A Secure Smart Shopping Cart

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Abstract— Smart shopping system with RFID technology using IoT is developed. Each and every product contains RFID tag. The smart cart consists of a RFID reader. A micro controller is installed on the cart for data processing and a LCD screen is equipped as the user interface. The customer scans and places any product in the trolley, cost and the name of the product will be displayed. If the customer wants to remove the item from the trolley, then cost of that item gets subtracted from the total bill. The information which is to be sent with the help of Bluetooth to the billing server. The bill data are not secure in present scheme. The Double layer encryption method is used for data encryption and decryption. The System is used to improve the security and speed of the system.

Key words: Arduino Uno, RFID Reader, RFID Tag, LCD Display, Bluetooth

I. INTRODUCTION

In the era of the Internet of Things (IoT), interactions among physical objects have become a reality. Everyday objects can now be equipped with computing power and communication functionalities, allowing objects everywhere to be connected. Additionally, many security and privacy issues have emerged and lightweight cryptographic methods are in high demand to fit in with IoT applications.

Internet of Things is refer to the general idea of things, especially everyday objects, that are readable, recognizable, locatable, addressable through information sensing device and/or controllable via the Internet. In the era of IoT, interactions among physical objects have become a reality. Everyday objects can now be equipped with computing power allowing objects everywhere to be connected. This has brought a new revolution in industrial, financial and environmental system and triggers great challenges in data management. There has been a great deal of IoT research on different application such as smart phones, e-health systems, wearable devices etc.

The internet of things (IoT) is a computing concept that describes the idea of the physical objects being connected to the internet. The term internet of things (IoT) is closely identified with RFID as the method of communication.

II. INTERNET OF THINGS – APPLICATIONS

- Building and home automation
- Manufacturing
- Medical and health care systems
- Media
- Energy management
- Transportation
- Environment monitoring
- Smart city
- Agriculture

In Shopping Mall Sometimes customers face problems regarding the incomplete data about the product and waiting at the billing counters. Hence improvement is required in the traditional billing system. To improve the quality of shopping for the customers this system is developed. With this system, customer will have the information about price of every items and total price of the item. A Secure shopping cart system will save time of customers and it reduces the manpower required in mall.

III. RELATED WORK

Ruinian Li et.al proposed IoT applications on Secure Smart Shopping System uses UHF RFID reader.It is used to read the items in the cart.They uses Elliptic curve cryptography for data security. Each smart cart is equipped with a UHF RFID reader, a micro controller, an LCD touch screen, a Zig-Bee adapter, and a weight sensor. The smart Shopping cart is able to automatically read the items put into a cart via the RFID reader. A micro controller is installed on the cart for data processing and a LCD touch screen is equipped as the user interface. In order for the smart cart to communicate with the server, they have chosen Zig-Bee technology as it is low-power and inexpensive[1].

You-ChiunWang et.al proposed A Lightweight, Interactive Sensor-based Cart for Smart Shopping in Supermarkets designs a 3S-cart system to integrate the WSN technology with shopping carts to support smart shopping. It uses natural actions of customers on carts to infer their behaviour and provides real-time interaction to improve the shopping experience. 3S-cart can also cooperate with other systems such as membership, visual surveillance, bar/QR-code, and RFID. Two applications, sales-promotion and product-navigation, are developed to show the practicability of 3S-cart[2].

Dr.K.A.Shirsath-Nalavade et.al proposed IoT Based Smart Shopping Cart (SSC) With Automated Billing and Customer Relationship Management (CRM) system is used to automate the work of counter billing system using mobile application through scanning barcode of products and automatically generate bill. To reduce the time complexity of user's shopping system and make the system user friendly. This system is help to facilitate the customer to set their budget limit before starting the shopping, and notifies if customer shops beyond limit. The products are scanned quickly as soon as they are placed into the shopping cart and paperless bills are generated and sent to the customers registered E-mail[3].

