bluetooth to construct a local area network (LAN), the customer's purchases and their prices will be automatically updated in the Android application. The Internet of Things (IoT) will then automatically transmit that bill to the shop's administrative system.

P.A. Jeyanthi et al, (2022) Holidays bring a lot of people to large shopping malls to make purchases, and during times of sales and discounts, the crowd will grow even more. On those days, more people purchase goods. For billing purposes, he or she should proceed to the bill counter after completing the purchase. It takes a while for the biller to use barcodes to bill the items. Long lines in the billing area will result [7] if it persists. This difficulty is avoided with the usage of this research. To solve this issue, the shopping cart should include an LCD screen and an RFID reader, and the merchandise should have RFID tags. It instantly recognizes the product, its name, and other details when a consumer places an item in the cart.

A. Karthikayan et al, (2023) Shopping malls are a common destination for city dwellers to peruse goods. The busiest days of the week for retail outlets are the weekends and holidays. There's a sense of urgency because of the sales and discounts. A wide range of products are in people's shopping carts. Prior to making a purchase at the cash register, customers must first select the things they want [8]. Customers may have to wait for a long time until the bill victimization bar code scanner is installed at the billing counter because it takes time. Because of this study, people spent less time in checkout queues. In the same way, the smart shopping cart

makes it easy to see how much each item costs. Following payment through the app or in person

F. Martinez et al, (2021) People's lives are being changed by the Internet of Things (IoT) by combining common protests. For instance, in a marketplace, every item might be linked to every other item, creating a foundation for astute purchasing. In such an IoT framework, each item can be uniquely identified by an affordable RFID tag, which can then be scanned using a vehicle equipped with an RFID reader while it is in a great shopping basket. The Internet of Things (IoT) is transforming people's life by connecting seemingly insignificant items [9]. For instance, everything in a marketplace might be related to everything else, creating a clever purchasing pattern. Under such an IoT framework, each item may have an acceptable RFID tag attached to it that, when inserted directly

A. SaiKrishna et al, (2020) People's quality of life has improved due to contemporary technology, and shopping malls are crowded. Reducing the billing procedure is crucial to saving customers' time. RFID-based smart shopping systems are used for marketing. The bill is generated and presented once each item in a smart shopping cart is read one by one [10]. Following the generation of the final bill, the consumer uses the pre-charged cards as the shopping center has given them to pay the amount.

H. Ham, Martinus et al, (2021) – Customers do not want to wait in a long line at the supermarket checkout, and it may even reduce the number of customers and their loyalty. Making the checkout process efficient is therefore essential since it frees up customers' time so they can engage in other activities. The goal of this research is to develop a system that includes smart shopping carts, a smartphone application that serves as an interface, and a cashier application that is integrated with a server and database to facilitate data transmission. This system will allow

customers to scan their own items, with the cashier only needing to handle payment.

S. Mekruksavanich et al, (2020) The purpose of this study was to introduce the suggested architecture and operation of a smart shopping system based on RFID technology. This system uses intelligent shopping carts that customers may use to find the things they want, together with suggested promotional goods and billing information that is computed while the user is shopping. The items will be instantly recognized by the smart shopping cart and added to the bill. By using this strategy, customers will be able to skip the lengthy lineups at the checkout counters, saving time, and the supermarket's supervision will be more effective [12]. Additionally, the sensor on the shopping cart will update the amount of products and send it to the main server.

A. Vinoth et al, (2023) It is difficult for many clients to wait in a long line to get their goods billed. For the wrong customer, this leads to a poor bill and financial loss. Trolleys are used to facilitate shopping at supermarkets and grocery stores. Shopping can be made easier with the proposed smart cart [13], which automatically recognizes the products being added to the cart and displays the pertinent information on the user interface. Even though people are frequently seen becoming enthusiastic about online purchasing through ecommerce websites, shopping malls are still popular. Shopping malls and shopping centers provide a wide variety of shopping carts. An intelligent shopping cart with technological assistance that can identify products is shown in this study.

