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Smart Cart Obsonium based on Secure System

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Abstract*: Nowadays IoT has its influence over every sector of life ,striving hard to improve quality of life. Obsonium is a never ending business and to improve the quality of obsonium we can take the help of technology. In today's technology, many companies are developing products that ensure convenience toward all people who needs a good obsonium experience from today's hectic obsonium which takes a lot of time for billing and getting out. Thus, we have developed a Smart Obsonium Cart, that allows faster check-out. First the product will have a RFID card which will filled first by shop Admin with other de- tails of the product. Then cart uses the RFID reader technology to identify the products details which is already available in the database. The total cost will be displayed on the mobile attached to the cart as and when the product is added to the cart. The user can view the details of the product on his mobile. IoT helps to design such a cart which will automatically scan the product and add the respective amount to be paid in the bill on our own smart phone itself.

Technologies used in this system are RFID tags and RFID reader for fetching the price of each unique item. Arduino microcontroller to perform the sum of the prices of the products and to prepare the final bill. Mobile application for the final display of bill and the complete obsonium list. Security is provided by the weight scanner and validating the products bought to avoid tag tampering. All the item's information is stored in the cloud at first. Checkout verification is also done by passing the cart after payment through a lane with RFID readers.

Keywords* : *Obsonium, IoT, Smart cart, RFID (Radio-Frequency Identification), Machine Learning, Cloud Computing, Mobile Computing.

I. INTRODUCTION

The world is witnessing an industrial revolution with the rapid growth of IoT(Internet of things). We have smart cities, smart cars, smart homes all connected with a smart phone, but obsonium is still done in the conventional way. Nowadays standard of living of people is rising and hence everybody is able to fulfill not only the basic needs but also the luxurious goods. The only thing humans are running out of is time. Nobody has time to wait in long queues for billing process and acquiring desired products. The main purpose of this smart cart is secure automatic billing and checkout process. IoT helps to implement this idea using RFID technology.

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RFID tags will be attached to the products and the cart will have the RFID reader installed which will automatically scan product in range. This system will save time of customers and manpower required in malls. A smart phone with an app is Used here. A user friendly GUI which can be accessed by everyone is provided. The scanned products are automatically billed in the android application, thereby significantly reducing turnaround time .

The proposed system additionally will be able to help in-

1.Inventory management of the items in the shop.

2.Weight sensors will ensure that only scanned items are placed into cart.

3.Positioning the items can be done and frequently bought items will be suggested by studying the pattern of a person obsonium.

II. LITERATURE SURVEY

Modernization of smart obsonium systems is done by few researchers all over world and the concept is not yet implemented since security provided is not enough.
Obsonium malls and supermarkets usually adopt security systems like cameras or closed-circuit television (CCTV) to ensure safety , which can also be used to analyze customer preference of product. For example, Zhang et al. [2] analyzed the images captured from cameras for developing an object retrieval application to identify specified products.

In [3], each customer is made of aware of the desired product using a RFID reader in smart phone and locate the object but this system works less efficiently when in crowd and obstruction increase.

3S-cart system is built using the WSN technology for obsonium carts to support smart obsonium. It remembers the actions of customers on carts to provide real time interaction based on their behavior for improved obsonium experience. 3S-cart can also cooperate with other systems such as membership, visual surveillance, bar/QR-code, and RFID.[1]

Most of the smart carts proposed use the RFID tags and readers because of inexpensive and lightweight technology[5][6]. Where as some carts proposed to scan only the barcodes using smart phone and reduce the RFID use and other hardware[4].

III. METHODOLOGY

Design objectives to be satisfied are:
1.Reading RFID tag- Every product in the shop is assigned a unique identification code which is read by the RFID reader and information is fetched.
2. Validate the weight of bought items in cart and the items present in the list on the android app.
3. Processing bill – Price for each product should be added as new products are added consecutively.

