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SMART CADDIE: THE IoT ENABLED SMART SHOPPING CART

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Abstract - *This paper describes about an IoT enabled Smart Shopping Cart. In a grocery store all items can be connected with each other, forming a smart shopping system. In such an IoT system, an inexpensive RFID (Radio Frequency Identification) tag can be attached to each product which, when placed into a smart shopping cart, can be automatically read by a cart equipped with an RFID reader. As a result, billing can be conducted from the shopping cart itself, preventing customers from waiting in a long queue at checkout thereby saving time. We also added a smart shelf system, which is equipped with an RFID reader, and can monitor stock, also updating a central server. Another benefit of this kind of system is that inventory management becomes much easier. Moreover, an Android application is provided to the customers for getting their purchase information and bill details. Using this, application a customer can easily purchase products and they can pay money easily without waiting in a queue.*

Key Words: **IoT, RFID tags, RFID reader.**

1. INTRODUCTION

The Internet of Things(IoT) is a network of home appliances, mechanical and digital machines, sensors, objects, animals or people which are interrelated, provided with unique identifiers and the ability to exchange data over the network without the requirement of human to human or human to computer interactions. There has been a variety of researches of IOT on different applications like smart homes, wearable devices, healthcare systems etc. In this paper, we propose a smart shopping system based on the Radio Frequency Identification Technology(RFID). In this system cell products of the shop are attached with an RFID tag and the shopping cart is equipped with an RFID reader. So that any product that is kept into the cart are tracked by the RFID reader. Billing information can also be generated on the smart cart. As a result, customers don't need to wait in long queues at the terminal.

In our proposed system each cart is equipped with an RFID reader, an Arduino microcontroller and an LCD touch screen. The smart cart can automatically back all the product put in to the cart using the RFID reader. A microcontroller is used on the cart for the processing of data. An LCD touch screen is used as the user interface. When a customer finishes the purchase, they can pay at the checkout point using the billing information generated on the smart cart. An RFID reader is attached before the exit door to verify that all the items in the cart have been paid for or not.

2. LITERATURE SURVEY

RajuKumar et.al proposed a system which assist a person in everyday shopping in terms of reduced time spent for purchasing in [1]. The main objective of that system is to provide a technology oriented, low cost, easily scalable and rugged system for the assistance of shopping. The system consists of 3 key modules which are

1. A Server communication component.
2. A User interface and display component and
3. Automatic billing component.

The server communication component is responsible for the connection of the shopping cart with the main server. The user interface to the customer and the automatic billing component handles the billing of the products in association with the server module. The three modules were integrated into embedded systems and it was tested to satisfy the functionality. RFID (Radio Frequency Identification) Technology was used in this paper. The shopping cart and server communication is handled using wireless ZigBee module. One of the issue of the product is customer confidence. Further more sophisticated microcontroller, larger display system, GPS to track the product, internet facility inside the cart to browse the offers, deals and facility of payment within the cart by using swiping card can be used to make cart more advanced and provide better consumer experience.

Amal Bandal et.al in [2] they have developed a smart shopping cart system which will keep track of the purchased products and also the online transactions for billing the products using RFID and ZigBee. This system will also give suggestions for the products to buy based on the information regarding the previous purchase history from a centralized system. In this system every product has a RFID tag attached to it and the card will be equipped with RFID reader and ZigBee. There is centralized system for the recommendation and online transactions. Also there is RFID reader at the exit door for anti-theft. If a product is removed it should be get deleted from the Bill. One problem of the system is that RFID reader and the ZigBee transceiver implemented on the cart should work properly.

Mr. P. Chandrasekhar, et.al proposed a centralized and automatic billing system using RFID and ZigBee communication in [3]. Each product of the supermarket will be equipped with RFID tag. Each shopping cart of the supermarket will be equipped with a product identification device that consist of Microcontroller LCD, RFID Reader, EEPROM, ZigBee Module. RFID reader will read the purchasing product information and store the information into EEPROM. The EEPROM data will be send to the central billing system through the ZigBee Module. The data transfer between the micro controller and EEPROM is made through I2C serial protocol.

3. SYSTEM OVERVIEW

3.1 Item Reading

The smart shopping system should accurately read all the products put into it and removed from it. A product put into one smart cart shouldn't be read by another cart nearby.

3.2 Item Tracking

The server should accurately monitor all the products of the store. RFID readers are installed on the shelves, so that the products in the shelves can be monitored and the stock of the products can be updated to the server.

3.3 Payment Verification

RFID readers are installed before the exit door to check whether all the products in the cart are paid or not. Any wrong payment will trigger an alert.
Apart from these major objectives, many other enhancements can be achieved in the future such as advertising, navigation, coupon recommendations, special offers etc.

4. PROPOSED SYSTEM

Our proposed smart shopping system consists of the following components:

4.1 SERVER

Before moving to the shelves, all the products should be added to the server. Server consist of all the information of the products such as location, price, stock etc. The server communicates with all other entities of the smart shopping system through a communication system like ZigBee.

4.2 SMART CART

Components are equipped on the smart shopping cart as depicted in **Fig 1**.

Fig -1: Smart Shopping Cart

4.2.1 ARDUINO UNO

The microcontroller used in this system is Arduino Uno R3. Arduino is an open source electronics platform which is based on easy to use hardware and software. Arduino is used because it is in-expensive, can run on cross platforms, provides a simple, clear programming environment, open source and extensible software and hardware. Arduino coordinates the RFID reader, communication module and user interface to perform computing functions [4]. **Fig 2** shows the image of the Arduino Uno.