F. Ahmad et al, (2022) Many facets of society have undergone significant transformation as a result of the COVID-19 pandemic. Social distance is one of them; it limits the number of people in public spaces and physical touch. One location that is impacted by social distancing to reduce the virus's spread is supermarkets. While

trolleys are primarily used to facilitate grocery shopping, they also provide direct physical touch with customers [14]. Thus, as the world adjusts to this situation, a smart cart that can reduce direct physical contact and assist stop the spread of COVID-19 without sacrificing customer enjoyment when grocery shopping must be developed.

D.Shakya et al, (2021) As technology develops, individuals of all ages are becoming more and more receptive to electronic gear. Particularly in shopping centers, electronic gadgets like smart card readers, bar code scanners, and radio frequency identification are becoming more and more popular. High population cities in Sri Lanka [15] cause a massive rush at hyper markets and shopping malls. Even though they have multiple counters, only one customer can be served at a time; the others must wait in line until the billing procedure is over. Customers have a terrible experience in shopping malls because of the lengthy lines. In order to solve the aforementioned problems and try to alleviate the discomfort that the consumer would experience, this study introduces a smart shopping system.

NagarajaBodravara et al, (2022) Shopping has become very popular, especially on weekends, in urban or metropolitan areas. The availability of everything in one location has led to the success of super markets, large bazaars, etc. Shopping is made quick and easy with the use of a trolley. [16] Customers find it difficult to adhere to COVID-19 regulations and to wait in a long line for billing. Since technology is advancing daily in all domains, the smart trolley, which is based on the Internet of Things and has an advanced invoicing system, is equipped with an RFID tag, an LED display, and a barcode scanner.

ShivikaShrivastav et al, (2020) Supermarkets today are nearly fully equipped with cutting-edge technology. Because the trolley is the simplest way to transport things at supermarkets, people buy various items and load them onto it. Customers must, however, push the cart by hand

during the entire shopping experience, and they must wait in lengthy lines to pay their bills during the billing process [17]. Because people have hectic schedules, this is a time-wasting process. In order to circumvent these issues, the research teams have devised a very sophisticated and efficient method. Shopping malls employ this technique as a tactic to boost the number of buyers in order to address these issues. In urban areas, we can see a massive flash around

M. Shahroz et al, (2020) In the current technological era, the majority of customers must wait in the supermarket to shop because it takes a very long time. Because of a barcode-based billing system, a large crowd at the supermarket over weekends or special offers makes it difficult to wait in long lines. In this context, a Smart Shopping Cart based on the Internet of Things (IoT) [18] is suggested, which includes Bluetooth, an Arduino microcontroller, RFID sensors, and a mobile application. Wireless connection is essential for RFID sensors. Each product has an RFID tag, and the RFID reader quickly reads the product information. Each product's details are then displayed in the mobile app. The client effortlessly handles

Pradhan et al, (2021) Instead of waiting in a line for a few things, the smart shopping trolley system's primary goal is to satisfy the needs of the customer and cut down on the amount of time spent on the billing process. The suggested system makes it easier for individual consumers to view their actual bill after any deductions or discounts related to their purchase. In order to pay the bill, customers must access their account and use any digital payment method [19]. This system was created with security in mind to prevent robberies, and it is also easy to use. By guaranteeing the customer's comfort and reducing the hassle of barcode scanning, it cuts down on the amount of time spent making a purchase and freeing up the customer from standing in a long line.

Chimurkar et al, (2020) The number of malls and shopping complexes is growing daily, and there is a noticeable spike in these businesses on the weekends and at the end of the week. Customers purchase various goods and load them into carts. Once every product has been chosen, the cashier counter must be visited to bill the items. A long line forms at the billing counter as a result of the cashier's extremely time-consuming process of scanning each product's bar code to create the bill [20]. This study proposes a Smart Mobile Autonomous Robotic Trolley (SMART) prototype to assist customers with their shopping by cutting down on time spent on the task and evaluating products based on their expiration date and total billing.

