International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-7, Issue-6, March 2019

# Implementation of Smart Cart in Retail Marts using RFID Tags and Wi-Fi Module for Fast Bill Generation

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***Abstract::*** ***In the contemporary world shopping plays a key role in our daily life. The retail marts is the place where all the commodities, basic necessities of the consumer are readily available and lot of people are willing to go to retail marts for shopping. So with the increase of crowd in the retail marts generating a bill to the customer is taking longer time. This paper proposes a Smart Cart (SC) sensor based system for fast bill generation in retail marts. The Wi-Fi module using in this SC is very flexible to use and it operates under the frequency band of 2.4-5GHZ with an operating speed of 55 Mbps and covers a long distance with the support of WLAN. An SC prototype has been developed by incorporating the required sensors to the cart (a box attached to it). The implementation of SC requires components such as ATmega328microcontroller, LCD Display, ESP8266 WiFi-Module,EM18 RFID Reader, Passive RFID Tags.***

***Index Terms: RFID TAGS, Smart Cart, Wireless communication, Bill Trafficking.***

## I. INTRODUCTION

In the present generation, Wi-Fi technology has taken over a major part of communications. Wi-Fi technology includes access points, wireless devices and end routers. With the advancement in Wi-Fi technology have made it the most effectively and widely used communication medium, both in personal and enterprise networks. The main advantages are mobility, flexibility and low cost deployment. In addition, maintenance is easy, especially in places where deploying the wired network is critical and crucial. In the same manner Retail mart is a place where all the necessary commodities and required groceries, basic amenities of human being's are readily available so the consumer can easily purchase the items what he required in the mart. After completing the shopping the customer has to stand in queue for billing and sometimes he use to wait for a long times in a queue for bill generation. To overcome the problem we proposed a solution in this paper. By using the SC method the generation of the bill, crowd management getting easy. In this paper the main intention is to provide centralized and auto billing by using RFIDS and WI-FI technology. The customer willing to take any product that product has to scanned by using RFID reader , like that each required item by the customer is to be scanned by the RFID reader which is placed in the cart .The item price, item name selected by customer can be seen on the LCD display mounted on the cart. The Wi-Fi module is a device with fully supported with TCP/IP stack .This Wi-Fi device allows the microcontroller to connect to the Wi-Fi network and make the connections of TCP/IP supported commands and make the communication between the Cart and the biller system. By this the entire product list and items cost selected by the customer can be transmitted through wifi module to billing point. So the customer can make the billing easy and no need to wait in a queue for a long time. The WI-FI module in the SC supports the IEEE 802.11protocol series with a data rate of 54MBPS and it operates under the frequency band of 2.4-5 GHZ, lastly the time synchronization for generating the output is less than 5milli seconds. This paper is organized as several sections. Section 2 describes Literature work, Section 3 describes Literature survey. Section 3 presents the Experimental Set Up. The paper concludes with Section 4, which discusses the conclusion and future scope of this project.

**Revised Manuscript Received on 30 March 2019.**
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## II. LITERATURE WORK

Prem Kumar G, Sushruth B Bangre, Kavya M, Varun M, Anupama R implemented a smart shopping cart (SSC) [1] by eliminating the existing systems and proposed a new system with extra features like identifying the location product is available in the mart by the consumer, using a prepaid RFID card for billing. He suggested the payment method by adding money to the customer owned registered card with the help of RFID card he need not go the counter for billing he can pay the amount directly by using card.

Vipul Chawla and Dong Sam Ha explained different types of RFID tags [2] and the components present in the RFID tags and the working of each component in the tag ,explained the frequency range of different RFID tags for different application and finally they suggested passive RFID tag is most suitable for the application because no power source is required to the Tag and is easy to use with less cost.

Angela I. Barbero, Eirik Rosnes, Guang Yang, and Øyvind Ytrehus, explains how the code is designed from reader to tag in near field passive RFID systems using inductive coupling [3] concept and clearly mentioned how the code is encoded and decoded from RFID Tag to RFID Reader, power issues and the how the voltage is induced in to the RFID Tag.

A Smart Cart system with Zigbee module has been proposed by *P.T.* Sivagurunathan ,P. Seema, M. *Shalini, R. Sindhu* [4][5].

