

# RFID Enabled Mobile Billing in Retail

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**Abstract:** Electronics commerce is mostly welcome, with the increasing use of mobile devices and electronic payments. Shopping nowadays usually involves waiting in line to get your products scanned for checkout which can result in a great deal of wasted time for customers. RFID holds great promise in the retail world, for both customers and stores in inventory control, due to its relentlessly advantages over the conventional approach. This technology offers the customers a choice to pay the bill amount either by using mobile phone, through SMS, or at the billing counter. The proposed system for payment using mobile contains 3 main components: User Interface & Display component, Server Communication component and Billing & Inventory Management component. As the product with the RFID tag is put in the trolley, the cost of the product gets added to the billing amount. Thus, the bill is generated at the trolley itself and displayed on the alphanumeric 16 x 2 LCD display, saving the time required for scanning at the counters. The billing amount will be transferred to billing server by wireless Zigbee transmitter. The Zigbee receiver is connected to the Server using USB. At the server, GSM modem is used to communicate with the customer's mobile phone. Thus, this paper deals with developing a Smart Shopping Trolley, a system that makes the payment faster by avoiding the need to go to the billing counters for payment, allowing faster check-out.

**Keywords:** Radio Frequency Identification (RFID) Reader & tags, Wireless Zigbee Module, Microcontroller, Server database, Mobile, GSM Modem, LCD

## I. INTRODUCTION

Shopping seems to be a great entertainment. With the advancement of time, giant shopping complexes have sprung up. The noble thought behind such shopping arenas is to provide all the things under one roof, the customer might want to buy. The customer might have a particular cumulative budget in mind. But there is a difficulty for a customer to assume the cost of the products he needs because the one which is printed is not the exact price. It then becomes very troublesome for him to keep in mind the total cost of all the things he buys. As a result, a lot of confusion may arise, disrupting the essence of shopping. Moreover, the huge queue in the malls to scan the products frustrates the customers. Barcode scanning is a time consuming process engaging the customers to stick to the billing section for a long time. Hence there is a need to switch to a Radio Frequency Identification (RFID) system for smart purchase and instant billing. Our Application blends Radio Frequency Identification (RFID) and wireless technologies to provide 'on the spot' billing in malls. The idea is to develop an advanced Shopping Trolley which performs the basic functions of scanning products using RFID tags. This is a revolutionary concept that will change the experience of shopping. This will solve the entire queuing problem for billing. There is no need to go to the counter; every trolley is a counter itself. The user just has to drop their products in the trolley; the trolley will automatically identify all the products dropped into it and the bill will be displayed on the trolley screen, thus the users will have real time data on their bill. The user can then proceed ahead for the bill payment through mobile [1]. Once this is done the system will automatically withdraw the amount

from user's membership account by checking into its database. It reduces labour efforts and increases efficiency by minimizing errors. The system helps in the store management with an automatic update of the inventory on every purchase of a product. The Smart Shopping Trolley has the potential to make the shopping experience more pleasant and efficient for the shopper and the inventory control easier for the store management. Such implementations have found champions on every continent: Wall -Martin in the US, Marks & Spencer and Tesco in the UK, Metro in Germany, Coles Myer in Australia, and Mitsukoshi in Japan are all leading retailers that are currently implementing RFID solutions across their supply chain. Moreover, under a US-led worldwide initiative, governments are using RFID to embed biometric information such as iris scans into passports to improve security [2].

## II. SYSTEM DESIGN

*Objective:* The main aim is to provide effective customer service in supermarkets by raising the efficiency of total supply chain through dynamically choosing the products and quick billing of it. And To have a centralized server with supported billing and inventory updates to achieve operational excellence and effective supply chain management.

The Proposed System for 'RFID Enabled Mobile Billing in Retail' describes about the detailed designing approach with the working model. Fig. 1 shows the hardware kit of the mall application. This is to be mounted on the trolley. Initially when the kit is turned on, the display greets the user with a welcome message. Fig 2 is

SIM 300 GSM modem used for communication with mobile.