Pritha.N et.al proposed Smart Trolley System for Automated Billing using RFID and IoT. In tnis system the customer puts the product in the Smart Trolley, the Radio Frequency ID reader scans the tag and the Electronic Product Code number is generated for the item. Radio Frequency ID reader passes the Electronic Product Code to the microcontroller. The name and price of the product obtained by the controller gets displayed on the LCD of the Smart Trolley, where client can see the item data. LCD is interfaced with microcontroller in 4bit mode. It is used to indicate the

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purchaser, the action taken by the purchaser that is inserting of an item, removal of an item, item's price and total billing cost of items in the trolley. At the billing Counter, the total bill data will be transferred to PC through GSM/GPRS module[5].

Bhagyashree Bhumkar et.al proposed Automatic Billing Trolley using RFID and Zigbee with Android Application Rewarding System. In this System the products are attached with RFID tags. RFID tags will be read by RFID reader which is attached on trolley. Reader will send this information of item to micro-controller then micro-controller executes the code embedded in it. The total amount will be displayed on LCD. Using Zig-Bee, micro-controller will send this information to central billing server. Billing server will print the bill. This system will take less time to calculate bill for large scale applications. In case of rewarding points, people doesn't need to carry the bonus point card for getting reward points. Easily by installing the application into Android phone they will get bonus points according to their shopping or it depends on that mall[9].

IV. EXISTING SYSTEM

Barcode scanner is used for billing process in the current System. Vendor scans the product through the barcode scanner. while billing if the customer have to remove some products because of exceeds his budget, again some more items required to check which products has to remove from the basket. Customers waste their lots of time at the billing counter. This is to be a slow process and Customer has to wait for long queues. This is a one of the reason for most of the people want to leave the mall for waiting a long queue to buy a few products and scratched or crumpled barcodes may cause problems. So we need to develop a project for automated shopping trolley with RFID reader which aims to reduce the total waiting time of customers and total man power requirement for shopping malls.

A. Limitations of Existing System

- Lack of Security
- Stock maintenance is difficult.
- The waiting time is high.

V. PROPOSED SYSTEM

Each smart cart is equipped with a RFID reader, a micro controller, an LCD screen, and Bluetooth adapter. The smart cart is able to automatically read the items put into a cart via the RFID reader. A micro controller is installed on the cart for data processing and a LCD screen is equipped as the user interface. In order for the smart cart to communicate with the server, we have chosen Bluetooth technology (data exchange purpose) as it is low-power and inexpensive.As products are removed from trolley price is automatically reduced.

We also set a RFID reader before the exit door to check that all items in the cart have been paid for. We consider security and privacy issues related to smart shopping systems as no previous research has tackled it. The Shopping system is automatic monitoring the product quality and quantity so the customer satisfaction is achieved by using this concept.

VI. SYSTEM ARCHITECTURE

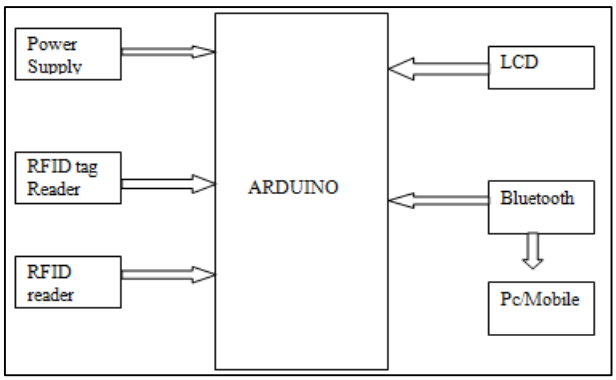

Fig. 1: Architecture of proposed System

The trolley section consists of power supply, microcontroller, RFID tag, RFID reader, LCD display and Bluetooth adaptor. The 12V power supply is given to the microcontroller. After giving the power supply, the customer put the items into the trolley. With the help of RFID tag and RFID reader the customer will have the Information about the price of every item that are purchased in, and to display the total cost of items using LCD display. The LCD display consists of 8x8 display unit, which is more than enough to show the details.

VII. ALGORITHM

Double Layer Encryption is used for smart shopping cart using IoT System. Double layer Encryption is the process of encrypting an already encrypted message one or more times using a different algorithm.