In these articles, the authors used Atmega 328 micro controller and RFID Tag number reads by the RFID Reader and verify whether it is available in the store data base are not if yes it will retrieve the data and the details shown on the screen .If the tag details are not found in the store data base the product details has to be registered in the data base.

Theo Pavlidis, Jerome Swartz, and Ynjiun P. Wang proposed a bar code system for product details and generating a bill by using bar code [6]. The authors explained different types of bar codes and briefly outline the alternatives to bar coding. He majorly proposed two types of coding techniques by using these coding techniques a label was created to that particular product. By using binary codes bar code has been generated to the product and the code is unique, and how to retrieve the data of the product at the time of scanning. In this research article the authors mentioned few techniques for reading the bar code.

You-Chiun Wang, and Chang-Chen Yang Wang proposed an advance smart shopping concept [7]. By identifying the customer behavior at the rack he predict that whether the customer willing to take the product or not. If the customer is waiting at the rack for more than 30 seconds, then the details of the item has been displayed on the LCD screen attached to the SC.

## III. RFID HISTORICAL DESCRIPTION

### 3.1RFID Technology

RFID- Radio Frequency Identification is a technique applicable only in the given range communication. RFID Technique usage in Retail marts is More Efficient than Barcode technique. By using RFID technique we can eliminate line of sight concept, altering the product data can also be possible. bComparison of RFID Technology with the Bar code Technology:

| DESCRIPTION | RFID'S | BAR CODE |
|---|---|---|
| Read Rate | High Through put multiple tags can be read simultaneously | Very low Through put, tags can read only one at a time |
| Line of sight | Not Required | Required |
| Read/Write capability | It is having an ability to read, write and modify the data when ever required. | Ability to read only not for writing purpose. |
| Durability | High much better protected | Low. It can be easily damaged cannot be read if dirty or greasy. |
| Security | High security. Hard to replicate. Data can be encrypted | Less security.Much easier to reproduce |
| Event Trigerring | Can be used to trigger certain events | Not capable. |

Table 1 Explains the Difference between RFIDs and Bar Codes.

The RFID system mainly having of mainly three parts which are RFID reader, RFID tags, Antenna. The main purpose of the RFID reader is to induce power, synchronization clock to the tag and acts as a carrier for return data from the tag. RFID reader continuously sends radio waves with particular frequency Whenever the object with attached RFID tag comes in to the range, the object sends a feedback signal from the antenna to the reader and the reader reads all the object details.

**Frequency Range of RFID Tags**:

| Frequency | Mode | Range | Transfer Range |
|---|---|---|---|
| 125-135 KHZ | Passive | Short Range up to 0.5 meters | Low |
| 13.56 MHZ | Passive | Medium range up to 1.5 meters | Moderate |
| 860-930 MHZ | Passive | Medium range up to 5meters | Moderate to High |
| 433 MHZ | Active | Ultra low range up to 10 meters | High |
| 2.45 GHZ | Active | Long range up to 100 meters | Very High |

Table 2:Operational range frequency requirements of RFID Tags.

The RFID tags which is of mainly of three types, one is Active Tag which is of having own power supply and the second one is Passive Tag Which is not having power supply of its own and relies on the RFID Reader for the source of energy, the remaining one is semi passive tag which is having of its own power supply to send feedback signals they should depend on the RFID reader range signal. By using this technique we can track multiple objects at the same time

### 3.2Comparison Of RFID Tags:

| Description | Active RFID Tag | Passive RFID Tag |
|---|---|---|
| Tag power source | Internal to the tag | Energy transfer to reader via RF |
| Tag battery | Battery is Required to get power | No battery is required to get power |
| Availability of tag power | Continuous | Only with in the field of reader |
| Required signal strength from reader to tag | Less signal required | Requires high signal it must power to the tag |
| Available signal strength from tag to reader | High signal required | Less signal required |

Table 3: Technical differences between Active and passive RFID Tags

The RFID system works under the principle of Inductive coupling means the transponder and the antenna are coupled by the magnetic flux through both coils like a transformer, because of coupling it produces a voltage which is induced in to the RFID Tag. The induced voltage is used as a synchronization clock for the controller and the sum portion of the voltage is rectified and used as a power supply to the controller and memory elements. By using the Load modulation technique data is send to the RFID reader.