Fig 1. Smart Shopping Trolley Unit



Fig 2. Hardware of SIM 300

#### A. Architecture

The main components to be used in the proposed design approach are divided into two parts. One part is for the design of Trolley Panel and the other one for the Counter Panel.

The block diagram of the trolley panel comprises of the following main units:

1. Microcontroller P89V51RD2 which is connected to RFID Reader and LCD.
2. RFID Reader (EM 4100) which is used to detect the product with RFID tag.
3. An alphanumeric 16 x 2 LCD (JHD 162A SERIES) to display the total number of products purchased with grand total.
4. Zigbee XBee S2 to trans receive data to or from server.

The Microcontroller to be used at trolley panel is P89V51RD2. The LCD used here belongs to JHD 162A. The RFID Reader used is the standard EM4100. The Zigbee to be used is XBee S2. As shown in Fig.1, the role of RFID reader is to read the RFID tags attached with every product in the shopping mall and prices of each product is added while putting it in the trolley and the added total price is displayed on the LCD. Also the information of the product is communicated to the server in real time using Zigbee [1], [9].

The block diagram of the counter panel comprises of the following units:

1. A computer which is used as server as well as database.
2. GSM Modem (SIM300) to communicate with the normal GSM mobile phone through SMS.
3. USB to SERIAL converter (CP 2102) to connect computer with microcontroller AT89C2051.

4. Zigbee XBee S2 to trans receive data to or from trolley panel.

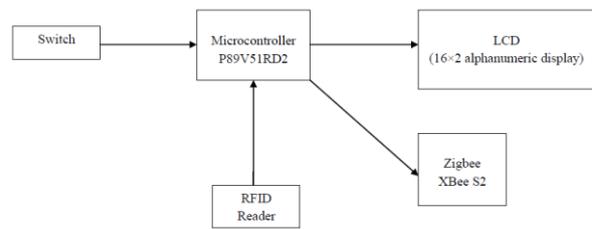


Fig 3. Block diagram of Shopping Trolley Panel

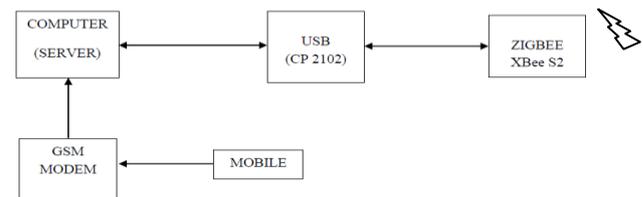


Fig 4. Block Diagram of Shopping Counter Panel

As shown in Fig 4., the counter panel hardware comprises of GSM modem, Computer, Zigbee and CP 2102. CP 2102 helps in the communication between the Zigbee and the server. The server data is then updated to reflect the existing and available products after a successful purchase. This will ensure smooth inventory management. Here a USB to Serial converter will be needed for achieving communication between computer and Zigbee. So the trolley to server communication is carried out using the two Zigbee's. And the updation of inventories is also done using Zigbee which is constantly communicating with the server. The UART communication between GSM Modem and Computer would be done directly. Here GSM Modem is used to translate the billing details to the system [1], [3]. Below we have the Algorithmic module.

1. When a customer with the trolley enters a shopping mall, trolley information is transmitted over the wireless ZigBee from the trolley to the server.
2. Based on the received information, the database is queried and relevant information is retrieved and transmitted to the trolley via the ZigBee module.
3. The received information is stored in the EEPROM present on the trolley. This serves as a temporary database. The relevant products information is displayed on the display unit.
4. All the products in the mall will be equipped with RFID tags which contain a Unique Identification code. These ID's are fed in the database, assigned to the corresponding products.
5. When person puts a product in the trolley, its code will be detected by RFID reader which is interfaced with processor.
6. Reader send this code to processor, after matching code with codes stored in memory, processor reads product's name, cost & other details. Then it displays on LCD.
7. As we put the products, the costs will get added to total. And once the shopping is done user can press "Order

Confirm” button. Thus the billing is done at the trolley itself. Simultaneously all the details are displayed on LCD. And bill is generated.

