

Secure and IoT-powered Smart Shopping Trolley for Enhanced Customer Experience

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ABSTRACT

Technology has changed so much, so is the rate of people of all ages who are attracted to electronic gadgets. In many industries, electronic devices such as smart card readers, barcodes, and RFID scanners are increasingly used. Supermarkets also need these kinds of gadgets. Currently, every person in the mall purchases the product placed in the trolley. Upon purchase, the person will have to stand in a queue for billing. In the billing process, an employee scan search product's barcode and bills it to the final. This process can take a lot of time and it can be even worse on holidays, special offers or weekends. To overcome this, a smart way to shop in malls has been developed. Each product has an RFID tag instead of a barcode. The Smart Trolley features an RFID reader, LCD and Esp8266 Module. When a person places any product on the trolley, it is scanned and the product's cost, name, and expiration date are displayed. The total cost will be added to the final check out bill. The bill is stored in the microcontroller's memory and transfer through Esp8266 module for counter checkup through android application. Once the purchase is complete, the customer can pay the bill through cash or digital payments. Arduino IDE software tool is used for programming and Proteus software is used to check simulation results before hardware implementation.

Keywords: Smart trolley, RFID reader, LCD, Android application, Arduino, RFID tag.

1. INTRODUCTION

Shopping is easy, but waiting at the bill counter can be very boring & laborious. Rush plus cashiers who prepare a bill with a barcode scanner take longer & have longer-lasting results. This innovative project includes an automated billing system that can be placed in a shopping trolley. This automated payment system includes an RFID reader controlled by Arduino instead of the traditional barcode readers. so, whenever the shopper goes shopping, he/she has to scan the barcode of the product card against the RFID reader attached to the cart. Therefore, all the required product details will be transferred to the micro controller's memory. Then a welcome text with account balance details is displayed on the LCD screen.

Any product, he/she has to scan it against the RFID reader & then has to get it into the cart. All the product details are displayed on the LCD along with the price of the product. As the shopper goes on adding products, every product is detected by the module & therefore the price will increase accordingly. In case if the shopper changes his/her mind & doesn't want any product added into the trolley, he/she can remove it by scanning the same product once again against the reader & the price added will be deducted automatically. A buzzer is used to verify whether the product is scanned is successful or not. Buzzer beeps once the product scanning is successful. At the end when customer done the final bill details will be displayed on the LCD screen. Immediately after the bill is paid an SMS is sent to the prescribed members mobile phone via GSM module. Hence this technique is an appropriate

method to be used in places like supermarkets. This will help in reducing manpower & helps in making a better shopping experience for customers. The advent of wireless technology along with the other communication techniques help in making e-commerce very popular. Smart shopping trolleys incorporate technology to enhance the shopping experience. They often feature RFID technology for tracking items, touchscreen displays for navigation, and may even assist in making purchase decisions or finding product locations in the store. These innovations aim to streamline the shopping process and provide customers with a more interactive and efficient shopping journey. Modern futuristic product is the one that aids the comfort, convenience and efficiency in everyday life. In this project, we discuss an innovative concept of RFID Based Smart Shopping and Billing System. The main goal is to provide a technology oriented, low-cost, easily scalable, and rugged system for aiding shopping in person. The smart shopping trolley will help shorten the checkout lines thereby helping the customers at retail stores. The System consists of an RFID based trolley which communicates with the billing counter wirelessly using a ZigBee Transmitter (nrf24L01). Each trolley will consist of a similar type of hardware with unique trolley address. The developed system comprises of User Interface and Display Unit (UIDU) and Billing and Inventory Management Unit (BIMU). The customers will be able to scan the items themselves and the LCD screen on the shopping cart will keep updating the total. The billing counter can at any point of time inquire about the current items present in the trolley. This will turn out to be very beneficial for the retail stores as more people will enjoy the shopping experience and come more often to shop. The System consists of an RFID based trolley which communicates with the billing counter wirelessly using a ZigBee Transmitter (nrf24L01). Each trolley will consist of a similar type of hardware with unique trolley address. The developed system comprises of User Interface and Display Unit (UIDU) and Billing and Inventory Management Unit (BIMU). The customers will be able to scan the items themselves and the LCD screen on the shopping cart will keep updating the total. The billing counter can at any point of time inquire about the current items present in the trolley. This will turn out to be very beneficial for the retail stores as more people will enjoy the shopping experience and come more often to shop. In the proposed system, we are using the RFID reader at the trolley side and every product in the supermarket has its unique RFID tag with unique ID. Once the customer drops a certain product in the trolley, then the tag attached to that product was read by the RFID reader and sent to the controller. The controller counts the product value and displays its value on the LCD screen of the trolley. Like that we can add any number of products of our need and check the total bill on the LCD screen.