### 3.3Technical Information Of RFID Tags:

| Description | Active RFID | Passive RFID |
|---|---|---|
| Communication Range | Active Tags can cover up to 100meters | Passive tags can cover only short range of 3 meters or less. |
| Multi Tag collection | Active tags collect 1000s of Tags information from a long range by using a single RFID Reader. | Passive Tags Collects 100s of Tags information from a less range by using single RFID Reader. |

Table 4: Functional capabilities of Active and Passive RFID Tags

## IV. EXPERIMENTAL SETUP

The block diagram to the RFID proposed Smart Cart concept is shown in below figure. The proposed concept mainly consists of Two sections one is at the SC Section and the other one is the Main System linked to the server section. In the proposed concept we are replacing the Bar Code technology with RFID Technology which is having many advantages. By using RFID technology the billing generation time getting very less and we can eliminate line of sight, we can read the object from the long range. RFID Tags are rewritable. The proposed hard ware system designed with simplified components.

### 4.1 Design of the Smart Cart section:

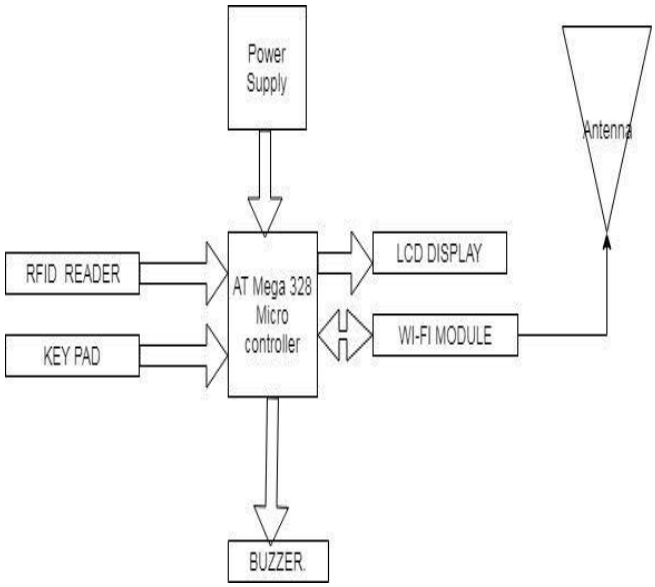


**Figure 1: Block diagram of proposed SC system.**

In the Proposed system each product is attached with the RFID Tag and when an RFID reader reads the RFID Tag the information is transmitted to the Microcontroller and it connect local server data base. The RFID tag number is compared with the existing data base if the information is available the product data is retrieved from the data base and transmits the details of the product on the LCD screen. This process is repeated till the end of the shopping.

After the customer finishes the shopping he use to press the completion of shopping button which is encorporated in the SC then the total number of products he had placed in the cart and amount of final shopping list will be displayed in the screen. The total list of the SC with the Unique code transmitted to the main PC with help of Wi-Fi module which is placed in the SC.

### 4.2 RFID Reader:

RFID reader operates with a voltage of 5V.When an RFID reader is getting in active state it transmits an electromagnetic signal to RFID tag and RFID tag number is transmits to the RFID reader with an interface this tag number transmits to the Arduino board. The tag number is store in the server data base maintained by the inventory management.

### 4.3 RFID Tags:

In the proposed system each product is attached with RFID Tag with a 12 digit unique code and operates with a very low frequency range of 125 KHz. Tag consists of mainly three components such as antenna, encapsulation and transceiver.

Arduino Board: Arduino uno is Microcontroller based board base on the ATmega 328 Micro controller having of 14 digital I/O pins and 6 analog pins and operates with a 16 MHZ crystal oscillator. The Arduino uno is having the SRAM Capacity of 2KB and EEPROM capacity of 1KB.It is having of 4 ports out of which one is entirely used for USB port chip to the USB device port on the board.