8. At the billing Counter the total bill data will be transferred to Server by wireless ZigBee transmitter interfaced with processor. It is 2.4 GHz RF module which works in free ISM band so does not require licensing.
9. The ZigBee receiver is connected to billing Server using USB, it receives billing data.
10. The user can then proceed ahead for the bill payment through mobile.
11. It is very simple; customers only need to have an account in the mall or must have membership. In this customer should have money in their account. If it is not so, he can refill his account.
12. Firstly we assume that customer’s account is refilled with enough money. After bill generation customer will send a text message from his mobile phone with the format given below  
\*Amount, Username, Password, Account Number#
13. Then server will check for all the fields entered; viz; Username, Password and Account Number. If all the fields entered are correct then it will proceed otherwise it will send an error message.
14. Then it will check for account balance and amount entered; if amount entered is more than account balance then it will show an error message “Insufficient Balance.” otherwise it will proceed further and will display a message “Transaction Successful.”
15. Also automatic updating of inventories will be done at the central server database.

#### B. Working

The received products were checked with the product details on the server and found the same with the contents on the server. Finally, to simulate shopping, unique RFID cards were used to indicate distinctive products being shopped. As the RFID card reader read the product, details were displayed on the display unit. The product details of the shopped products were temporarily stored in the local memory. Once the shopping was done, “Order Confirm” button was pressed, the memory contents were read and billing was done. The same product information data was sent back to the server to update the inventory.

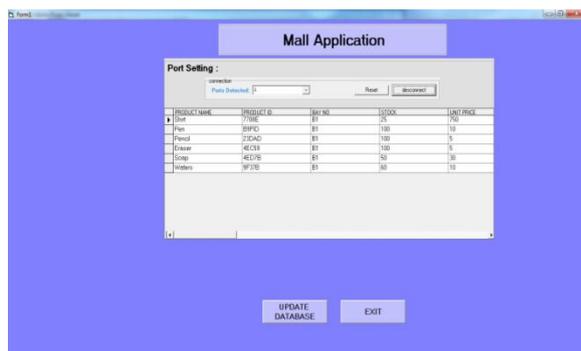


Fig 5. Inventory Interface

Fig 5. shows the Interface for Inventory and Billing. This is designed using **Visual Basic 6.0 (VB 6.0)**. And for the database **MySQL** is used which again is an open source system. Through this the store management will be able to keep a track of stock of all the products. Also, the stock will be updated automatically. This will thus help in better inventory management and with each product identified uniquely, along with the usage of centralized server, support billing and inventory updates.



Fig 6. Mobile Payment Interface

Fig 6. shows Mobile Payment Interface. The message that is initially sent by the mobile phone to the GSM module appears here. After processing the received message, the GSM module will then revert with the signaling and information message to the mobile phone.

### III. CONCLUSION

In this work, we have implemented a RFID Enabled Mobile Billing in Retail. The Smart Shopping Trolley provides effective customer service in supermarkets or malls by raising the efficiency of total supply chain through quick billing of products. It will save the customer’s time by shortening the checkout lines. The entire bill generation and payment process can be done at the trolley end itself. Also, all billing information in microcontroller can be sent to central computer (server) using Zigbee technology resulting in better inventory control and billing. So it achieves operational excellence and effective supply chain management. The intended objectives were successfully achieved in the prototype model developed. The developed product is easy to use, low-cost and does not need any special training.

### IV. FUTURE SCOPE

1. The location detection of the trolley in the shopping mall can be considered as an important aspect through wireless technologies like GPS, IR Transmission, etc.
2. With the advent of systems, trolley will eventually replace salespersons, hence helping in reducing final cost of goods. As a result, more profit margin.
3. Security analysis of Zigbee also can be explored and studied.
4. Consumer Shopping Pattern can be studied using techniques like POS with the help of existing database.
5. A more sophisticated micro-controller and larger display system can be used to provide better consumer experience.

6. Additional audio assistance system can be implemented for people having visual impairments.

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