Futuristic Trolley for Intelligent Billing with Amalgamation of RFID and ZIGBEE

Varsha Jalkote [1], Alay Patel[2], Vijaya Gawande[3],Manish Bharadia[4], Gitanjali R. Shinde[5], Aaradhana A Deshmukh [6]
Student , SKNCOE, University of PUNE , Maharashtra, INDIA
Asst. Professor, University of PUNE , Maharashtra, INDIA [15-,6]

ABSTRTACT
As we know that there is a huge crowd in the malls in metro cities. Specially it becomes more crowded on holidays. People purchase different items in the malls and puts them in the trolley. At the cash counter billing process is done using bar code scanner. This is very time consuming process. To avoid this we are developing a system which we called as 'Futuristic Billing Trolley Using RFID module and ZIGBEE module'. In this system we are using RFID tags instead of barcodes. This RFID tags will be on the product. Whenever the customer puts a product into trolley it will get scanned by bvgfc RFID reader and product price and cost will be display on LCD display. Like this the process goes on. We are using ZIGBEE transmitter which will be at trolley which is used to transfer data to main computer. At the main computer ZIGBEE receiver will be placed which will receive data from transmitter. To store the products price and total billing memory used will be Atmel AT24C04. LCD used will be 16X2 alphanumeric display . It will be used to display products names, products cost etc.

1. INTRODUCTION
The basic idea of our paper is based upon the lines of the "Futuristic Trolley for Futuristic Billing with amalgamation of RFID and ZIGBEE" used in the Malls and Shopping Centers. Barcodes have been in existence for many years and have been used by departmental stores and supermarkets to manage purchases of merchandize by customers and keep track of inventory. However, the barcode system is no longer the best way to business operation. Customers are tired of waiting in long, slowly moving checkout line in departmental stores, especially, in holidays. With the decrease of prices through efficiencies of technology and large-scale production of semiconductor wireless components, there has been a search for new markets in which semiconductor chips can be used. This has led to the use of RFID also known as smart tags. RFID stands for Radio Frequency Identification.

In a very interesting article, the San Jose Mercury News tells us about Charles Walton, the man behind the radio frequency identification technology (RFID). In this paper we are using RFID technology for making an futuristic billing trolley. A device "BILLING TROLLEY" also called as "Data Logger Device" is an information storage system. Here the system parameters of an Futuristic Trolley like products name, products amount, company name etc. are continuously recorded. The system displays as well as announces the name of the product and cost.

This "FUTURISTIC BILLING TROLLEY" is also applicable for various applications and using proper interface the recorded data can be downloaded on and stored into a computer. The trolley being wireless consist of ZIGBEE module hence free to move in large area. The system is an efficient means for a commercial purpose as it is less time consuming and easy to control.

A shopping mall or shopping centers a set of buildings with retail shops with interconnecting walkways enabling visitors to easily walk from floor to floor .There has been a speeding growth in the number of shopping malls in India from late 2000 to early 2005.Within 5 years total number of malls in Mumbai has share of 31% and then Delhi, which has a share of 21% with 360 malls anticipated in India by 2007 and 600 malls by the end of 2010.[9]

The growth was fuelled by rising incomes, greater availability of credit and business lifestyles. Purchasing and Shopping at big malls is becoming daily activity in metro cities. We can see big rush at these malls on holidays and weekends. This crowd becomes huge when there are special offers and discount. People purchase different items and put them in trolley. After total purchase one need to go to billing counter for payments. At billing counter the cashier prepare the bill using barcode reader which is very time consuming process and results in long queue at billing counter.

The past two years have witnessed an explosion of interest in radio-frequency identification and supporting technologies, due primarily to their rapidly expanding using tracking grocery products through the supply chain.

Currently such applications monitor store-keeping units (SKUs) rather than individual goods, as the relatively high cost of RFID deployment and the very low profit margin of supermarket products make item-level tagging impractical.