K. Tripathy et al, (2020) Shopping is incredibly captivating and seductive, but it also wears you out because you have to wait in a long line to pay. In order to handle shopping and billing, it is suggested that a smart trolley be designed. This enables customers to enter the store immediately, make purchases using the smart trolley, and then leave. In addition to viewing his purchase [21] data on the shop's website, he receives the e-bill by mail. We require an Arduino board, an RFID reader, an RFID tag, an LCD display, an ESP8266 Wi-Fi module, a database manager, and a website to handle customer and product information that the administrator may access from anywhere in the above

S. Lakshmanachari et al, (2020) smart commerce, hospitality, transit, and a lot more. The creation of a shopping cart bill is the main goal of this study. By offering a digital billing system that allows consumers to get their bills via their registered email, the primary goal is to save them time. Each goods will have an RFID tag or card attached to it, and the database will store the information about the purchase. The billing will then be generated on both the server and the LCD. This system demonstrates how RFID technology will improve future accessibility security and ease of living.

A. Mandal et al, (2021) The automatic shopper following shopping cart system with auto-billing feature is presented in this paper. It uses Radio Frequency Identifier (RFID) technology and a motor drive control system for a mechanized trolley that uses a novel finite state machine (FSM) based on object tracking method to allow hands free movement. Computer Vision (CV) algorithms are used for motion detection and object tracking [23]. Together with an IEEE 802.11 (Wi-Fi) module that transmits real-time product check-out data to a cloud-based web application with the goal of industry 4.0 using the Industrial Internet of Things (IIoT), the trolley is outfitted with a Raspberry Pi 4 running open CV for image analysis.

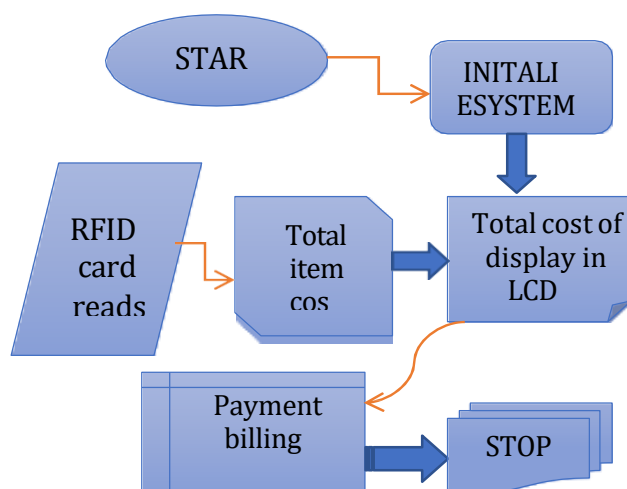
G. Chandrasekaran et al, (2020) We observe that the use of cutting-edge applications and computing technologies has grown significantly in our daily lives. Because smartphones and laptops offer high-speed internet connectivity, intuitive user interfaces, and personalized recommendations, many people are connected to this digital world through these devices [24]. As a result, things are now easier and simpler. In addition to ensuring that the products are of the highest quality, new technologies like social media have provided users a better and wider view on numerous items and information about various products in their everyday lives. People's demands and desires vary greatly, which is a result of our cities' overcrowding. Because of this, a lot of people like to purchase a variety of goods at malls and supermarkets.

S. K. Shankar et al, (2021) People are more inclined to purchase groceries from supermarkets and hypermarkets in the current environment. In this situation, it takes longer to determine a client's basic needs in a supermarket, and once those needs have been determined, the customer must wait in the billing line to finish the billing procedure for the chosen item. Customers are currently under tight instructions to maintain social distance because to the COVID-19

epidemic, but this is practically impossible, particularly during the billing process. In order to address this important issue, this study suggests an Internet of Things [IoT]-based smart cart with a sophisticated billing system that not only makes shopping safer and easier but also eliminates the need to wait in line. A smart trolley with an LCD display, a barcode scanner, and a Raspberry Pi make up the suggested system.