### 4.4WIFI Module:

In the proposed concept the Wi-Fi module Incorporated to the SC and make a connection establishment to the Main Server. The RFID tag number coming from the SC is compared with the Data Base if the Tag number is mapped with the existing data then the product details like Price, Name transmitted and displayed on the SC Screen. The mart portal is maintained at the server level and being access from the cart

### 4.5 Implementation of SC at Main computer:

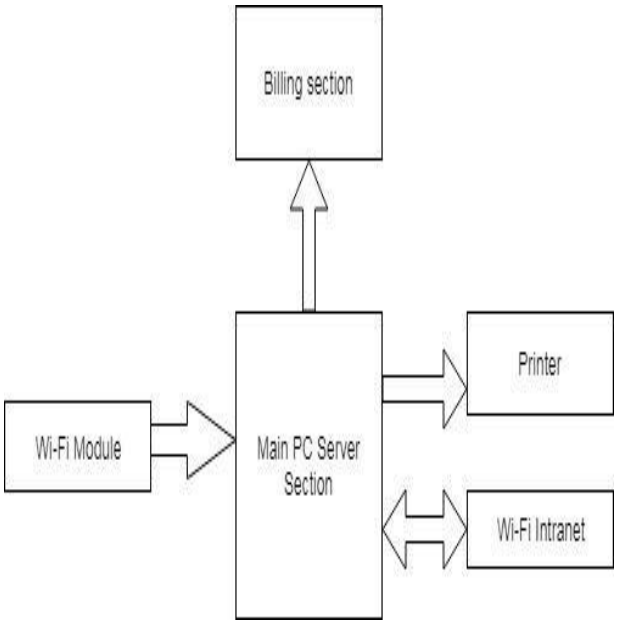


**Figure 2: Block Diagram at the billing section main computer.**

The Main PC Section explains after receiving the data from the SC the admin has to check whether the bill is generated are not. In the checking process the admin verifies the unique identification code of the SC by using SC code it examine whether all the tagged products are matched from the existing data base. If the details are mapped correctly then the bill is generated in the admin PC else the bill was not generated and an alert is sent to recheck the SC.

## V. ALGORITHM

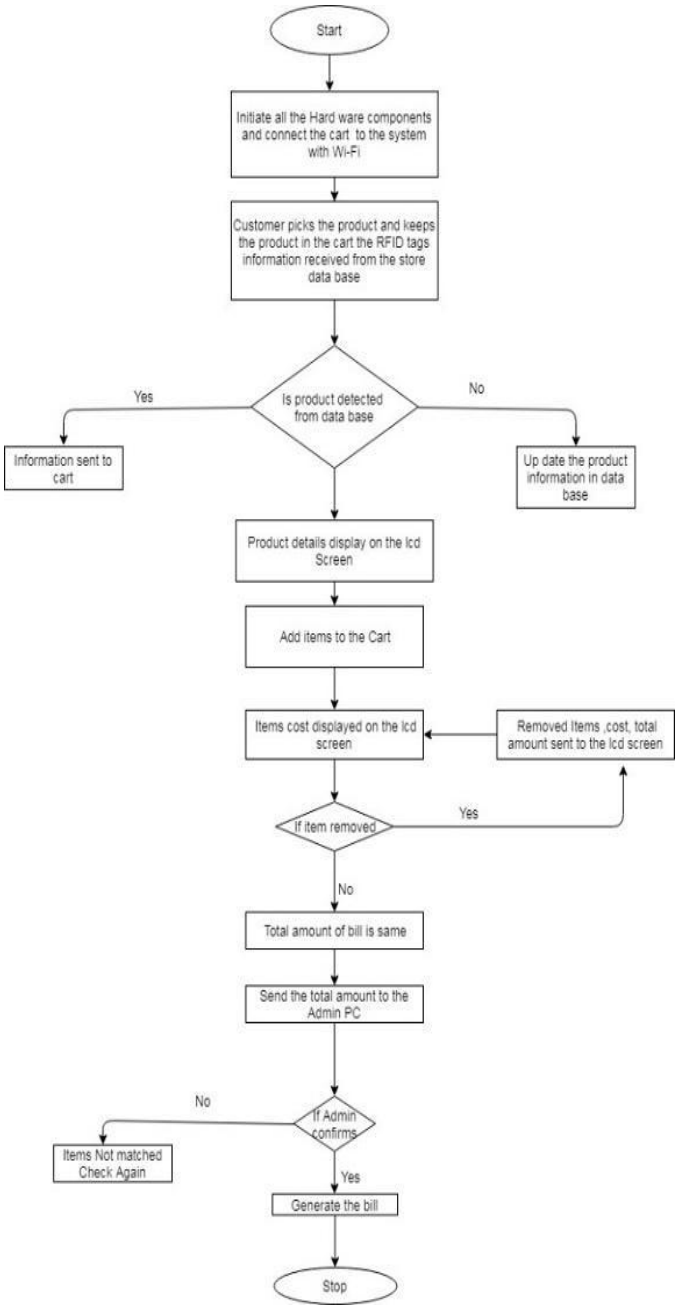


**Figure 3: Algorithm representation of the proto type.**

## VI. RESULTS AND DISCUSSIONS

The figures which are in the below section shown the experimental results of the prototype. From figure 4 to 8 presented the overall prototype of smart cart. In fig9 shown the table of various products and their prices which is bought by the customer through the smart cart.