2. LITERATURE SURVEY

As per our knowledge only few papers were found in the literature for the automated shopping trolley for supermarket using RFID. The automated shopping trolley for supermarket billing system implemented by Sainath (2017), exploited barcode for billing of products, where customer scans the product using barcode technology. The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of barcode scanning requires line of sight for scanning and it should be fixed within its boundary. Cash register lines optimization system using RFID technology by Budic (2017), developed a system for shopping using RFID. The RFID is employed for scanning products and the information is stored in the database which could be paid online or in a central bill. It also uses web application to maintain entire shopping details. It requires maintenance of web application server. No necessary steps have been taken for the products that are accidentally dropped into the trolley by the customer. IOT based intelligent trolley for shopping mall by Dhavale Shraddha (2018), applied RFID technology for billing during purchase in shopping malls and IOT is used for bill management by means of ESP module. The payment details will be sent to the

server by which central billing unit will deal with customer's payment. The ESP module will be working as a short distance Wi-Fi chip for wireless communication. But there is a drawback which includes constraints such as distance and interference. Server will be busy if customers are high and internet connectivity should be stable for finishing the process. Smart shopping trolley using RFID by Komal Ambekar (2018), implemented smart way of shopping trolley with RFID and ZigBee by which bill is generated by scan of products in the reader and bill transmitted to central billing department by which bill can be paid at the counter which is a major difficulty for the customer. Smart shopping cart with customer-oriented service by Hsin-Han Chiang (2019), accomplished a concept of automated shopping trolley with automated billing where they used face recognition for customer authentication. It is not a simple process as face recognition of customers during shopping hours will not be easy and accurate as malls can be crowded. Many errors are possible while using recognition for authentication. Smart RFID based Interactive Kiosk Cart using wireless sensor node by Narayana Swamy (2019), applied RFID for automated shopping.

They used dedicated website for billing maintenance and for user interaction. Every user with the unique id accesses the webserver for the bill payment and invoice information. Internet service is mandatory in this type of service. So, the process may fail due to internet instability and server error problems may also occur due to high load. Shopping and automatic billing using RFID technology by Vinutha (2020), has an automatic billing with server end. This scans products by radio frequency identification and then the bill is generated at the server end which is then communicated to the customer. This requires server maintenance and internet connectivity both for the customer and shopkeeper. Smart shopping cart with automatic billing and Bluetooth proposed by Prateek Aryan (2021), is a process where billing is done in a trolley and transferred to the android mobile of the user via Bluetooth. Every customer can't be expected to have a smart phone and Bluetooth can have connectivity issues and range is less. Automated smart trolley with smart billing using Arduino by Suganya (2022), developed a model of automatic shopping with Arduino and an android application which again requires network to be connected always. Android operated mobiles may or may not be present with every customer. Network instability leads to delay in the billing, RFID enabled smart billing system by Vanitha Sheeba and Brindha Rajkumari (2023), did a concept model consists of RFID and ZigBee which transmits generated bill to the server and then the bill is collected by the worker in the bill counter by identifying customers. But this again will lead to queue for billing since only bill generation is alone automated by scanning using RFID. Our idea has a stable and simple billing process of making payment in the trolley itself. Since it avoids the requirement of Wi-Fi, ZigBee, ESP module and others which is used above. It can be paid using customer card or the ATM card. Above concepts don't ensure security and theft of products either intentionally or accidentally. We used door by which products cannot be dropped without scanning by the customer. We also have used separate IR sensor to avoid the accidental dropping of products. To make it more effective we used code logic which correlates the IR count and RF count in the microcontroller. For security we installed password authentication feature by which each customer possesses unique card with unique password. Barcode technology is replaced by RFID in our system which gives fast and accurate scanning of products.

3. EXISTING SYSTEM

In existing system, customer will not know the amount of total purchase, until he went to the counter for paying bill. One can remove certain product, once he approaches to the counter, where he decides which product should be reverted back. To avoid these types of troubles, we develop a smart trolley, where one can know the total bill of the products purchased and bill amount is also sent to the billing section wirelessly. If the product is already Scanned there is no cancellation of the product. There should

be a delete button to remove the product if the customer doesn't want the product anymore. In our smart trolley we are implementing a delete button to remove the product. There will be no weighing scale to check the weight of the products to compare with weight displayed on the Lcd it will verifies both weight there may be chance of customer not scanning the product and putting it in the trolley.