Yet, economic and technical concerns aside, it is easy to envision a supermarket in which each item is tagged with an RFID label and all shopping carts feature RFID readers. The carts could potentially include onboard computers that recognize products placed inside and that display information and promotions retrieved wirelessly from the system back end. Item-level deployment of RFID technology would also allow for quick checkout aisles that scan all products at once and thus eliminate queues, which are consistently reported as one of the most negative aspects of supermarket shopping. A simple extension of this system would be to embed RFID devices in consumers' loyalty or frequent-shopper cards to identify individuals. This could expedite system login and charge the shopping cost directly to the customer's account at the point of sale-unless removed at the POS. [5,6].

2. EXISTING SYSTEM

2.1 TRADITIONAL BILLING METHOD

Currently available method in shopping malls is barcode method. In this method there are barcode labels on each product which can be read through specially designed barcode readers. A barcode reader (or barcode scanner) is an electronic device for reading printed barcodes. Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating optical impulses into electrical ones. Additionally, nearly all barcode readers contain decoder circuitry analyzing the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port.

When we select any product for buying we put it in the trolley and take it to the billing counter. The cashier scans the product through the barcode scanner and gives us the bill. But this becomes a slow process when lot of products is to be scanned, thus making the billing process slow. This eventually results in long queues. [7].

2.2 BARCODE VS RFID

If compared, RFID technology is found to be more comprehensive than barcode technology. It is possible to read RFID tags from a greater distance. An RFID reader can access the information of the tag from a distance of around 300 feet, whereas barcode technology can't be read from a distance of more than 15 feet. RFID technology also scores over barcode technology in terms of speed. RFID tags can be interpreted much faster than barcode tags. Barcode reading is comparatively slower because it requires a direct line of sight. On an average, a barcode reader takes around one second to successfully interpret two tags, whereas in the same time the RFID reader can interpret around 40 tags. RFID tags are well protected or either implanted inside the product, and hence is not subjected too much wear and tear. Interpreting a barcode requires a direct line of sight to the printed barcode, because of which the barcode is printed on the outer side of the product, and is thus subjected to greater wear and tear. It also limits the re-utilization of barcodes. As barcode lacks read and write facility, it is not possible to add to the information already existing on it. On the other hand rewriting on RFID tags is possible. [3].

