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Smart Trolleys System For Smart Shopping

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ABSTRACT:

The Internet of Things(IoT) is changing human lives by connecting everyday objects together. For example,A Super market is a place where customers come to purchase their daily using products and pay for that. When we go to shopping mart for shopping, we have to work for selecting the right product. Also after that, it is hectic to stand in line for Billing all the goods.Hence, we are proposing to develop a Smart shopping cart system that will keep the track of purchased product and also online transaction for Billing using RFID. The system will also give suggestions for products to buy based on user purchase history from a centralized system, every product in Mart will have RFID Transmitter and every cart will be having RFID Receiver attached to it. There will be a centralized system for the recommendation and online transaction and also we have a automatic Trolley control using WIFI, and the trolley can be controlled using mobile phone and ever one can control the trolley by connecting through hot spot and can easily controlled through the system.

INTRODUCTION

The place where the people get their day to day requirements such as cloths, food products, electrical application etc is shopping mall. Sometimes users have problems related to the wastage of time at the billing section. There is a large rush at shopping malls at the festival time, holidays and special discounts etc. In such situations use of barcode reader technique results in wastage in time & the customers have to wait at the billing counter till all the items get scanned by using barcode reader. The disadvantages is removed by implementing IOT implemented Smart trolley. Instead of barcode technique RFID system is used. In this system unique RFID reader is used for every trolley and RFID Tags for every product. The RFID reader will read the label which is there on the particular product when user buys any particular product . The prize of product, name of the items and the bill of shopping items will be displaying on the LCD. The IOT based smart trolley present and is simple to use and it

does not require any training for the customers. The RFID reader technique has so many advantages over the barcode reader technique. Barcode system only read one items at a time. Reading frequency of RFID is 40 tags. So here the use of the RFID reader is more efficient than the traditional barcode reading techniques. Here the customers can easily use this technique. This system will save time of user and manpower in shopping mall.

Shopping mall is a place where people get their daily necessities ranging from food products, clothing, electrical appliances etc. Sometimes customers have problems regarding the incomplete information about the product on sale and waste of unnecessary time at the billing counters. Continuous improvement is required in the traditional billing system to improve the quality of shopping experience to the customers [3].Now day's numbers of large as well as small shopping malls has increased throughout the global due to increasing public demand & spending. At the time of festivals, special discounts, holidays, etc. there is a huge rush in shopping malls. The use barcode reading technique in such situations always results in waste time since customer has to wait till whole items get scanned. These advantages can be avoided by using IOT based intelligent trolley proposed in this paper [1]. This system uses RFID technique instead of barcode. Proposed system uses separate RFID reader for each trolley and RFID Tag for each product. When customer buys any product RFID reader reads the tag which is present on the product. The cost of product and the total bill of shopping items can be displayed on 16*2 LCD. IOT based intelligent trolley presented here is easy to use and does not requires the special training to customers. RFID technique has many advantages over barcode systems. RFID reader reads the tag from a distance of 300 feet whereas barcode can read the information at distance not greater than 15 feet. Also the barcode need one site of propagation. Reading frequency of barcode reads is only two tags whereas reading frequency of RFID is 40 tags [5]. So the use of RFID is more useful than traditional barcode reading technique. Here use of RFID is helpful for customer. Then what about owner? As each one of us is aware that single owner can have ownership of more than 2or3 malls or in each mall many sections are available, then how someone make control over it. Solution to above mentioned challenge is the use of ESP module. It will reduce the required hardware and also gives the real time information about commercial activity in all malls from any location. Using this system, customer will have the information about price of every item that are scanned in, total price of the item and also brief about the product. So use of this IOT

DESIGN AND FABRICATION

RFID reader reads the tag from a distance of 300 feet whereas bar code can read the information at distance not greater than 15 feet. Also the barcode need one site of propagation. Reading frequency of barcode reads is only two tags whereas reading

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single owner can have ownership of more than 2or3 malls or in each mall many sections are available, then how someone make control over it. Solution to above mentioned challenge is the use of ESP module. It will reduce the required hardware and also gives the real time information about commercial activity in all malls from any location. Using this system, customer will have the information about price of every item that are scanned

The MEGA 2560 is a microcontroller board which is based on ATMEGA 2560.The MEGA 2560 is designed for more complex projects with
54 digital I/O pins.16 Analog inputs,4 UARTs(Hardware serial port),a 16 MHZ crystal oscillator, a USB connection and power jack.A computer with USB cable or power it with a AC to DC adapter or battery to get started.

