

SMART SHOPPING SYSTEM USING IoT

Nandini V S¹, Navya Shree Y², Vaishnavi Priya J P³, Priyanka S⁴, Shubha Kulkarni⁵

¹Electrical & Electronics Engineering, DSCE

²Electrical & Electronics Engineering, DSCE

³Electrical & Electronics Engineering, DSCE

⁴Electrical & Electronics Engineering, DSCE

⁵Electrical & Electronics Engineering, DSCE

Abstract - The IoT is changing human lives by connecting every objects every day. Exciting cases and products can be developed by interconnecting these objects with the Internet. A Smart Shopping is one among them. Nowadays shopping has become a part of our daily activities. Customers spend a lot of time for purchasing a right item. After done with the shopping, it is required to stand in a long queue for billing purpose. So, lots of time is required for each individual due to existing barcode technology. The core objective of this paper is to improve the shopping experience of customers by reducing the time consumption during the checkout process. In this system, every product will be incorporated with RFID tag and every cart is attached with RFID reader and Zigbee. When product is placed in cart it reads the RFID tag and price, name of the products will be displayed on the LCD screen. Total items and Total cost will be displayed on LCD as well as s sent to billing counter and android application in mobile. Bill can be paid via application without actually having to wait in a long queue for checkout process.

The present Shopping environment is classified as below

- Shopping in-person
- Shopping in absentia

Shopping in absentia is supported in various ways together with Online shopping, teleshopping, etc. wherein a customer does not have to be physically present in the marts. Shopping in-person is nothing but a physical visit to the place and choosing the items based on numerous elements.



Fig 1 Shopping Environment

Keywords- Zigbee, RFID, IoT, Android application, Smart Shopping,.

I. INTRODUCTION

Evolution of net began by connecting computers. Later several computers were connected along that created World Wide net. Then mobile devices were able to connect with the web that ends up in mobile-Internet technique. Folks started utilizing the web via social networks. Finally the thought of connecting daily objects to the web was put forward, that led to the Internet of Things technology (IoT) [1].

INTERNET of Things (IOT) is the network of objects embedded with RFID, embedded systems, sensors and package that allow objects to assemble and exchange knowledge for a typical goal. Management, wireless communications, and period of time higher cognitive process. Human beings have consistently developed technology to support their essentials ever since the origin of humankind.

The fundamental purpose of this technology, irrespective of its state, has simplified tasks and made every task uncomplicated and quicker. A sizeable number of customers will walk out from mart if the line is too lengthy.[2]

II. LITERATURE SURVEY

In the year 2013, Raju Kumar proposed an idea based on 'Intelligent smart cart'. His main objective was to design an intelligent shopping cart which can be used in supermarkets, where each item will be will attached with RFID tag to identify particular product.[5] This cart will also have LCD display placed on to the cart will update customers about number of products and their net bill.

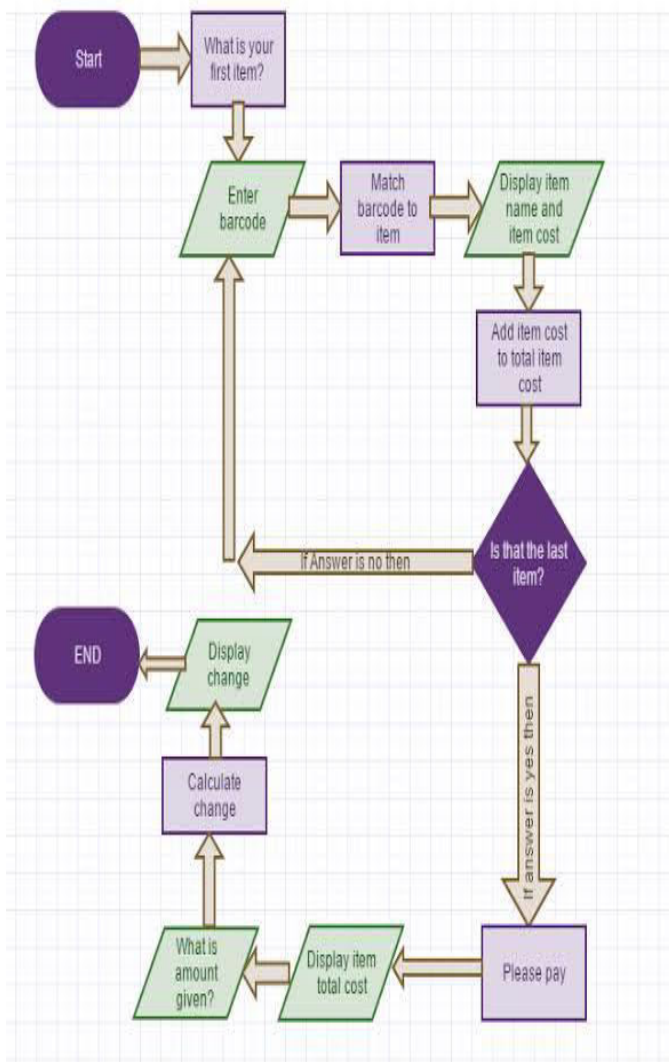
A paper proposed by Zeeshan Ali, 'RFID Based Smart Shopping and Billing' described about developing a smart cart system with the help of navigation. Zeeshan Ali's proposed paper describes the implementation of smart shelves. When the smart trolley enters into the shop, product data is delivered to the carts using IR technology.[6]