Final bill will be displayed on the LCD as well as the smart phone application.
4. Payment- Mode of payment can be selected as cash or card or online payment.
5. Checkout and verification- The cart should pass the point of sale check where all the products are verified for the successful payment.
Components-

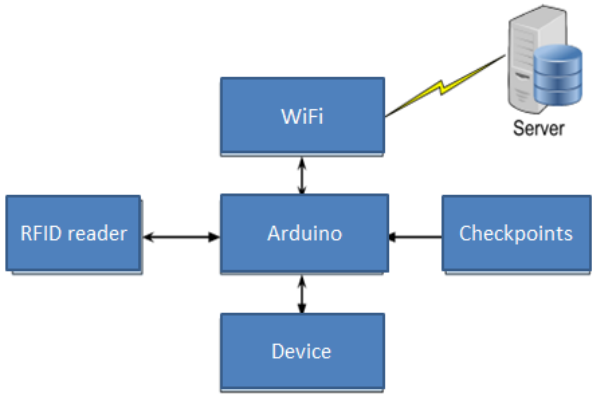

Fig 1.Components of cart

1) Server: All products and related information in the shop is stored on the server database. Every product must be registered on the server first. The server communicates with all the other entities in the smart obsonium system through wifi.

2) Smart Cart:

Cart Components

• Microcontroller (ARDUINO): Arduino Coordinates with the RFID reader, Wifi, weight scanner, and LCD touchscreen to perform computing functions.

•WIFI: Wi-Fi to connect smart cart to the mobile application.

• Weight Scanner: The weight scanner can weigh items that are put in the cart to ensure the tag corresponds to the correct item. The RFID reader can fetch the actual printed weight and the microcontroller can calculate the sum of all the weights of products. Thus the actual sensor reading and the calculated sum is checked for validating no misuse of cart.

• RFID reader: We use an ultra-high frequency RFID reader which allows a reading range up to 10 meters. We can control its reading range.

• User Interface: Displays product information, possible navigation choices, billing information, and coupons etc.

3) Smartphone (android application).

4) Smart Checkout Point: The checkout point is the exit door which is equipped with a RFID reader with a proper range of transmission for the customer to validate a purchase. After the payment is done the customer can walk through the door with RFID reader installed and if any item is not paid or the sum of amounts does not match with the bill paid then alarm is triggered.

IV. MATHEMATICAL MODULES

Set theory applied to the project

1.IoT :-

Set(I)={I0,I1,I2,I3,I4,I5}

$I0 \in I$ = Connect RFID and ESP8266 to Arduino Uno.

$I1 \in I$ = Start Uno.

$I2 \in I$ = Get Readings.

$I3 \in I$ = View Results.

$I4 \in I$ = Connect Mobile.

$I5 \in I$ = Send readings

2.Mobile :- Set(M)={M0,M1,M2,I3,M3,M4}

$M0 \in H$ = Connect IoT.

1. $M1 \in H$ = Receive Readings.
2. $M2 \in H$ = Find data of product from Cloud.
3. $I3 \in H$ = View Results.
4. $M3 \in H$ = Create billing.
5. $M4 \in H$ = pay Bill.

Venn diagram of intersection of two sets

Fig 2:Venn diagram

Probability of our Project Modules

1. In IoT Module:-

We have two possibilities for getting correct product readings i.e. Whether RFID tag is properly attached to it or not.

P (present) =1/2 P (not) =1/2

Hence, P (readings) = P (present) + P (not)

=1/2 + 1/2

= 1

2. In Mobile Module:-

We have two possibilities for getting successful billing i.e. whether product rates are properly entered to the cloud or not.

P (present) =1/2 P (not) =1/2

Hence, P (billing) = P (present) + P (not)

=1/2 + 1/2

= 1

V. WORKING

The series of actions to be performed in the proposed smart obsonium system is-

1. Select the cart and login using unique id and password into the android application.
2. Choose the desired product and place in the cart. The RFID reader on the cart reads the RFID tag on product and displays on LCD.
3. RFID reader reads the tag and sends the data to the server using Arduino.

4. Weight sensors sense the weight and save it on the sever to calculate the total sum of the cart dynamically.
5. The information about product is sent to the display device that is android application of a smart phone.
6. Final bill is produced on the application interface and the payment option is selected.
7. For checkout and payment verification the cart is to be passed through the lane with RFID reader and if any product is found to be unpaid the shop owner is informed.

