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SMART BILLING TROLLEY VIA WEB APPLICATION

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Abstract: ***In recent times crowd is more in shopping malls day by day i.e customers grab different items and place them in a trolley and then when they are moved to the cash counter the billing process is done using bar code scanner where this process consume more time . To overcome this a system is developed by which was called as 'SMART BILLING TROLLEY VIA WEB APPLICATION' without any human intervention . RFID tags are used instead of barcodes. This RFID tags will be attached to the product. Whenever the customer place a product in trolley it will be scanned with the help of RFID reader and product price and cost is displayed on smart phone display through web application using Zigbee. and the process moves on. By using e –wallet to pay the bill amount in mobiles and all details are updated in to the main server of the shopping malls using IOT .***

Keywords: ***Rfid,Zigbee, ,Micro Controller, Weight Scanner, Digital Wallet***

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. There has been a great deal of IoT research on different applications, such as smart homes, e-health systems, wearable devices, etc. In this paper, we focus on a **smart shopping system** based on **Radio Frequency Identification (RFID)** technology. All items for sale are attached with an **RFID** tag, so that they can be tracked by any device equipped with an RFID reader in the store .

It also limits the re-utilization of barcodes. As barcode lacks read and write facility, it is not possible to add to the information already existing on it. On the other hand rewriting on RFID tags is possible and displays the details of the item on the **LCD**. Therefore we choose RFID based trolley. Using **Zigbee** the bill details and the total amount is send to the smart phone via **web application**. And after checking the details the payment transaction is done by digitally using digital payment using mobile or from home by parents if case of son / daughter goes for shopping.

II. RELATED WORK

Study on IoT applications is a popular topic in recent years, but smart shopping systems have not been well- investigated. There are some research works being published in recent years regarding improving customers' shopping experience. In 2011, the idea was proposed on tracking a customer in the store and discovering customers' interests in order to offer personalized coupons. The idea of smart shelves and smart carts were also discussed in their work. Smart carts can be tracked using RFID technology and smart shelves can monitor the location and statuses of the items.

There were multiple attempts made . Shanmuqapri-. proposed a basic design using RFID and a barcode reader for product identification, while using Zig-Bee for communication Kumar *et al.* represented the first physical implementation with RFID and Zig-Bee Gupta *et al.* gave a very unconventional design for a smart cart, and they are one of the first examples to address the anti-theft issue . Their design was similar to a mail receptacle: a chute where items are inserted and scanned, then dropped into a closed chamber. The chamber had a door on the top which could only be opened if the user had paid for the items. The design indirectly guarded against wireless communication security threats by not allowing any wireless communication - the cart was physically wired up to a point-of-sales system to pay when the user was done shopping. Ali *et al.* designed a smart cart system with navigation Their design included the implementation of smart shelves, which determined when smart carts enter an aisle (using infrared sensors) and delivered product information to carts.There are more designs in this area in the last three years [12]–[14], but none of

them included novel ideas. In all the previous designs, a customer had to scan the items one-by- one manually, which is not convenient. Furthermore, security issues have never been explored in any past work.RFID technology has been widely studied in recent years and it is a major technology applied in IoT applications [27]– [29]. Amendola *et al.* reviewed the RFID technology and its use for applications on body-centric systems [30]. Welbourne *et al.* developed an RFID ecosystem with a suite of web-based, user-level tools and applications [31]. For grocery marketing, most stores are using barcodes nowadays, but we have reason to believe that RFID over barcode is a general trend as RFID can achieve distance reading, which intellectually brings the property of IoT and connect all the objects in a store together

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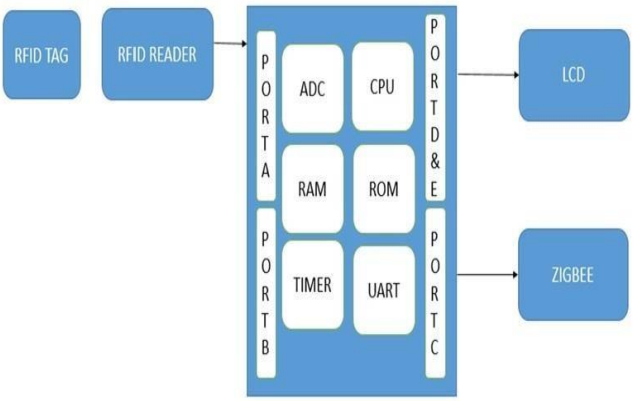

III. SECURITY ISSUES AND CONCERN

To make our security model practical, we do not assume the existence of a secure channel. The communications should be resistant to any eavesdropper who actively monitors the traffic.

Based on our design, the security of the RFID tags is well- protected.

1. **Tag Tamper-Proofing (Tag Security):** The tag design must be resistant to the following misuses:
a) re-writes in order to pay less.
b) obstructions and replacement by fake tags.
c) swapping the tags of different items.
d) breaking or tampering to avoid paying the price altogether.