3. Proposed Solution

The proposed system is an advanced Smart Shopping Trolley with Automated Billing that utilizes RFID (Radio Frequency Identification) technology for item tracking and billing. The system's objective is to reduce the time taken by consumers to pay for their goods and to provide real-time, dynamic total cost figures during the shopping. Based Item tracking for Billing. The system's objective is to reduce the time taken by consumers to pay for their goods and to provide real time, dynamic total cost figures during the shopping process. Some of the reasons include lower time and long lines of queue. The main parts consist of RFID tags, RFID reader plus an LCD (Liquid crystal display) ESP8266 Wi-Fi module for both communication and after the completion of a process it receives message and sends to the bill counter and the customer at the same time.



Block Diagram

Usage: Commonly used in retail for inventory management, access control, and other applications where the tags are scanned at close range.



Figure 1: RFID tag

3.1 RFID:

RFID stands for Radio Frequency Identification. It's a technology that uses electromagnetic fields to automatically identify and track tags attached to objects. These tags contain electronically stored information.

RFID Reader: An RFID reader in a smart shopping cart is a key component that enables automated product identification and billing. It works by scanning. The RFID reader is a network connected device that can be portable or permanently attached the tag sends a wave back to the antenna, where it is translated into data. The transponder is in the RFID tag itself.

RFID Tags: RFID tags are made up of an integrated circuit (IC) an antenna and a substrate. The part of an RFID tag that encodes identifying information is called the RFID inla.

There are two main types of RFID tags:

Active RFID Tags:

- **Power Source:** They have their own power source, usually a battery.
- **Range:** They can transmit information over longer distances (up to hundreds of meters).

- **Usage:** Often used in applications where long-range tracking is necessary, such as in large warehouses or for tracking vehicles.

Passive RFID Tags:

- **Power Source:** They do not have a battery and rely on the energy from the RFID reader's radio waves.
- **Range:** They have a shorter read range (typically up to a few meters).



Figure 2: *RFID Reader*

3.2 LCD Display:

Every product has an RFID tag, which the RFID reader uses to display the product's name, price, and quantity on an LCD as soon as the item is placed in the cart. Customers pay the amount after shopping to avoid the laborious and time-consuming billing process.



Figure 3: *LCD Display*

3.3 ESP8266 WiFi Module:

Enables communication between the trolley and the store's server or cloud based system for data processing and updates. It is employed to allow

internet access to a variety of embedded system applications. The ESP8266 Wi-Fi module was created by Espressif System to handle both the microcontroller's TCP and IP, capability and any WiFi.



Figure 4: *WiFi Module*

3.4 RFID Tagging and Tracking:

Tagging Items: An RFID tag that includes a unique identity and product data including the price and description is attached to every item in the store.

Tag Data: The RFID tag data is pre-programmed with the item's details and stored in a central database managed by the store.

3.5 Microcontroller and Data Processing:

A microcontroller is a piece of technology used to process data or monitor and coordinate the operations of other devices in a system.

Microcontroller: An RFID reader sends data to a microcontroller for analysis before a decision is made. Understanding the meaning of tags, to get the item data and the sum of the costs. The microcontroller keeps record of items that are in the trolley at any one time and the total cost is updated too. RFID reader. Interprets the tag information, retrieves the item details, and calculates the total cost.

Data Handling: The microprocessor keeps track of the things that are in the cart at any one time and adjusts the overall cost safely. It also interacts with the WiFi module and LCD display.



Figure 5: Microcontroller

3.6 LCD Display Integration:

Display Setup: Real information of items and total cost is displayed on the 16 x 2 LCD connected to the microcontroller .It features a clear and easy to operate format which displays the list of items included in the trolley as well as the current costs and total amount needed for the purchase. When products are added or deleted it is also updated.