3. Proposed system

3.1 BLOCK DIAGRAM OF THE SYSTEM AT TROLLEY

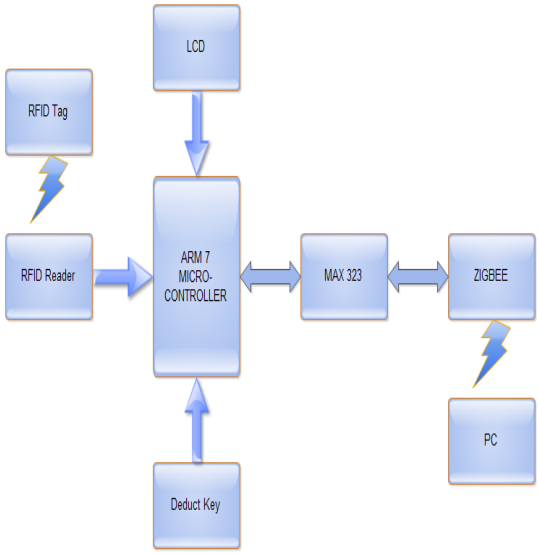

Figure 3.1: Block diagram

3.2 SYSTEM ARCHITECTURE

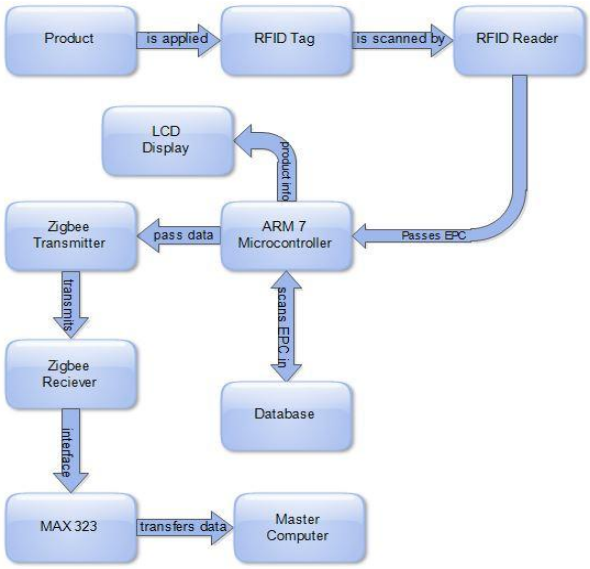

Figure 3.2: System Architecture

3.3 SYSTEM FLOW

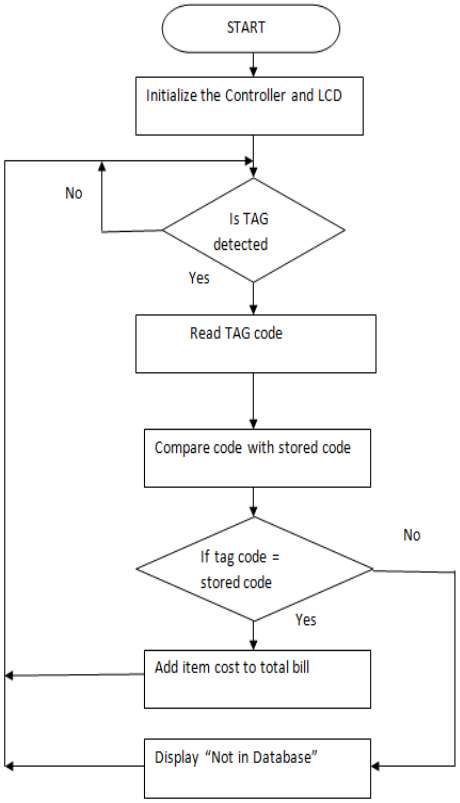

Figure 3.3: System Flow

Fig 3.2. System Architecture

In our Futuristic Billing Trolley system environment, each product will have the passive Radio Frequency ID tag which is bearing a unique Electronic Product Code.. This Electronic Product Code provides the info like name, price etc about the product.

When the customer will put the product in the Futuristic Billing Trolley, the Radio Frequency ID scans the tag and the Electronic Product Code number is known by Radio Frequency ID reader. Radio Frequency ID reader passes the Electronic Product Code to the ARM 7 micro-controller where ARM 7 compares the Electronic Product Code with the database of the system containing various products. After that the name and price of the product obtained by the ARM gets displayed on the LCD display of the Futuristic Billing Trolley, where user can see the product information.

The ARM 7 microcontroller also passes the data obtained from the database to the Zigbee transmitter from where the data is wirelessly transmitted to the billing computer. The master computer receives this data through Zigbee receiver using Max 323 interface. Max 323 interface is the interconnection media between the Zigbee receiver and the computer

Fig 3.3. System Flow

Algorithmic module: - As mentioned in Figure 3.1 and 3.2 following are the steps :-

1. All the items in the mall will be equipped with RFID tags. When person puts an item in the trolley, its code will be detected by RFID reader which is interfaced with processor. RFID reader is serially interfaced with LPC2138. It requires 12V supply for operation & after receiving the tag code it gives interrupt to the controller.

2. Reader send this code to ARM processor, after matching code with codes stored in SPI memory, processor reads item's name, cost & other details. Then it displays on LCD. The item details like name, cost & total bill of items inserted in trolley are displayed on LCD.