2. **Communication Security:** The communication in the smart shopping system needs to be protected. For example, to guarantee the confidentiality and integrity of a transaction, lightweight cryptographic systems need to be utilized to prevent an attacker from eavesdropping data or modifying data sent between the carts and the server.

3. **Reading Collision:** Intuitively, the reading range of the RFID reader should be carefully set to avoid collisions with other carts.

IV. RFID:

Passive and **Active** these are the two categories of RFID tags. Passive tags have no battery life, and Active tags have battery life.Through the RFID implementation of mobile technologies and automatic recognition, technologies become easier for smart cart.With the help of wireless networks, RFID makes the conventional retail process fast, transparent and efficient.

RFID PARAMETERS:

Frequency	Mode	Range	Transfer Rate
125-135KHz	**passive**	**Shote Range(up to 0.5m)**	**Low**

13.56 MHz	**passive**	**Medium Range(up to 1.5m)**	**Moderate**
860-930MHz	**passive**	**Medium Range(up to 5m)**	**Moderate to High**
433MHz	**passive**	**Ultra Long(upto 100m)**	**High**
2.45GHz	**passive**	**Long Rnge(upto 10m)**	**Very High**

V. ZIGBEE

Communication between shopping carts and sever take place using ZigBee. ZigBee provides low cost and low power connectivity for equipment that need battery. So it increases the battery life of equipments. ZigBee provides a data rate of 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz.

ZIGBEE PARAMETERS

Supply voltage: 5v DC
- Detection range: (10-30) m
- RS232 Output
- TTL uart also provided
- Frequency: 2.4GHz
- Tx and Rx Status LEDs
- Low power

VII. WEIGHT SCANNER

The weight scanner can weigh items that are put in the cart to ensure the tag corresponds to the correct item. It can also help with a security check: if a malicious user peels off the RFID tags before putting it into the cart, the cart can detect it as no weight is sensed.

VIII. DIGITAL WALLET

A. A digital wallet will be in electronic device that allows an person to make electronic transactions. This can include purchasing items on-line with a computer or using a smartphone to purchase something at a store. Every person bank account will be linked to the digital wallet.

IX. DESIGN GOALS:

Our proposed smart shopping system should achieve the following major goals:

1) Item reading: The smart cart should be able to accurately read items put into or removed from the cart. An item put into one cart should not be able to be read by another cart nearby.
2) Items tracking: The server should maintain the state of items in the store. With RFID readers installed on the shelves, the items can be monitored and the item stock can be updated to the server.
3) Payment verification: We propose installing RFID read- ers before the exit door, which can scan all the items in the smart cart, and check with the server if everything in the cart has been paid. If a dishonest customer tries to leave the store without making a payment, he will not pass the verification.

Apart from the major goals, many other functions can be achieved in future, such as navigation, advertising, coupon rec- ommendation, etc. Advertising and coupon recommendations can be easily added to the functions of the smart cart, and navigation can be reached by utilizing the Zig-Bee gateways to determine the location of a shopping cart through triangulation techniques [36].

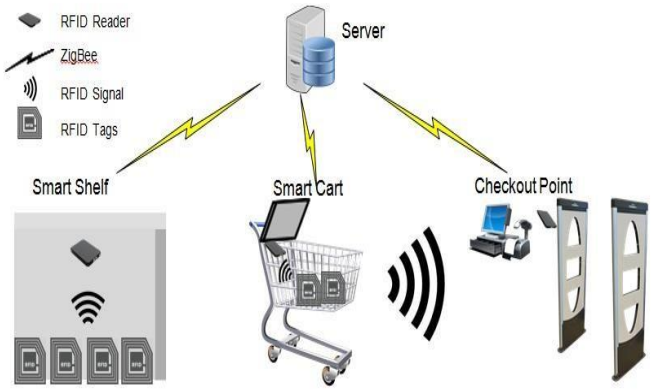

Fig. 5. System Model

X. BUILDING A FUNCTIONAL SMART CART

We built a prototype to test our design and functionality. Fig. 3 shows the components of our designed smart cart and the specific descriptions of each component can be found in Table II. The workflow of our smart cart is illustrated through Fig. 4. According to our tests, when putting an item into the smart cart or removing an item from the cart, the smart cart is able to accurately read it. One surprising result is that, the metal outside the cart blocks the signal to a pretty high extent that, when the reader is inside the cart, no item outside the cart can be read. This clearly indicates that an item put into a smart cart will not be read by a nearby cart accidently. We are also able to test how to set a RFID reader at the checkout point so that the items in the cart can be accurately read.

XI. SECURITY MODEL

To make our security model practical, we do not assume the existence of a secure channel. The communications should be resistant to any eavesdropper who actively monitors the traffic. The security of the system is based on the difficulty of solving the ECDLP, which cannot be done in a feasible amount of time.