Figure4:Interfacing the RFID Reader to Arduino


Figure 5: 12 Digit Code of RFID Tag

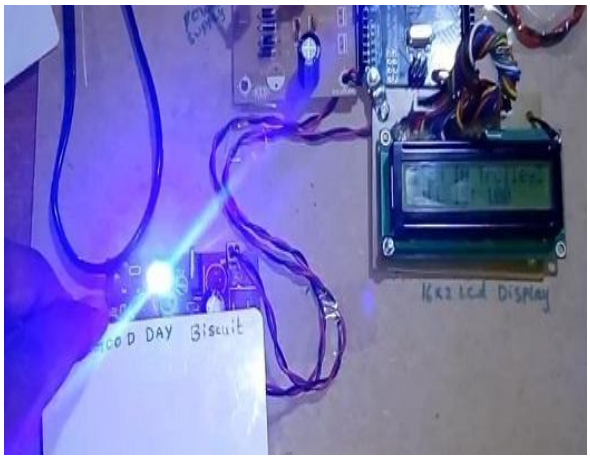

Figure 6: Reading amount of product

The image shows the RFID Reader reads the product and it displays the product item cost on the LCD screen.


Figure 7: Reading the second product RFID Tag

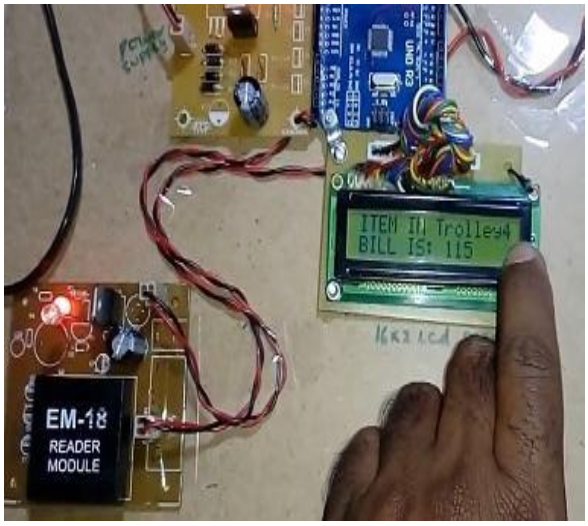


Figure 8: Total amount of products in cart

RFID BASED SC
DETAILS ON MAIN PC

| CODES | PRODUCTS | UNITS | PRICE |
|---|---|---|---|
| 100200300123 | DAIRY MILK | LONG | 50 |
| 100200300124 | FIVE STAR | SMAILL | 10 |
| 100200300125 | MUNCH | BOX | 100 |
| 100200300126 | LUX | SMALL | 20 |
| 100200300127 | REXONA | LARGE | 20 |
| 100200300128 | LIFEBUOY | LARGE | 20 |
| 100200300129 | SANTOOR | SMALL | 20 |
| 100200300130 | BREAD | SLICES | 40 |
| 100200300131 | MILK | PACKETS | 25 |

Figure 9: The Product list in the SC Displayed on the Main system.

## VII. CONCLUSIONS AND FUTURE SCOPE

The aim of our work is to reduce the waiting time of the users at billing counters in shopping malls. For that we have developed a prototype using Wi-Fi and RFID technology. Our algorithm presented in Section V gives the exact details of our working model. Our prototype model is getting the same result in less time compare with the existing methodologies. The future Scope of our system is Localization of product in the mart and show the direction of product place which is available in the mart.

## ACKNOWLEDGMENT

We are thankful to the DIST-FIST, who provided lab and experimental set up In the Department of Electronics and Computer Engineering. We are grateful to KLEF providing very good research environment.

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