User Interface: A feature of the display informed the shoppers. The list of products the trolley and total cost when items are being added or with drawns are added or removed, it gets updated

3.7 Real-Time Cost Tracking:

Dynamic Updates: At the trolley a leaf-shaped LCD display flickers with the names of items in the trolley and the overall sum to be paid

Final Checkout: At the cash register the total amount is shown on LCD display and payment is made in the shortest time possible since everything has been calculated already

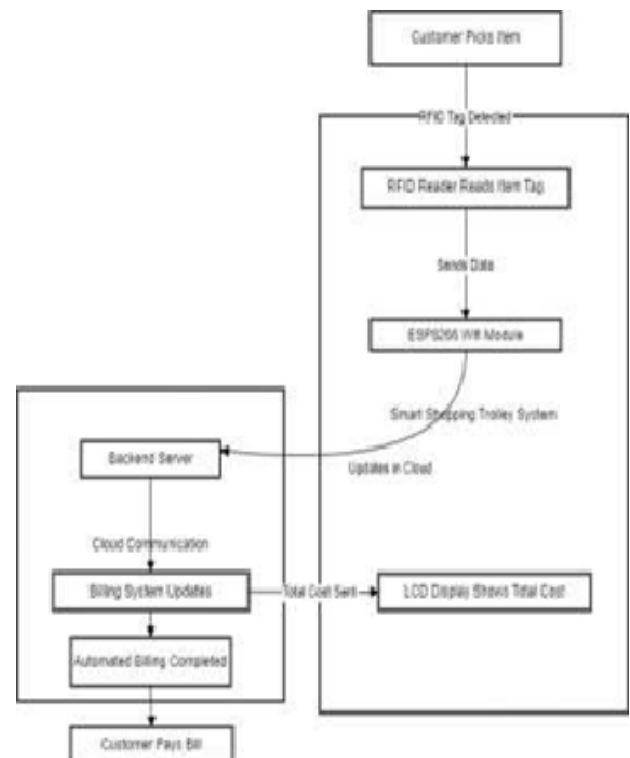
3.8 WiFi Module Performance:

In general, the ESP8266 WiFi module was rather efficient, although the results depended on the store's WiFi network. The availability of strong signal across the store to facilitate effective communication between the trolley and the server is important.

System Architecture:

The Smart Shopping Trolley with Automated Billing System is proposed to consist of the

following sub components RFID tags and reader, an LCD display and ESP8266 WiFi module



The billing procedure can be done automatically, and cost display to the consumer in real-time is one of the objectives of the system. Integrated with product data and a distinct number identifier, RFID tags are placed near the products of the store. Installed on the shopping trolley, the RFID reader is used to read the RFID tags of items in order to obtain their data. Seen placed on the trolley, the LCD display operates with the added items on the trolley as well as the total costs involved. Serves to establish a connection with the trolley and the store server or the cloud to process data and send updates.

4. Results and Discussion:

4.1 Results:

Customer respondents observed that they were able to check out much faster because the use of the automated billing system reduced the time required to manually scan and double check prices on items. The LCD display of the cost functionality received a favourable response. Following the real-time cost figures which are

displayed when making a purchase were applauded.



Figure 6: *LCD Display Intergration*

Employees in stores commented that the system saved them a lot of time was convenient to use through it, they did not need to use other methods of price scanning and billing. It also emerged that little training was needed for staff to use the system and it easily blended with operations in the stores.