3. As we put the items, the costs will get added to total. Thus the billing is done at the trolley itself. Simultaneously all details are displayed on LCD. LCD used is 16X2 character alphanumeric type display. And also if we want to remove some inserted item then we press the deduct key and remove a particular item. That item's cost gets subtracted from total bill and item removal message is displayed on LCD.

4. To store the item price and total billing data, memory used is AT45DB161. It has capacity to store 2MB audio files on chip & is interfaced to microcontroller using SPI protocol.

5. LCD is interfaced with microcontroller in 4bit mode. It is used to indicate the customers the action taken by customer that is inserting of an item, removal of item, item's price and total billing cost of items in the trolley.

6. At the billing Counter the total bill data will be transferred to PC 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.

7. The ZigBee receiver is connected to billing PCusing RS3232 protocol, it receives billing data & gives it to the PC for printing. This data contains all details of purchased items with total bill of items. The total bill is displayed in Visual Basics 6.0. It shows name of every item, its corresponding cost and the total bill of all products. The bill is displayed in VB after GET DATA is clicked in screen.

8. The data send by ZigBee contains all details of the items purchased i.e. name of the item, it's price etc.

9. RFID tags we are going to use are 125 KHz passive type tags. Transponder (tag) that is attached to the object. An RFID tag is composed of a miniscule microchip and antenna. RFID tags can come in a wide variety of sizes, shapes, and forms. Communication between the RFID Reader and tags occurs wirelessly and generally does not require a line of sight between the devices. An RFID Reader can read through most anything. The RFID Reader emits a low-power radio wave field which is used to power up the tag so as to pass on any information that is contained on the chip.

10.We are going to use ZigBee modules (transmitter & receiver) to transmit the billing details from trolley unit to the billing PC at counter wirelessly when customer completes putting the items in trolley and reaches at counter for billing.

The person at counter clicks the GET DATA option and hence data is transmitted from trolley to the PC using ZigBee.

11. LCD is used as main output device for the customers. It displays the details of items, price and total bill etc to indicate the activity made by customer.

$(X_i, m, n) \longrightarrow Xf = \sum_{i=0}^{n}(m * X_i)$

Adding total cost of products

$Xb = \sum_{i=0}^{n}(Xf * n) \longrightarrow (Xb)$

- Input:
  - Xi is the cost of the product in the trolley
  - m is the number of products(same)
  - n is total number of products in the trolley
- Intermediate Values:
  - Xf is the cost of product along with its quantity
  - Xb is the cost of all products
- Output:
  - Total Cost: Xb

3.4 PCB Design

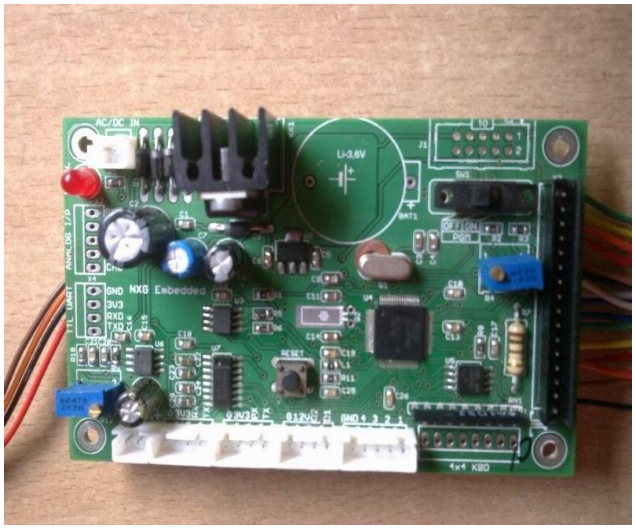

Figure 3.4: Printed Circuit Board

Fig 3.4 PCB Design

In our system, there are two PCB in which one PCB is a Dual Layer Green Masking for building the overall circuit & the another is a small Single Layer Green Masking PCB is made for LPC2138 header connections. The reason for using dual layer PCD is that it can accommodate higher density of components and the tracking of the circuit tracks is easier.The dimensions the PCB are 105mmX65mm.