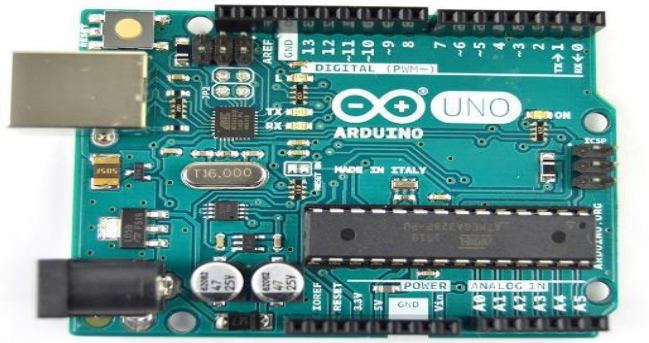

Fig -2: Arduino Uno R3

4.2.2 COMMUNICATION MODULE

This module is used to communicate between the server and the shopping cart, smart shelves and the checkout points.

4.2.3 RFID Reader and RFID Tag

RFID reader(RC522) is used to accurately read all the products put into and taken out of the cart. All the products should be equipped with an RFID tag which stores all the information about the products. **Fig 3** shows the RFID reader and the RFID tag.

Fig -3: RC522 RFID Reader and Tag

4.2.4 USER INTERFACE

An android application is used as the user interface to give the view the previous purchase history and the current purchase details of the customer.

4.2.5 SMART SHELVES

All the shelves of the store are installed with RFID reader to monitor the status of all the products in the store.

4.2.6 SMART CHECKOUT

At the checkout point the customers can make payment through any of the payment modes like credit card, debit card or by cash. After payment, the customer should pass through a lane where RFID reader is placed to verify whether all the products are billed or not.

5. SYSTEM MODEL

The following figure **Fig 4** depicts the system model. The communication module helps the communication between the server and the smart shelves, smart carts and the checkout point.

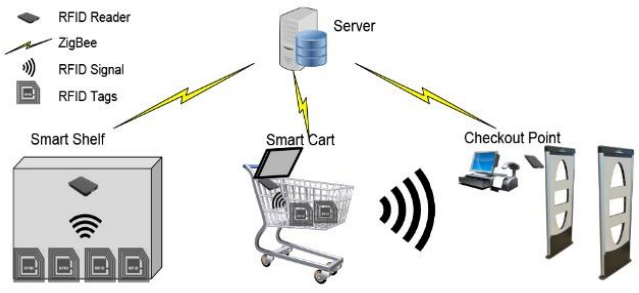

Fig 4: System Model

The smart shelves can monitor all the products on it by reading the RFID signals from the RFID tags which are equipped on the products. The smart shopping carts can read and retrieve information of the products inside it. The checkout points can verify the purchase made by a customer.

5.1 REGISTRATION

Before moving all the items to the smart shelves, the supermarket needs to register all of them in our design of the smart shopping system. Information such as price, location and coupon are stored in the database of the server, rather than in the RFID tags, because information would change over time and it becomes inconvenient for the server to manage them.

The RFID tags should be tamper proof, so that any malicious attempt of taking off a tag or switching tags between items will lead to failure. The customers of the supermarket also need to register with in the customer application. He\She needs to create a login id and password. Then he\she can login to view the current purchase and previous history details.

5.2 CHECKOUT AND VERIFICATION

Even if the smart cart can generate the billing statement, we equip a point of sale (POS) before the exit of the store. This is done to prevent physical attacks on the smart cart's POS which can be easily moved to regions out of the sights of the employees of the commercial store.

To ensure that all the products in the smart cart are billed before leaving the store, a RFID reader and a microcontroller is installed before the exit door. The RFID reader installed on the exit door will read all the items in the smart cart and will verify with the server if a valid purchase has been made. This can be easily performed by giving two statuses to each and every product of the store "for sale" and "sold", in the servers database. When a product is purchased and paid, the server will be immediately asked to change the status of the particular product from "for sale" to "sold". With the implementation of this only an honest customer can the pass the verification and exit door will open for him/her.

Fig 5: Checkout Points

Fig.5 depicts the checkout point. The customer should first make his payment at the pos. After the payment has been made, the customer can walk through the lane to the exit door, where a RFID reader on the top will read all the items

in the cart, and verify with the server that everything has been paid for. When the customer has passed the verification the exit door will open and let the customer pass.

6. ADVANTAGES

The advantages of the smart shopping system are:

1. It automatically generates all the billing information.

2. Customers do not need to wait in long queues at the checkout of the store.

3. The system monitor all stocked items and send item status updates to the server. When items become sold out, the server can notify employees to restock the products.

4. This system provides easiness for the system to do inventory management as all the items can be automatically read and easily logged.

5. Furthermore, the customer application increases the confidence of the customers.

7. CONCLUSION

In this paper, we propose a smart shopping system which uses the RFID technology. We implemented an android customer application for enhancing the customer confidence. Customer can view the previous history and current purchase details through the application. This system also brings security to the store, as only billed products are allowed to pass through the exit door. This system also enhances customer satisfaction as customers don't need to wait in long queues to bill their products.

8. FUTURE WORK

Our future work will be focusing on the improvement of 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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