The Proposed system is based on 4 important technologies: Infrared sensors used for dynamic location detection and tracking, RFID tags for product identification, Zig-Bee for having wireless communication with Server, and integrating system with LCD display for billing and inventory management.

III. EXISTING SYSTEM

Every product present in the cart is attached with the barcode that has its own Unique ID. These unique ID's are stored in the server. If a purchase has to be done, product has to be scanned against barcode scanner where it reads the tag and that item can be placed in the cart.

The details of the each item is read and displayed on the LCD screen. Simultaneously bill also gets updated and server also feed the same data in the database. This process gets repeated once it is finished customer can press the complete button. Once the "Complete" button is pressed there is an option provided to the customer whether to complete the shopping with the same items purchased or to remove some items from the cart. This is entirely based on the customer's choice. After done with the shopping, the customer can pay the bill at the counter and leave the mart.



FLOW CHART OF EXISTING SYSTEM

Challenges of present system

- Scanning the info of each item is very time consuming.
- Consumers are required to estimate total sum to be paid manually to verify.
- Consumers have to wait in a long queue for the billing purpose.
- Barcode scanners require an inline vision of the barcode to read clearly.
- In order to read the barcode present on each item, the barcode scanner has to be in the range less than 10ft.
- In the current system, bar codes that is been used are for skimming the product data where the consumers have to wait in long row for taking the bill monitored by system.

BARCODE (existing technology)	RFID (proposed technology)
a) Person is required to read barcode on product.	a) Automatic reading of RFID tag from product.
b) Barcode must be visible on the surface of product.	b) RFID can be placed inside the product.
c) Line of sight required to a read barcode.	c) No line of sight required to read RFID.
d) The readability of barcodes can be impaired by dirt, moisture, abrasion, or packaging contours	d) RFID tags are not affected by such conditions.
e) Short reading distance.	e) Long reading distance.
f) Barcode does not have READ & WRITE capability.	f) RFID tag having READ & WRITE capability.

Comparison between BARCODE & RFID Technology

IV. PROPOSED RFID TECHNOLOGY

From the past 10 years the use of RFID has been developing swiftly all round the globe. All over, the retailers are rapidly increasing the use of RFID technology into their markets in order to enhance the customers experience in shopping. RFID technology uses radio waves to trace and transfer information with efficiency without humans aid. [3]

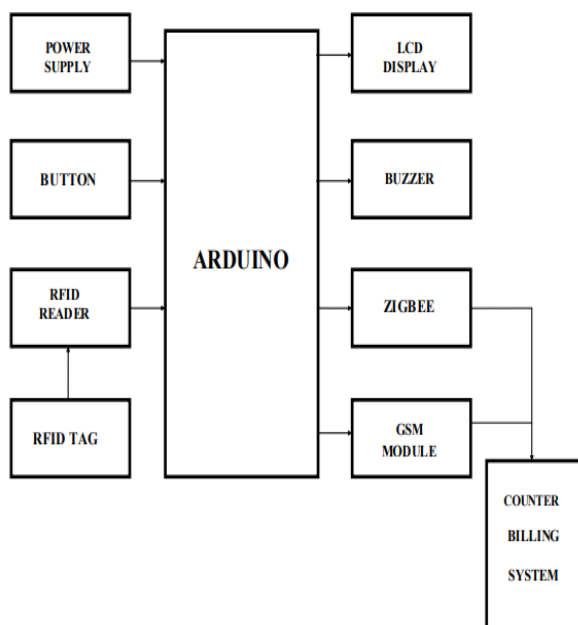
RFID-based system collects information regarding a specific item just by viewing its tag, thereby sends the relevant data to system. RFID-Readers will be able communicate, view the tags and trace the products within the coverage area[9]. Tag detection does not require people help thereby reducing the cost to be paid to every employees as salary and human errors while fetching data.[10]

In recent times, barcode-based system is been used in most of the marts, supermarkets wherein each item is attached with a barcode label and its related data is stored in the server.