4. PROPOSED SYSTEM

An RFID tag (of frequency 125khz) is attached to every product in the mall and the reader (EM- 18) is attached to the trolley. At the time of purchase, the tag attached to the product is scanned by the reader. Each tag has a unique EPC. Based on the EPC received by the Arduino, the information of the product is displayed on the LCD along with the updated cost. This information is also sent to central PC with the help of HC-05 Bluetooth transmitter at the trolley and HC-05 receiver at android phone using Bluetooth application. If the customer wants to remove the added product, the product can be removed by pressing remove button. Then the cost of the corresponding product will be deducted from the bill. The push button is provided at the trolley to indicate the end of the shopping. On pressing of push button, the final bill is displayed on the LCD display. Customer can pay the bill through manually or can make payment using digital payments.

Working operation

Step 1: Start

Step 2: When the system is powered up display the initial data.

Step 3: Scanning the RFID tag of the product.

Step 4: Now the product scanning process is ready. If the scanned product code is detected, display all the product details on the LCD screen. If not, the product has to be scanned until it gets detected. This process applies to each & every product.

Step 5: If a scanned product is scanned once again then that product is removed from the microcontroller's memory & in the ongoing bill.

Step 6: Finally, if the card is successfully scanned, then the complete bill summary is displayed on the LCD.

Step 7: After pressing the push Button, the final bill will be displayed, an SMS is sent to the prescribed customers mobile phone via a GSM module regarding the shopping details.

Step 8: Stop.

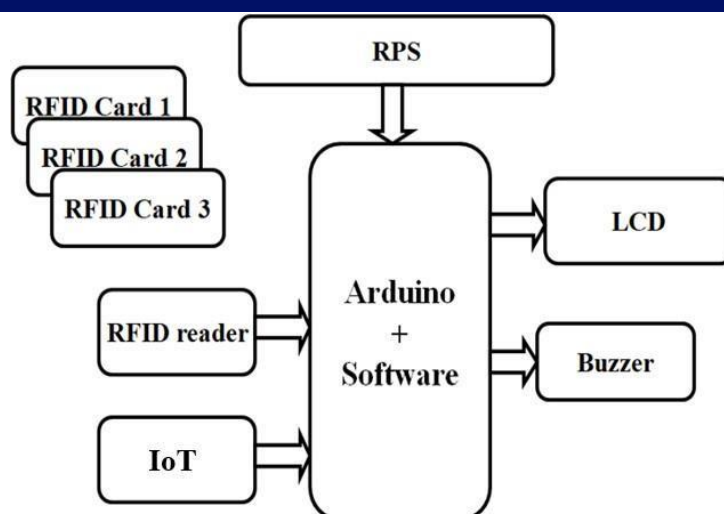


Fig.1: Block diagram.

As shown in the above block diagram, the Arduino is interfaced with all the remaining components. Once the microcontroller is powered up with the use of a 9v battery it is initialized and set to the basic settings, now the system is ready to proceed which means the RFID card and the tag can be scanned. Then the RFID card or tag is scanned the RFID reader fetches all the details from the scanned card or tag, and if the scanning process is successful the product details will be transferred to the microcontroller's memory and then will be transferred to the LCD module to be displayed on the LCD screen. Here the RFID module uses the SPI communication technique to transfer or to retrieve the data from the RFID card or tag. After the shopping is completed the entire bill details will be displayed on the LCD screen, each card or tag acts as a product, where the product details are pre early set or dumped into the card. When the bill amount is paid, the shopping details will be sent via the sim900 GSM module to the prescribed customer's mobile number. The entire working process is implemented by the software called Arduino IDE. The Proteus simulation software is used to check the simulation results before hardware implements.