DNA and RSA algorithm is used to ensure twofold protection in cloud. All the data stored in cloud servers can be encrypted using this algorithm. Only the authorized user, who possesses the private key as well as the DNA reference sequence, will be able to decrypt the data from the cloud.

A. Encryption Algorithm

1) Step 1: Convert the plain text into its binary format.
2) Step 2: Assign DNA bases to the binary format.
3) Step 3: Replace DNA bases with the numbers given in the reference DNA sequence.
4) Step 4: Using RSA algorithm, convert it into cipher text C using C = P e modulo N
5) Step 5: Transmit the cipher text C.

B. Decryption Algorithm:

1) Step 1: Convert the cipher text into plain text using
2) P = C d modulo N
3) Step 2: Replace the numbers with DNA bases given in the reference DNA sequence.
4) Step 3: Replace DNA bases with the binary numbers.
5) Step 4: Convert the numbers back into plain text.

VIII. RESULTS & DISCUSSION

A. Assembling Hardware Components

The trolley section consists of powersupply, ATMEGA8 microcontroller, RFID tag, RFID reader, LCD display and bluetooth adaptor. The 12V power supply is given to the microcontroller. The power indication LED is used to check whether there is a power flows through the circuit or not.

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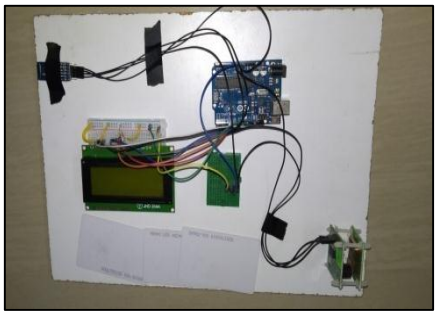

Fig. 2: Hardware Components

B. Functional Smart Cart

Every cart is connected with a RFID reader, a microcontroller and LCD screen. When the customer starts dropping products into the trolley, tags will be read by the reader and the reader sends the information to the microcontroller. The microcontroller will display the cost of that product on the LCD screen for user. If the user wishes to remove any product from the cart then they can take away that product from trolley and cost of that particular product will be subtracted from the total amount instantaneously.

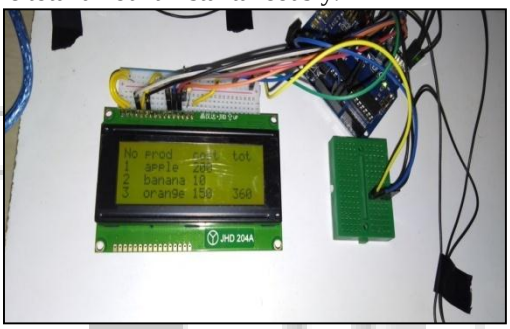

Fig. 3: Items added to the cart

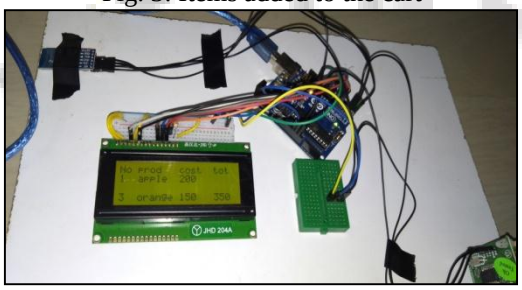

Fig. 4: Items remove from the cart

C. Level I Security

The wireless billing system is made up of the Bluetooth communication module. When a commodity is placed in the cart, RFID reader reads the tag information and conveys the same to the microcontroller that will then communicate with the server through Bluetooth. We adopt double layer encryption method to encrypt the message. The smart cart needs to perform the encryption when the data is transferred to billing server.