The performance of the Arduino is stored in the IoT and all the datas are stored in the server and whenever the datas are required it can be re taken and all the values can be rechecked and datas can be saved in the web page.All the individual users has the separate database and all the datas are stored separately and their shopping datas can be stored there and does not inter fer with another datas, all the users gives a separate token number and when ever they come for shopping they should tell the token number and can purchase and enter the new datas in the server and the trolley set up is fully connected with IoT. When the shopping is overed there is a key in the system the user has to press and the datas automatically interfer in the system and pay the bill without any delay and their list can be verified at anytime.

The Trolley have an movable set up which connected with relay and the WIFI system and the user connect with mobile and can control easily and the separate app to control the trolley
,the user has to enter the app and control the trolley according to their wish and does not have any discomfort with this app and easily controlled by all the user and make the shopping method easier

MATERIAL USED:

Arduino MEGA 2560 designed for more complex projects with 54 digital I/O pins and 16 Analog inputs,it has USB connection and power jack. IoT is connected with the system to store all the datas in the server and can cross the products.The trolley is connected with WIFI to control the wheels and can move the trolley which uses ESP 8266 WIFI port and encrypt the values. 12 V battery is used as a input source which is used for the power supply and can be recharged when the battery is dried. Voice playback is mounted to tell the offered products and it tells accurate offer for the product. RF reader is attached with

trolley and the RF tags are used as a input and the tag value of the product is stored in the system by detecting in the RF reader and the values added, finally the overall values stores in the IoT.

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, Klabjan et al. [7] proposed the idea of 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 in 2003. Shanmuqapri-van et al. proposed a basic design using RFID and a barcode reader for product identification, while using Zig-Bee for communication [8]. Kumar et al. represented the first physical implementation with RFID and Zig-Bee [9]. 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 [10]. 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

[11]. 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.

PRELIMINARIES

A. 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 [34].

Let F_p denote the field of integers module p and an elliptic

curve E over F_p is defined by the equation:

where a; b 2 F_p and $4a^3 + 27b^2$ 6 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 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

A private key will be selected uniformly and randomly from the interval [1; n 1], and the corresponding public key is

Q = dP .

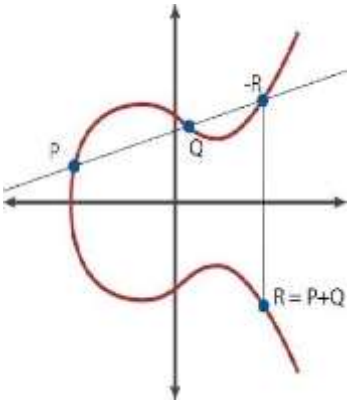

Fig. 1. Group Law on an Elliptic Curve

B. Elliptic Curve Discrete Logarithm Problem (ECDLP)

1)

$$y^2 = x^3 + ax + b \qquad (1)$$

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.

SMART SHOPPING SYSTEM

A. Design Goals

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

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.

by P :

$$hP\ i = f1; P; 2P; 3P; :::; (n\ 1)P\ g \qquad (2)$$

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

D. 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.

REGISTRATION

Before moving all items to the shelves, the store needs to register all of them. We give a design of the RFID tags here shown in Fig. 6.

In our design, information such as price, location, and coupon are stored in a database of the server, rather than in the tags, because such information might change over time, and it is more convenient for the server to manage them.

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 can not be done in a feasible amount of time.

BILLING GENERATION ON SMART CARTS

As an IoT application, a smart shopping system should involve lightweight cryptographic methods due to limited computational power. We combine symmetric and asymmetric

encryption to tackle this issue. When an item is put into a smart cart, the RFID reader on the smart cart should read the tag and then send the tag information to the micro-controller that will then communicate with the server via Zig-Bee to request product information. We adopt ECDSA to sign.

CONCLUSION

When the customer enters the shopping mall, he/she will receive a trolley on which there will be a RFID Reader, LCD Display and Android device. The trolley will start its processing once the vendor presses the „START" button on the trolley which will be only seen by the vendor. Thus, now the customer can use the smart trolley for shopping. Whenever the customer places a product into the trolley, the RFID Reader will read the tag information and display the related results on the LCD Display. These steps are repeated till the customer finishes his shopping and the "STOP" button are pressed by the vendor. Once the "STOP" button is pressed there is an option provided to end the shopping with the same purchased products or to delete or remove some of the products from the trolley. This totally depends on the customer choice. At the end of shopping, the customer can straight away pay the bill and leave the shopping center. Inventory status of the products is also updated in IoT at the end of shopping. From review on topic of smart trolley it is concluded that smart trolley can be implemented with microcontroller and provides various functionality such as billing, information, weighs of purchased items. Also the system will reduce the rush at the billing counter and save the valuable time of customers.

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