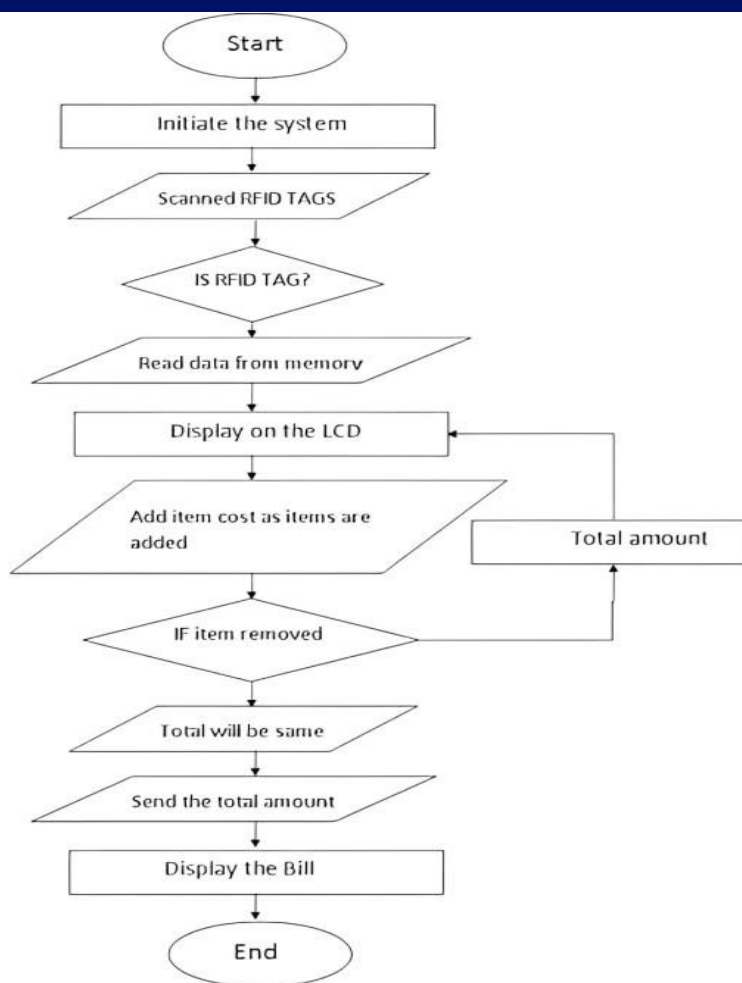


Fig. 2: Flow diagram

Functionality

Initially, we will connect the smart shopping trolley system to mobile through an app with the connection medium using WIFI. when the product RFID tag is scanned the RFID Scanner will read the data of RFID tag and displays the tag data on the LCD. The tag data contains product name and its price. As we keep on adding the product tags the lcd will display the name of the product and keep on adding the price of the products and gives the total amount of the bill. If any product is invalid the buzzer will give beep sound. The app is also updated with bill after scanning the products. After scanning all the required products customer can pay the final bill through digital payments or cash.

5. HARDWARE IMPLEMENTATION

This is the pin diagram where all the hardware components are connected components. This ARDUINO microcontroller having 28 pins. In which 14 GPIO pins as digital pins and 6 GPIO pins. 16MHz crystal oscillator connected internally. The step- down transformer, Bridge rectifier capacitor with 1000f Resisters and led are connected in Regulated power supply which provide the 5v to the Arduino and all input/output modules.