To perform inventory control, any person is supposed to scan the barcode that is present on particular item and compare them with the inventory list. But this process is more prone to errors and also lengthy thus it is performed less frequently. The implementation of barcode technology is limited in terms of functionalities leads to need of RFID technology to provide a solution to the mentioned problem.

RFID is turning into desirable technology as an alternate to barcode systems. These RFID systems provide us the method that automatically identifies the product and also stores and retrieves by using RFID tags. An RFID tag can be linked to or integrated within a product which would be more helpful for the identification purpose using radio waves..

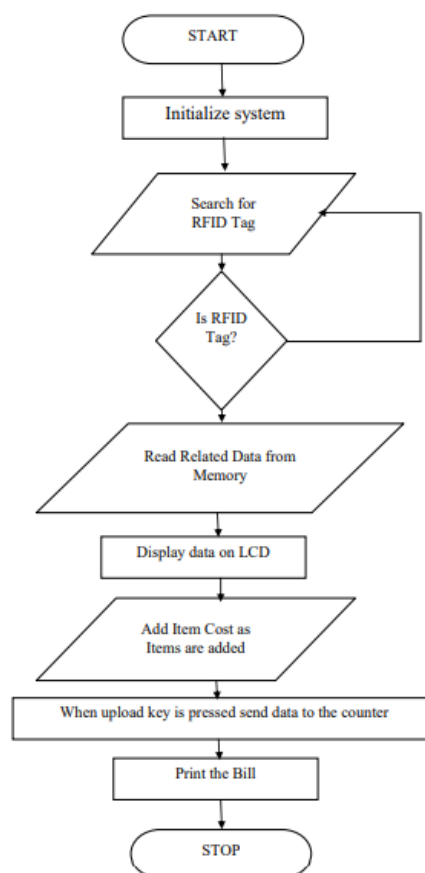
V. BLOCK DIAGRAM



- **Power supply**-It is used to power the whole components present
- **RFID reader**- It is used to read the data's present in the RFID tag.
- **LCD Display**- It Displays the item name, cost and the total amount of all the items.
- **Buzzer**- A buzzer is interfaced with an arduino used to give a beep sound while scanning the products.
- **Push Button**- After we are done with the shopping, we can a press a button saying to generate the bill.
- **Zigbee**- It is used for wireless communication between smart cart and smart cart after done with the shopping the data will be send to Central Billing System through ZigBee module.
- **GSM Module**- It is used to send the final bill to the customer's Phone.

VI. WORKING PRINCIPLE

The main intension behind this system is to come up with an automated and centralized billing system. Each item present in every shopping mall, super markets will be attached with an RFID tag which has its own unique ID, to identify its type. These Unique ID's are stored in the server that are assigned to the corresponding items present in the mall or supermarkets. Every cart is attached with a Arduino board, LCD display, an EM-18 RFID reader, Zigbee module, GSM module, Buzzer, and Buttons.



FLOW CHART OF PROPOSED SYSTEM

When the purchase has to be done, the customer can drop the product into the cart by scanning the product against the RFID reader. RFID reader fetches all the details from the scanned RFID card or tag, and if the scanning process is successful the product details will be transmitted to the Aurdino's memory and then the product name, it's individual cost and its info will be displayed on the LCD screen. If the budget level of customer is low, he can remove the required products from the cart by press hold the button and scan those products again and simultaneously the bill get's updated.

The total cost will be displayed on the LCD display as well as on the system. This process is repeated until 'Complete button' is pressed.

Once the shopping is completed, customer can press the 'complete button' present on the cart. Thus, the final bill will be sent to the billing side system with the help of Zigbee for further payment process. When the payment is done, the shopping details ie the bill will be sent via the sim900 GSM module to the prescribed customer's mobile number.

Main advantage of our proposed system is that customers need not to wait in the long queue for receiving the bill instead the billing information is sent to prescribed customer's phone number. Thus, the customers can straight away pay the bill either through online or offline mode and leave the store happily.

VII. TESTING

UNIT TESTING

Unit testing is a first level of software testing where each components of software are tested to validate that each component performs as designed can be done by having one or a few inputs and usually a single output.