4.2 Discussion

However, the principal advantage of the smart shopping trolley is the effectiveness of the shopping and payment process. High number of clientele, swift cashier services through the automated billing, cost tracking system minimized their time waiting in queues thus enhancing shopping experience. The use of IoT technology and RFID in automating the billing is more convenient and up to date according to the customer needs. The running total displayed helped the users make prompt decisions on what they wanted to buy taking into consideration the total amount they spent. This research therefore established that the RFID system was instrumental in item tracking even as the accuracy was influenced every once in a while by factors in the environment. Future refinements may be used to enhance the shielding and position of the tag antenna so that it does not possibly interfere with the electronics. In general, the ESP8266 WiFi module demonstrated a rather high efficiency level.



Figure 7: *EM-18*

although its efficiency depended on store's WiFi facilities. WiFi connectivity is also essential across the store so that there is live transmission between the trolley and the server.

5. Conclusion

In conclusion, this research confirms that the utilization of the automated shopping trolley system is worthy to be a solution in enhancing the shopping experiences. Some of the important facilities include barcode scanner, touch screen, and thus the shopping cart itself is integrated have made it easier for the buyer to pay for the products at the cart itself without being scheduled for many hours when bills are preparing. The smart shopping cart has been designed in such a way that the microcontroller node MCU and RFID technology has been used for scanning the products, the bill amount and the bill display is done on LCD. Art is created with RFID technology and a microcontroller (node MCU) playing a key role in product scanning, bill preparation, and LCD display. Supermarkets, malls, and shopping centers are some of the locations where this creative initiative might be utilized to buy goods. Here, every goods in stores is safely accessed via an RFID card. All of the product's necessary details will appear on the LCD screen once a product is scanned and added to the cart. As a result, our system uses RFID tags to make it much easier and faster to access the merchandise. If a product is purchased, the LCD should display the product's name, price, and total bill.

References

1. S. K.Shankar; S. Balasubramani; S. Akbar Basha; Sd Ariz Ahamed; N. Suneel Kumar Reddy, Year: 2021, "Smart trolley for smart shopping with an advance billing system using IoT", In 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), pp. 390– 394.
2. Tapan Kumar Das; Asis Kumar Tripathy; Kathiravan Srinivasan, Year: 2020, "A smart trolley for smart shopping", In 2020 International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1–5.
3. S. M. A. K. Azad; Sri Ramya Siraparapu, Year: 2024, "Evaluation of Scheduling Approaches for Efficient Data Transmission in Wireless HART Networks", In 2024 International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1– 5.
4. M. Jaishree; S. Jeyaprabha; K. Mohan, Year: 2021, "Smart shopping trolley using IOT", In 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Vol: 1, pp. 793– 796.
5. Rajan Singh; K. Nishanth Rao; Raju Naik; K. Anjali; P. Vineeth, Year: 2022, "Smart trolley using automated billing interface", In 2022 international conference on Advancements in Smart, Secure and Intelligent Computing (ASSIC), pp. 1– 5.
6. T. Naveenprabu; B. Mahalakshmi; T. Nagaraj; Naveen Kumar SP; M. Jagadesh, Year: 2020, "Iot based smart billing and direction controlled trolley", In 2020 6th International conference on advanced computing and communication systems (ICACCS), pp. 426– 429.
7. P. Aruna Jeyanthi; S. Raja Mohamed; Mohammed Alarfaj; Singam Sandeep Reddy; K. S. Jenin, Year: 2022, "Design and development of a smart shopping cart system", In 2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICT), pp. 184– 188.
8. G. Pradeepkumar; V. Ramesh; A. Karthika; A. Karthikeyan; R. Sacithraa; K. Vanitha, Year:2023, "Smart shopping trolley based on IoT with mobile application", In 2023 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), pp. 1221– 1225.
9. P. Castillejo; J.-F. Martinez; J. Rodriguez-Molina; A. Cuerva, Year: 2021, "IoT applications on Secure Smart Shopping System".
10. A Sai Krishna Firdaus; Ch Lokesh; K. Preethi; G Manmadha Rao, :Year: 2020, RFID Based Smart Trolley for Automatic Billing System.
11. Sakorn Mekruksavanich, Year: 2020, "Supermarket shopping system using rfid as the iot application", In 2020 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON), pp. 83– 86.
12. Metta Saridewi Wahab; Hanry Ham, Year: 2021, "Data transmission using RFID system on

smart shopping carts for checkout process efficiency in supermarket at Indonesia”, *Procedia Computer Science*, Vol: 179, pp. 902– 912.