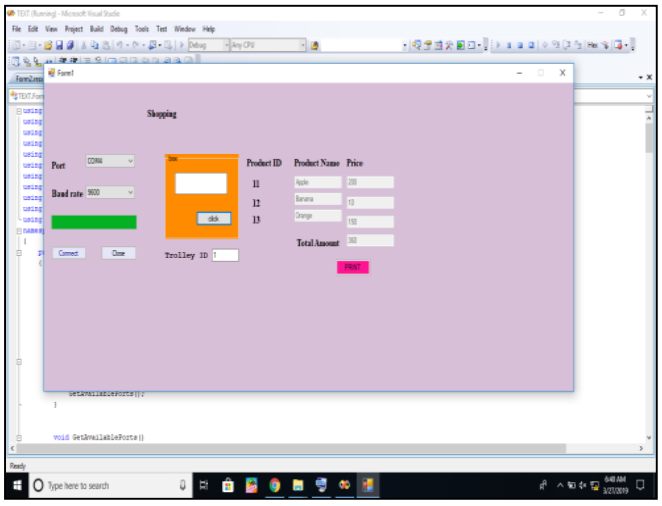

Fig. 5: Items in the server

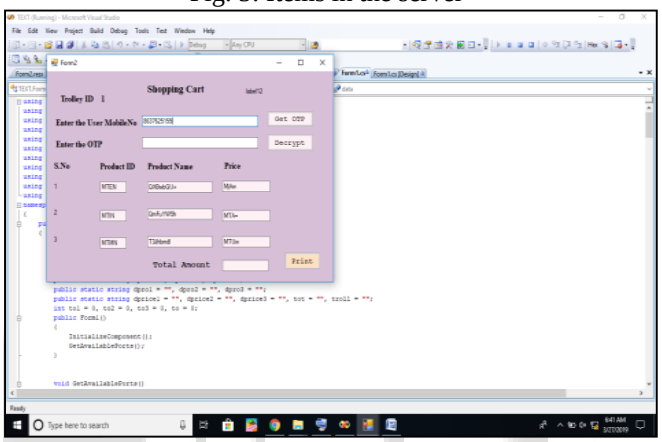

Fig. 6: Items in Encrypt form

D. Level II Security

At the counter side, billing server gets information which is sent by Bluetooth. The information which is retrieved from the cart is in encryption form. The system operator enters the trolley id it will display the billing information in encrypted form. The System operator gets the user mobile number and entered into the billing system. The customer receives a key as a message. Then the customer tells a key to the operator only then the data is decrypted using the key. Then the customer pays the amount and gets the bill.

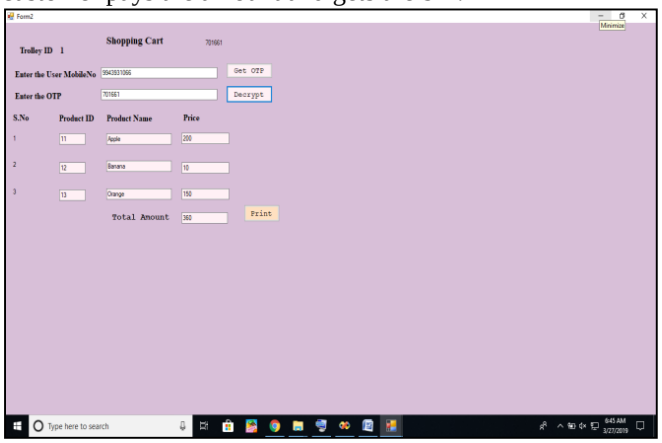

Fig. 7: Items in Decrypt form

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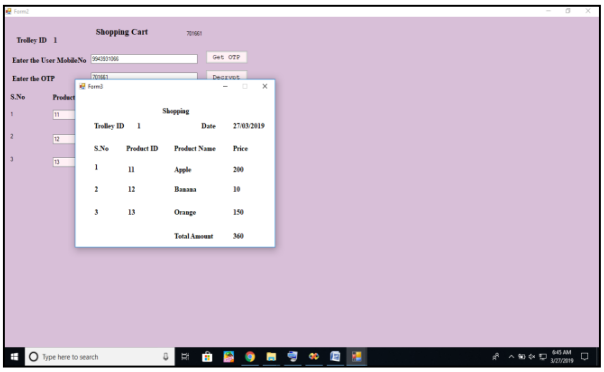

Fig. 8: The generated Bill

E. Checkout and Verification

To verify that a customer has made a valid purchase for all the items in the smart cart before leaving the store, a RFID reader with a microcontroller will be installed before the exit door. This RFID reader will read all the items in the smart cart and check with the server if a valid purchase has been made. This can be done by giving all the items two statuses - "for sale" and "sold" - in the server's database, and when an item is paid, the server will be informed immediately to change the item's status from "for sale" to "sold". Therefore, only an honest customer who has paid all the items in the smart cart can pass the verification and the exit door will open for him.