FUNCTIONAL TESTING

Functional Testing is a next level in testing methods that is used to test the functionality of the system. In our project, testing of RFID reader and Zigbee module is done by connecting both to the computer separately using USB to UART port converter.

Testing of RFID reader

Number of tests carried	Tags read Successfully	Tags failed to read
6	6	0

Testing of Zigbee transmission

Number Of tests	Sent	Received	Failed
7	6	5	1

INTEGRATION TESTING

In our proposed system, the RFID tags which are individually tested in functionality test are then integrated with LCD display, EM-18 RFID reader, Zigbee module and their working is tested. Similarly, every unit or module is integrated and tested.

SYSTEM TESTING

System testing of software or hardware is the testing that is conducted on a complete integrated system to validate the

system's compliance whether it meets it's specified requirements.

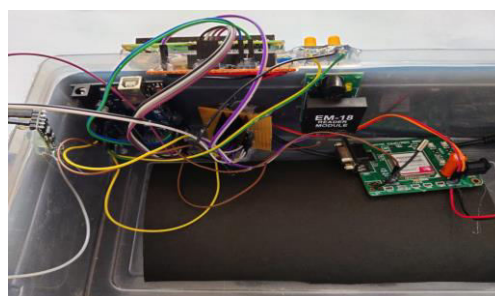
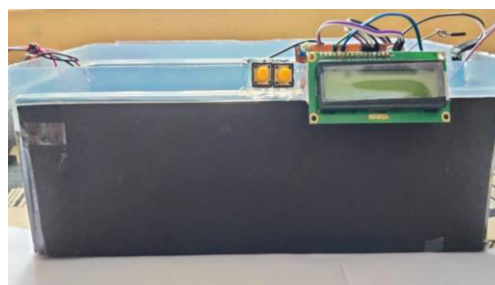
PERFORMANCE TESTING

Performance testing is a kind of non-functional testing that is carried out to examine the proposed system parameters in terms of its stability and responsiveness and also it is used to measure the quality attributes of the system.

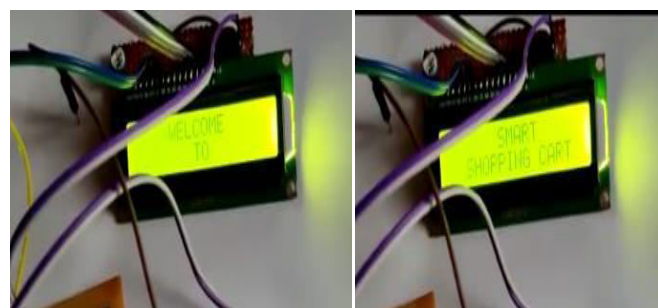
ACCEPTANCE TESTING

Acceptance testing is also a kind of testing technique used to check whether the software has met the desired and required specifications. The main purpose of this test is to verify that if it has met the required criteria so that it can be implemented and delivered to its end users

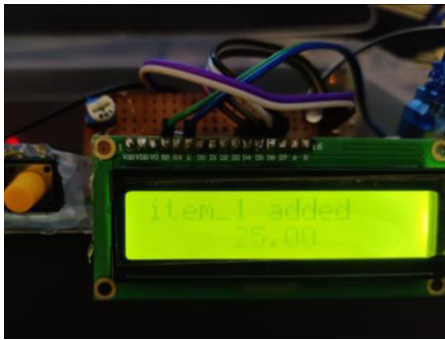
VIII. RESULTS



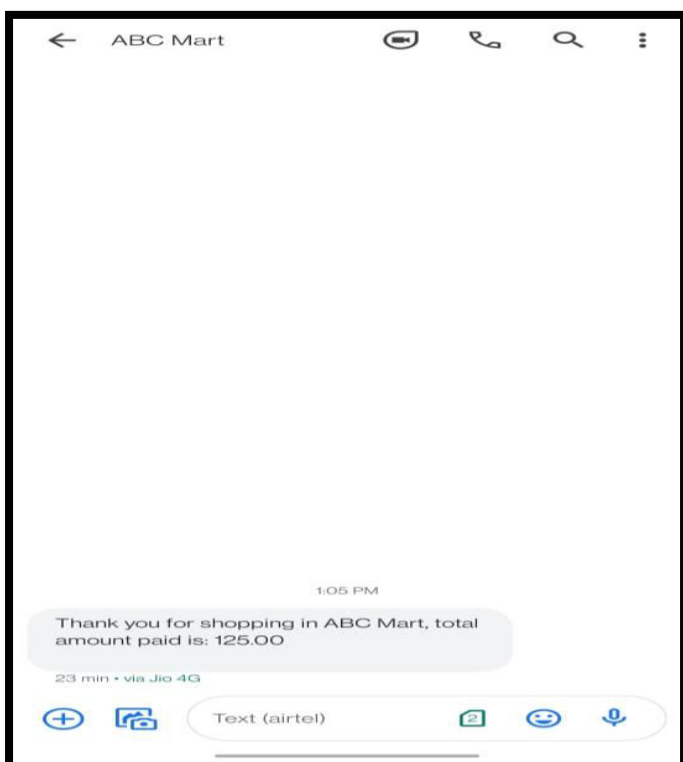
Below Figure is executed when the LCD Display is powered