13. A. Perumal; A. Vinoth; R. Sriraman; K. Kumar, Year: 2023, “Automatic billing trolley for an enhanced supermarket using rfid”, In 2023 7th International Conference on Computing Methodologies and Communication (ICCMC), pp. 840– 844.

14. Agustinus Yudhistira Wicaksono Setyanto; Farrel Ahmad; Jonathan Bagus Wicaksono; Kusprasapta Mutijarsa, Year: 2022, “Smart trolley with position localization method based on qr code mapping using computer vision and internet of things”, In 2022 International Conference on Information Technology Systems and Innovation (ICITSI), pp. 346– 352.

15. Vidumith Perera; Lakdinu Ekanayake; Ama Bandara; Dinithi Shakya; Udesch S. Oruthota, Year: 2021, “IoT based smart shopping system”, In 2021 10th International Conference on Information and Automation for Sustainability (ICIAfS), pp. 225– 229.

16. Bodravara Nagaraja; Basavaraj S Angadi; Ramesh Shankrappa Menasinahal; Manjunath Pasigar; Naik K Mohan, year: 2022, “RFID Based Smart Trolley for Automatic Billing System”, *International Journal of Engineering Research & Technology (IJERT)*.

17. Shivika Srivastava; Shivansh Rai; Shashi Kumar; Shippu Bhuhsan; Devasis Pradhan, Year: 2020, “IoT based Human Guided Smart Shopping Cart System for Shopping Center”, *Saudi Journal of Engineering and Technology*,

Vol: 5, No: 6, pp.278v284.

18. Mobeen Shahroz; Muhammad Faheem Mushtaq; Maqsood Ahmad; Saleem Ullah; Arif Mehmood; Gyu Sang Choi, Year: 2020, “IoT-based smart shopping cart using radio frequency identification”, *Ieee Access*, Vol: 8, pp. 68426– 68438.

19. Mayur Sanap; Priya Chimurkar; Narendra Bhagat, Year: 2020, “SMART-smart mobile autonomous robotic trolley”, In 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS), pp. 430– 437.

20. Dinika D. Pradhan; Sabita Mali; Ashwini Ubale; M. M. Sardeshmukh; Swapnalini Pattnaik; Puja Bajirao Sindhe, Year: 2021, “Smart Shopping Trolley Using Raspberry Pi”, In 2021 International Conference in Advances in Power, Signal, and Information Technology (APSIT), pp. 1– 4.

21. Tapan Kumar Das; Asis Kumar Tripathy; Kathiravan Srinivasan, Year: 2020, “A smart trolley for smart shopping”, In 2020 International Conference on System, Computation, Automation and Networking (ICSCAN), pp. 1– 5.

22. IS Siva Rao; Munchetty Ashutosh Rao; Madasi Surya Teja; Nakka Teja Sai Pavan; Bendalam Sai Krishna; Dharmana Raviteja, Year: 2020, “Shop GO: An IoT based solution for smart shopping”, In 2020 International Conference on Computer Science, Engineering and Applications (ICCSEA), pp. 1– 6.

23. Rajeev Ratna Vallabhuni; S.

Lakshmanachari; G. Avanthi; Vallabhuni Vijay,
Year: 2020, "Smart cart shopping system with an
RFID interface for human assistance", In 2020
3rd International Conference on Intelligent
Sustainable Systems (ICISS), pp. 165– 169.

24. S. Patel; N. Patel, R. Shah, Year: 2021, “IoT-
Based Surveillance Systems for Enhanced
Security”, Safety Science, Vol: 137, pp. 105182.