IX. Performance Evaluation

We test the robustness of the system with our prototype, and we find that the RFID reading is accurate and precise. According to our tests, the metal of the cart blocks the signal to a large extent and an item outside the cart cannot be read by the reader inside the cart. When a new item is put into the smart cart, it will be automatically read by the reader, which is continually scanning items within its range. After a product is read, its ID will be checked to see if it is a newly added item. If so, its information will be listed on the user interface. On the other hand, when an item is removed from the smart cart, the reader will no longer be able to scan its information.

X. Conclusion

In this paper, we propose a secure smart shopping system utilizing RFID technology. This is the first time RFID is employed in enhancing shopping experiences and performance evaluation are discussed in the context of a smart shopping system. We detail the design of a complete system and build a prototype to test its functions. We also design a secure communication protocol and present performance evaluations. We believe that future Shopping mall will be covered with RFID technology and our research is a pioneering one in the development of a smart shopping system.

References

[1] Ruinian Li, Tianyi Song, Nicholas Capurso, Jiguo Yu, Jason Couture, Xiuzhen Cheng(2017), "IoT applications on Secure Smart Shopping System" IEEE.

[2] You-Chiun Wang, Chang-Chen Yang (2016), "3S-cart: A Lightweight, Interactive Sensor-based Cart for Smart Shopping in Supermarkets" IEEE.

[3] Dr.K.A.Shirsath-Nalavade, Aarti Jaiswal, Swati Nair, Gayatri Sonawane, Suchita (2017), "IOT Based Smart Shopping Cart (SSC) With Automated Billing and Customer Relationship Management (CRM)." IJRASET.

[4] Mrs. Devi Ramakrishnan, Pavithira T, Monisha E, Likitha M(2018), "IoT applications on secure smart shopping system" IRJET.

[5] Pritha N, Sahana S , Selvin Stephy N , Shiny Rose S, Unnamalai S(2018), "Smart Trolley System for Automated Billing using RFID and IoT" IRJET.

[6] Dhavale Shraddha D, DhokaneTrupti J, Shinde Priyanka S(2016), "IOT Based Intelligent Trolley for Shopping Mall" IJEDR.

[7] K.Gogila Devi, T.A.Kaarthik, N.Kalai Selvi, K.Nandhini, S.Priya (2017), "Smart Shopping Trolley Using RFID Based on IoT" IJIRCCED.

[8] K.Lalitha, M.Ismail, Sasikumar Gurumurthy, A.Tejaswi (2017), "Design of an intelligent shopping basket using IoT" IJPAM.

[9] Bhagyashree Bhumkar, Tejasvini Changal, Bhagyashri Dahifale, Ganesh Deshmukh (2016), "Automatic Billing Trolley using RFID and Zigbee with Android Application Rewarding System" IJAREEIE.

[10] Ou Wenxing, Wang Lei, Jiang Zhipeng, Yu Changhong(2015), "Implementation of Smart Shopping System based on NFC Technology" , ICMTMA.

[11] Zeeshan Ali, Reena Sonkusare (2014), "RFID based Smart Shopping: An Overview", IEEE.

[12] Akshay Kumar, Abhinav Gupta, S Balamurugan, S Balaji and Marimuthu R (2017), "Smart Shopping Cart", IEEE.

[13] Hsin-Han Chiang, Wan-Ting You, Shu-Hsuan Lin, Wei-Chih Shih, Yu-Te Liao, Jin-Shyan Lee, Yen-Lin Chen (2016), "Development of Smart Shopping Carts with Customer-Oriented Service", IEEE.

[14] Yerlan Berdaliyev, Alex Pappachen James (2016), "RFID-Cloud Smart Cart System", IEEE.

[15] Prasiddhi K, Dhanashri H. Gawali (2017), "Innovative Shopping Cart for Smart Cities", IEEE.

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