When the item1 is scanned against the EM-18 reader, the item name and its individual cost gets displayed on the LCD Screen. Similarly, when other items are removed or scanned its name and cost gets displayed on the screen as shown.



When customer is done with the shopping, 'Complete Button' present next to LCD Screen has to be pressed to generate the final bill. The total amount gets displayed on the LCD Screen as shown in above figure. This billing information is sent from the cart to Billing counter with the help of Zigbee module. Here, the customer can make their payments either via online or cash.



The biggest advantage in our proposed system is that customer no longer needs to wait in the huge queue to receive the computerized bill. Instead we have made use of a SIM900A GSM Module to send the billing information to the prescribed customer's mobile phone.

Hence, the customer can view the bill at anytime in their mobile phone and can leave the mart or supermarket happily. This would never dull the customer experience in shopping.

ADVANTAGES AND DISADVANTAGES

Advantages:

- More beneficial at the time of Current Pandemic situation.
- RFID based system do not require direct line of sight to read the tag
- Reduces the employment costs and eliminates human errors.
- Customer no longer need to wait in long queues at the checkout point for the generation of bill
- More efficient due to use of RFID as it has longer range than Barcode system.
- Can View the Billing information anytime in the mobile.

Disadvantages:

- A smart shopping system mainly depends on RFID technology, Zig-Bee, and micro-controller. For having such a system, each and every product in the store should be attached with an RFID tag. Due to this, implementation of such an efficient system into reality is quite expensive.
- When customer is done with the shopping, examining the bill along with the purchased products may be again required for cross checking.
- As it is an electronic based smart cart, regular maintenance and battery replacements is required whenever necessary.

APPLICATIONS

- This type of RFID technology is most commonly used in shopping mall, supermarkets or marts for automatic billing.
- Can be used as a common observatory system for the retailers as he/she can observe billing of all mall, supermarkets from anyplace.
- Manufacturing and Processing
- Supply Chain Management

- Retail Sectors
- Security
- Location Tracking

CONCLUSION

In this smart world, Internet of Things is a biggest milestone that connects various objects in a network. Internet of things gives the experience of seventh sense to the world and it is one of the leading technologies. This Smart way of shopping will help customers to shop efficiently. The Smart shopping cart helps us to save the time during the checkout process, which is considered to be one of the major advantage of this System. Here a new feature is implemented where he/she are supposed to scan the purchased product and bill will be generated automatically. An interesting feature is that in this smart shopping cart, the cart to cart communication can also be built. Thus it helps the customer to shop with their friends and family also.

As we opt for this smart shopping cart, shopping can be done effectively and efficiently which saves the time of both retailer and customer during billing. Also, thefts can be reduced in the Shopping malls and hence leads to cost efficient. In this very short time more customers can be served thus benefitting both customers and retailers.

FUTURE SCOPE

Our proposed smart shopping system using IoT can be further improvised and its overall cost can also be reduced. A smart lane is also an improvised version of smart shopping system where the Lanes can be made that is almost similar to metal detectors that are used in malls.[4].

Further advancements can be done by providing Customer cards that are attached with an RFID tag containing an unique customer ID which will maximize the shopping experience to great extent. Special offers and discounts can also be provided for those customers based on the shopping.

Smart carts present in every supermarkets ,malls etc are attached with RFID reader and LCD display where the customers will be able to know the net cost as well as the list of items that is been purchased. These Smart carts can also be further enhanced for requesting specific products if in case of out of stock, festive discounts, offer information, additional item information.[6]The development of IoT in retail sector will completely transform the system that is working currently. Shopping as we all know, it will never disappear but can be further enhanced in a innovative way.

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