XII. SECURITY ANALYSIS

We Analyze The Security Of The Communication Between The Smart Cart And The Server. The Communication Between The Checkout Point And The Server Are The Same.

1) Confidentiality: In Each Communication Between The Smart Cart And The Server, The Message Sent From The Smart Cart To The Server Is Encrypted Using The Smart Cart's Public Key. The Security Is Based On Ecdlp, Which Is Known To Be Computationally Infeasible To Break. The Message Sent Back To The Smart Cart Is Encrypted Using A Session Key, Which Is Only Known To The Server And The Client. Therefore, No Outside Adversary Is Able To Figure Out The Data In The Communications. This Also Indicates That The Privacy In The Smart Shopping System Is Well-Protected.

2) Integrity: The message sent from the smart cart to the server is signed with the smart cart's private key S_s, thus integrity is protected. When the server sends a message back to the smart cart, it creates a MAC using the secret shared with the smart cart s2, and no outside adversary is able to modify the message while passing the check of MAC. Therefore, data integrity is well-protected.

XIII. 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 can not 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. In this case, the smart cart determines that the item has been removed and will update the display correspondingly.

We now evaluate the computational and communication overhead of our proposed protocol. We focus only on the communications between the server and the smart cart, as the communication patterns between the checkout point and the server are the same.

COMPONENTS :

ELLIPTIC CURVE CRYPTOGRAPHY (ECC):

Elliptic curve cryptography (ECC) was invented by Koblitz[32] and Victor [33] in 1985. It is a public-key cryptographic system based on the algebraic structure of elliptic curves over finite fields. It is lightweight compared to other asymmetric cryptographic systems based on plain finite fields such as RSA, as it requires smaller key sizes to provide equivalent security Let F_p curve denote the field of integers module p and an elliptic E over F_p is defined by the equation:

$y2 = x3 + ax + b$

where a, b F_p and $4a3 + 27b2$ 0 (mod p). The set of points on an elliptic curve forms a group and Fig. 1 describes the geometric addition operations of adding P and Q: if we draw a line passing through P and Q, then this line will intersect a third point on the curve R, and the

ì inverse of this point, R, is the result of $P + Q$. The idea behind this group operation is that the three points P , Q, R are aligned on the curve and the points that form the intersection of a function with the curve sum to zero.

Suppose E is an elliptic curve defined over a finite field F_p, and P is a point in $E(F_p)$ with a prime order n. To generate a public key pair, a cyclic subgroup of $E(F_p)$ will be generated by P :

$(P) = \{\infty, P, 2P,$

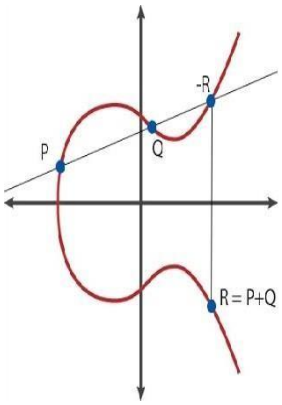

Fig. 1. Group Law on an Elliptic Curve

Elliptic Curve Discrete Logarithm Problem (Ecdlp)

Ecdlp Refers To Finding D With Dp = Q Where The Points P , Q Belong To A Set Of Points E On An Elliptic Curve. Ecdlp Is Known To Be Computationally Infeasible; And As Discussed Before, An Elliptic Curve Group Could Provide The Same Level Of Security Afforded By Rsa With A Smaller Key Size.

Elgamal Encryption based on ECC

There are different ways to implement encryption operations- based ECC, such as Elliptic Curve Cryptography Diffie- Hellman (ECCDH) and Elgamal encryption on ECC. ECCDH suffers from Man-in-the-Middle (MITM) attacks and is not suitable for our application.

Upon generating a pair of public keys Q and d based on ECC, the encryption and decryption operations of the Elgamal cryptosystem on message m are illustrated as follows:

Elliptic Curve Digital Signature Algorithm (ECDSA)

ECDSA was initially proposed in 1992 by Scott Vanstone as an authentication scheme based on ECC. It is much more efficient than RSA because of the smaller key length of the ECC system. The parties involved in the application of ECDSA need to agree upon Elliptic Curve domain parameters in order to process ECDSA. For the sake of space, we will not discuss the details of ECDSA here.

CONCLUSION AND FUTURE WORK

In this paper, we propose a secure smart shopping system utilizing RFID technology. This is the first time that UHF RFID is employed in enhancing shopping experiences and security issues 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 security analysis and performance evaluations.

We believe that future stores will be covered with RFID technology and our research is a pioneering one in the development of a smart shopping system. Our future research will focus on improving the current system, for example, by reducing the computational overhead at the smart cart side for higher efficiency, and how to improve the communication efficiency while preserving security properties.

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