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Embedded System for Autonomous Shopping Carts with Android IoT App for Social Distance Shopping

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ABSTRACT
Technology has transformed how much individuals of all ages like technological equipment. Smart card readers, barcodes, and RFID scanners are employed in numerous industries. Supermarkets need these tools too. Everyone in the mall buys the trolley merchandise. After buying, the person must wait for billing. A worker scans each product's barcode and bills it to the final. Holidays, special discounts, and weekends can make this procedure even longer. Mall shopping has been made smarter to overcome this. Each product has an RFID tag instead of barcode. RFID, LCD, and IOT modules are in the Smart Trolley. Any product placed on the trolley is scanned and its cost, name, and expiration date are shown. The whole cost will be applied to the final bill. The bill is stored in the microcontroller's memory and transferred via IOT module for android app counter checkup. The IOT module sends the customer purchase details after the purchase. The central android application receives this information from the trolley's IOT transmitter and the phone's IOT receiver via Telnet. To remove an added product, scan it again. The charge will be reduced by the product's cost. Programming is done with Raspberry pi IDE and simulation is checked with Proteus before hardware implementation.

Keywords: Social Distance Shopping, Auto Cart, Android IOT, RFID Reader.

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 Raspberry pi instead of the traditional barcode readers. A unique membership card is provided to every customer where all the personal details & the account balance details of the customer are stored. The shoppers can deposit cash in counters before shopping, balance & other details will be updated whenever the shopper deposits cash at the billing counter. so, whenever the shopper goes shopping, he/she has to scan the special membership card against the RFID reader attached to the cart. Therefore, all the required personal details will be transferred to the microcontroller's memory. Then a welcome text with account balance details is displayed on the LCD screen. Now the system will be ready to start scanning
the products. 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 membership card/product scanning is successful or not. Buzzer beeps once the product scanning is successful. At the end of shopping, the shopper has to scan the membership card, when done the final bill details will be displayed on the LCD screen. The bill amount will be deducted from the membership card & the remaining balance amount will be displayed. 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. 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.

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. After completion of the shopping, one should press the upload button at the trolley side to send the bill amount to the counter section over the Bluetooth communication module. The bill amount was received by the Bluetooth receiver and send to the PC to display in the Hyper Terminal.

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 (2014), 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 (2014), 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 (2016), 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 KomalAmbekar (2015), 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 (2016), 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 (2016), 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 (2014), 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 (2014), 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 Raspberry pi by Suganya (2016), developed a model of automatic shopping with Raspberry pi 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 (2015), 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 doesn'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. PROPOSED SYSTEM

The proposed system is a new and improved way of doing things. It suggests using a smart shopping cart that automatically calculates the prices of items as you shop. This means no waiting in long lines at the checkout. The system also keeps track of the store's inventory in real-time, ensuring that products are available when needed. Additionally, it gathers information about what customers buy, helping the store make better decisions about what to stock and how to improve the shopping experience. It's like upgrading the traditional shopping process to be faster, more efficient, and tailored to what customers want**.**

Working description:

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 Raspberry pi, 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 should be scanned again. 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 and the payment through recharged card can be done. Recharged cards are unique RFID tags provided for each customer. These cards contain the information such as the customer identification number and the balance available in the card.by scanning recharged cards, payment is done at the trolley itself. Finally, LCD shows the balance available in their card. This whole information is available on Bluetooth android app