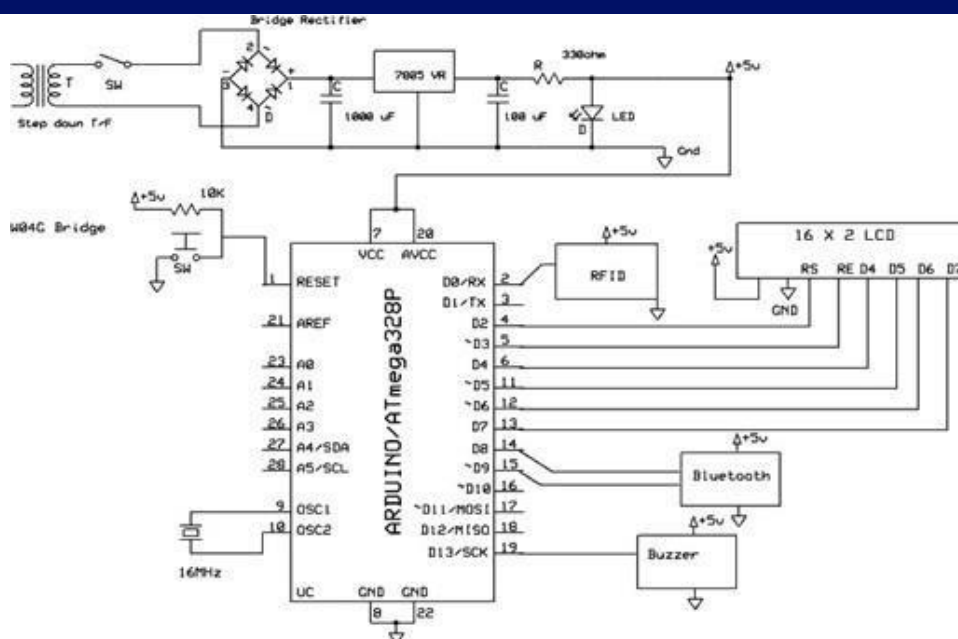
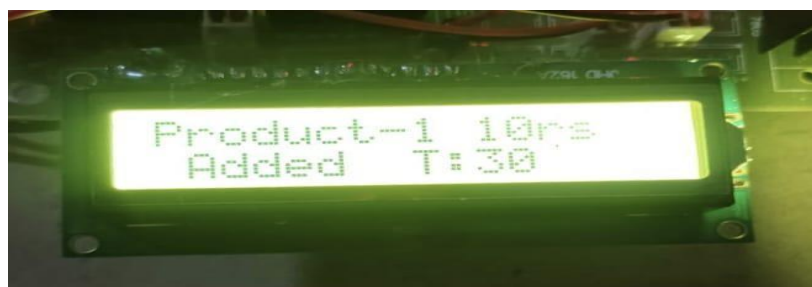
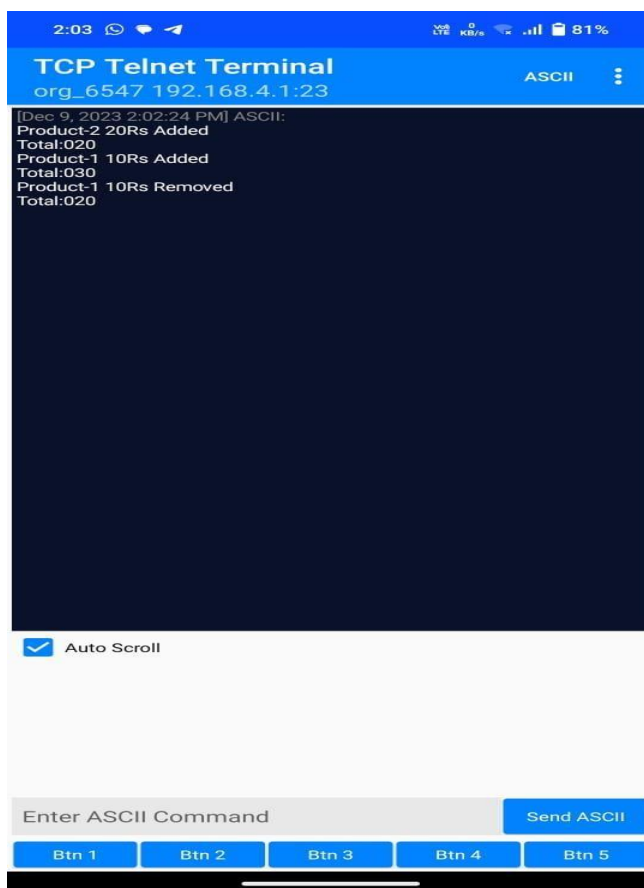


Fig. 3: Schematic diagram.

- 16*2 LCD Monitor has connected with the Digital pins 2, 3, 4,5,6,7.
- WIFI has connected to Digital Pins D0, D1 internal Transmitter and receiver pins. Enroll and identify switches connected to A0, A1 pins of the Arduino micro controller. Ignition switch connected to A2 pins of the Arduino micro controller.
- Vibration sensor connected to A3 pins of the Arduino micro controller. GPS connected to A4 pins of the Arduino micro controller.
- Keypad switches connected to A5,13 pins of the Arduino micro controller.





6. CONCLUSION

The progression in science & technology development is an unstoppable process. Now & then evolution changing technologies are being invented. We cannot imagine the upcoming future in which technology may occupy each & every place. This innovative project idea can be used in places like shopping complexes, supermarkets & malls to purchase the products. Here RFID cards are used to securely access every product in shopping places. If a product is scanned & put into the cart, all the required details of the product will be displayed on the LCD screen as well as display in android Bluetooth app for easy billing system at counter. Therefore, an RFID tag/card is used for accessing the products. Hence this project will help in improving the security & also the shopping time can be reduced. It also provides an enjoyable & user-friendly shopping experience to the customer. The future scope of clever purchasing trolleys holds significant capacity as generation continues to boost.

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