Bill generation

A smart system should minimize the human efforts and provide security at same time hence lightweight cryptographic methods are to be adopted due to limited computational power. 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 microcontroller that will then communicate with the server via wifi to request product information.

Security model

Tag tamper-proofing must be ensured so that any misuse of tag like removing a tag or replacing the tag will lead to failure. Prior to payment we check the weight of the cart and the items bought in all to prevent underpaying. If the weight of products in the cart is greater than they should be, an alarm is triggered. Conventional technique to ensure security is using the hidden secure electronic tags. Electronic Surveillance System can check for secure hidden tags.

Checkout and verification

Checkout point will be the exit door with RFID readers which will validate the payment for all purchased items. Before the customer leaves the store the RFID readers on the door with microcontroller will read all the items in smart cart and check if payment is done. Server stores the records of purchase made. The server's database can be made to store the two statuses for the items, 'paid' and 'unpaid' hence when the item is paid, the status will automatically gets changed into paid. Hence the shop owner will first ensure if all the products are paid and then only the cart can be disconnected.

VI. DESIGN

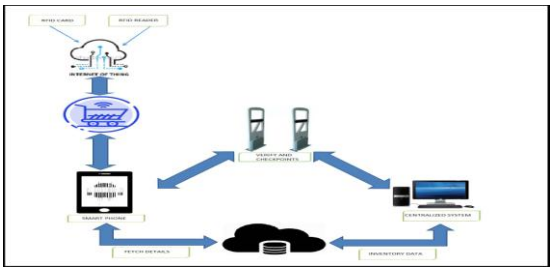

FIG. 3: SYSTEM ARCHITECTURE

VII. RESULTS AND DISCUSSION

Smart Obsonium cart was tested on various androids and emulators. In most cases, the performance of application and cart was efficient with zero errors. The app was able to connect the smart cart with minimum delay.

Based on the features displayed on the smartphone application, the obsonium cart was able to add or delete products. RFID scanning of all the products was correctly done, the app could scan the RFID tag from the product and identify the product .Total bill of the products purchased is generated and displayed to the end user.

During testing of the app, it was observed that there is 100% success rate in fetching details from cloud as well as generating the final bill.

The app was tested in several mobile devices and we obtained the overall response time for fetching details. We extracted 10 readings and the average was computed as shown in Table I. Other important task of the app is the scanning of products using RFID reader. Hence it's necessary to calculate its accuracy by observing the response time a user takes to scan the products to the app. Although the RFID reader is very efficient, various other factors such as orientation of the products speed of scanning etc. play a crucial role in determining this time. This is recorded for 10 readings and is tabulated in Table II.

Table I: Response time (Average of 10 readings)

Response Time (milliseconds)	Cart 1	Cart 2	Cart 3
Product 1	38.39	37.35	36.2
Product 2	32.09	30.93	31.35
Product 3	27.55	28.63	29.99

Table II: Response time (Average of 10 readings)

Response time (seconds)	Time taken to fetch details
Product 1	0.99
Product 2	0.79
Product 3	0.25

VIII. CHALLENGES

1) Tag Tampering: Designing tags to avoid following misuses:
   a) Re-writing tags to reduce payment.
   b) Replacing tags by fake tags or obstructing tags.
   c) Total payment can be reduced if one breaks the tag.

2) Collision:
   Range of the RFID readers must be set considering the possibility of reading the item from other cart in vicinity.

3) Secure communication:
   Communication between the server and the smart cart application must be secured. The data which is sent over to the server through the android application must be encrypted for ensuring customers privacy. Also the data which is fetched by the android application from the server should be ambiguity free and consistent.

IX. CONCLUSION

The Smart Obsonium Cart helps the customers to obsonium, billing and payment in Less time in easy way. In this project, we are developing a novel approach to provide Smart Obsonium Cart Using Iot and Cloud system together.

The basic idea of the project is integrating Android Application, Desktop Monitoring, cloud computing, IoT and AES together to achieve a user independent smart obsonium and monitoring system when it is needed most by a customer. We have assembled mobile computing, cloud computing and desktop together to build a whole new system which is secured and reliable.

It is more intelligent in recognizing the needs of the customer and help him in saving time and money. The data is secured using AES.Thus the aim which was to improve the obsonium experience is achieved.

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