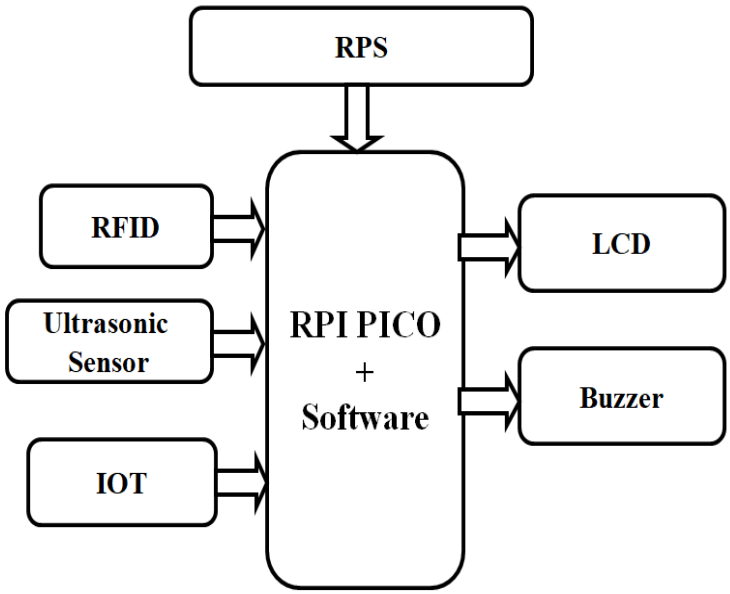


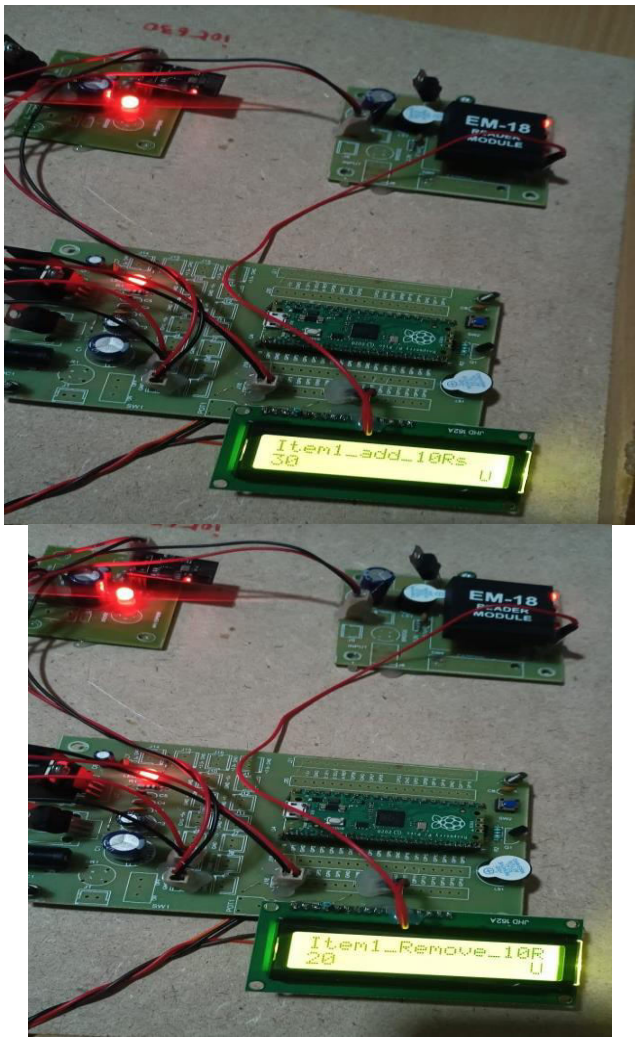
Fig.1.Block diagram

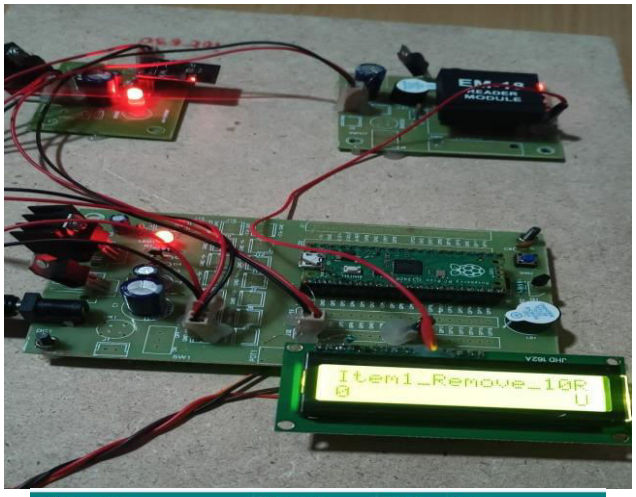
As shown in the above block diagram, the Raspberry pi is interfaced with all the remaining components. Once the microcontroller is powered up with the use of a 9v battery it is initialized and set to the basic settings, now the system is ready to proceed which means the RFID card and the tag can be scanned. 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 Raspberry pi IDE. The Proteus simulation software is used to check the simulation results before the hardware implementations.