4. BENEFITS OF RFID IN OUR PAPER

- Non Line-Of-Sight Technology

In traditional system we used barcode,so the product must be scanned one by one by considering line of sight.but in our system we simply put that product in trolley and it will get scanned automatically .

- Labor Reduction.

At the time of billing no need to check every product's cost. The operator will simply see the LCD cost, so it will reduce human resource.

- Enhanced Visibility.

As we are using ZIGBEE instead of other devices,it provides ous long range and high speed of data transmission.

- Reliability.

This is a reliable system as all the scanning and billing is handled by the system itself and adding and removing product will directly reflect on LCD as well.

- Security.

Every time when product is added bill is calculated, so no worry for miscounting.

- Ability to Withstand Harsh Environments.

As we are using RFID tag, it will not be affected by any harsh environment.

4.1 APPLICATIONS

- The main application of this system is at shopping malls to reduce the billing time and enhancing the shopping joy.
- The application is that it can also be used at Jewelers shop with some modifications.
- It can be used anywhere like shopping markets where the barcodes are used to good solution which avoids barcode technology.

4.2 LIMITATIONS

1. It cannot be used to keep the all sales track and item availability at the shopping malls.
2. We cannot implement the security regards to theft of items at malls by using the camera module in trolley level itself and keeping his track of events.
3. Using text to voice converter, we cannot implement the voice effect to notify the customer after inserting each item in trolley.
4. By using the smart card reader, we cannot make system which is used to billing through credit cards and ATM cards at trolley itself, and hence we can further reduce the overall billing time.

4.3 FUTURE SCOPE

The future of this system is very bright and progressive as it is key to cost savings and efficient management. Wireless futuristic trolleys can be integrated with Wi-Fi systems or for that matter even with the internet. In this way it would ensure a truly, electronic global supply chain management & inventory management. Moreover the scope can be expanded even more with slight modifications in following ways:

1. This technology can be used at airports because of its wireless nature and its ability to ensure better security.
2. With certain modifications it can be used to track movement of containers on docks and ports.
3. With the advent of futuristic systems, trolleys will eventually replace salesmen, hence helping in reducing final product of goods. As a result, better and more profit margin.
4. Global sales monitoring and inventory control from a geographically far off site.

5. CONCLUSION

Concluding this paper, we would like to highlight that we drew the inspiration and idea of this paper after observing large queues at the sales and billing counters at the Retail bazaars. While working on this paper we learnt substantially about RFID technology, embedded systems and wireless systems, especially ZigBee modules alike.

This system would help in cost saving at the supply chain level. At the same time it would also reduce the required no of

salesmen. Thus it is truly time saving method and guarantees the less time consumption out of all present billing methods.

6. BIBLIOGRAPHY

[1]ARM-LPC 2138 user manual by NXP Semiconductors.

[2]Dr.K.V.K.K.Prasad "Embedded/Real time operating systems" Dreamtech Publications 2010 Edition.

[3]Jay Warrior, Eric Mchenry & Kenneth McGee. They know where you are, IEEE SpectrumVol.40 (7), July 2003.

[4]RFID cashless/wireless payment.pdf

[5]Roussos G, BirkbeckColl." Enabling RFID in retail"IEEE Computer Magazine,Vol.39 , Issue:3PP: 25 – 30 ,20 March 2006.

[6]Thorsten Blecker& George Haung "RFID in Operations and Supply Chain Management"2008.

[7]www.buzzle.com/articles/how-does-a-barcode-scanner-function.

[8] www.ieee-RFID.org/2008

[9]www.siliconindia.com/shownews/India_to_have_600_shopping_malls_by_2010

[10]Jenny Lahr and Matt Des Marais "Mathematical Models of Consumer Preferences for Regional Malls" by Researchers: Jenny Lahr and Matt Des Marais