Step 1: Start
Step 2: When the system is powered up, display the initial data.
Step 3: Scanning of the RFID membership card.
Step 4: If the membership card scan is successful fetch all the personal details & display it on the LCD. If not, scan the membership card once again. Loop repeats until the scanning process is successful.
Step 5: 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 6: If a scanned product is scanned once again then that product is removed from the microcontroller's memory & in the ongoing bill.
Step 7: Finally, to end the shopping, the shopper has to scan the Membership card. If the card is successfully scanned, then the complete bill summary is displayed on the LCD.
Step 8: Immediately after the bill amount is deducted from the card, an SMS is sent to the prescribed shopper's mobile phone via a GSM module regarding the shopping details.
Step 9: Stop.
Step 10: Repeat the entire process if another membership card is scanned & detected.

4. RESULT





Item_status	Ultrasonic	Total	Date
Item1_add_10Rs	43	30	2024-01-24 12:26:22
Item2_add_20Rs	43	20	2024-01-24 12:26:08
Item2_add_20Rs	43	30	2024-01-24 12:22:42
Item2_Remove_20Rs	43	10	2024-01-24 12:22:06
	43	30	2024-01-24 12:21:49
Item2_add_20Rs	43	30	2024-01-24 12:21:32
Item2_Remove_20Rs	43	10	2024-01-24 12:20:55
Item2_add_20Rs	44	30	2024-01-24 12:19:29
Item1_add_10Rs	44	10	2024-01-24 12:19:12
Item1_Remove_10Rs	16	0	2024-01-24 12:16:24
Item1_add_10Rs	46	10	2024-01-24 12:15:05
Item1_add_10Rs	169	10	2024-01-23 16:41:06
Item2_Remove_20Rs	169	0	2024-01-23 16:40:47
Item2_add_20Rs	193	20	2024-01-23 16:40:14
Item2_Remove_20Rs	186	0	2024-01-22 19:33:59
Item1_Remove_10Rs	180	20	2024-01-22 19:33:13
Item1_add_10Rs	180	30	2024-01-22 19:32:49
Item2_add_20Rs	181	20	2024-01-22 19:32:30

RFID Module will sense the RFID tag of item and displays the quantity, price and total amount of product on LCD display. If we remove any item from trolley item's price, quantity is removed LCD display. Here in the above result, we have added one quantity to trolley, RFID sensed item and displayed as quantity 1, price Rs.10, total 10. If we remove item from trolley RFID again senses and displays as quantity 0, price 0, total 0.

5. CONCLUSION

In conclusion, the smart trolley with an IOT-based billing system utilizing Raspberry Pi offers a streamlined and efficient shopping experience. In this way, we created a user-friendly system that is quite beneficial in the real world. In simpler terms, creating a smart shopping cart with an IoT-based billing system using Raspberry Pi is like making shopping easier and faster. It lets you move around the store with a special cart that keeps track of what you put in it. The cart automatically adds up the prices, so you don't have to wait in line to pay at the end. This means you spend less time at the checkout, and the system helps the store keep track of what they have in stock. The benefits include quicker and more enjoyable shopping, no long lines, accurate and transparent bills, and the store can learn about what people like to buy.

Despite the success, there might be some challenges to improve, like making the system even easier to use or ensuring everything stays secure. Overall, it's a step forward in making shopping more convenient and efficient.

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