IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 7, July 2016

MIFARE: A New Technique for Smart Shopping Cart

Prajakta Kulkarni[1], Prof. Dr. Ashwini Barbadekar[2]

Student, Department of Electronics, Vishwakarma Institute of Technology, Pune, India[1]

Professor, Department of Electronics, Vishwakarma Institute of Technology, Pune, India[2]

Abstract: Shopping malls allow the customers to shop variety of products under one roof. Since it does not need the customers to go to various shops to buy different products, shopping in malls helps save the shopping time. Because of this, many people have started shopping in malls making them more and more crowded. So besides this big advantage, there is a major disadvantage of long billing queues taking much longer to bill the purchased products. Therefore it becomes pointless to go to shopping malls in order to save time. So if there were a system to generate the bill of shopped products automatically or simultaneously then it could save the billing time thereby revoking any need to stand in long queues. There are various techniques such as barcode scanner, camera, RFID tags and QR codes to generate the shopping bills on trolley itself. This paper presents a new technique that uses MIFARE tags and card reader to make the shopping trolleys smarter by introducing self billing upon them.

Keywords: Smart shopping cart, Barcode scanner, Camera, RFID tags, QR codes, MIFARE tags

I. INTRODUCTION

Nowadays, human lifestyle has changed. Day to day life of a normal human being has become a lot more hectic. Time has become money. So, people actually do not have much time to spend for shopping which is an inevitable thing. That is why people prefer shopping in the malls so that they can get all the products at the same place. This saves them from going into different shops to buy only a limited type of products. Though shopping in malls gives the advantage of saving time to people, they have only weekends to visit shopping malls. This creates a problem at the cash counter because of increasing number of customers. The customers have to stand in the billing queues for a lot more time than actual shopping time sometimes. Considering the general Indian population and way of thinking, the objective of the project is to design a smart trolley which will assist the customers in shopping by automating the billing process on the trolley itself which can easily be used by common people. The system should also keep a check upon total number of purchased and billed items in order to avoid wrong billing. The use of Mifare card reader and Mifare tags for the automation of billing process is the basic idea. The solution to the problem has been given by smart trolleys using different techniques till date. The methods used camera, RFID tags or barcodes to facilitate billing on the trolley itself [1]. The method using camera can be implemented using digital image processing to extract the barcode and read it. The system that uses barcode needs the customer himself to scan the barcode of the product using barcode scanner fitted on the trolley [2]. Another system used camera along with the barcode to keep a check on every customer's shopping [3]. The method using RFID tags provides near perfect solution scanning the tags within the mechanical limits of the trolley [4],[5],[6],[7]. Another system used QR codes to automate the billing. One more method used a smart card along with RFID tags to facilitate the payment[8]. In this method the customer needs to scan the QR code printed on the products through a mobile application [9], [10], [11], [12].

The first method using camera involves a lot of image processing and becomes difficult to implement. The last method using the barcode depends upon the customer himself to scan the product which is practically not feasible [2], [3]. Though the method using RFID seems to be a near perfect solution the tags being non-rewritable limits the level of performance [4],[5],[6],[7],[8]. The system involving QR code scanning needs unique QR codes for each and every type of products and a mobile application at the customer end which is too much dependency on the customer [9], [10], [11], [12].

The proposed system involves Mifare card reader and tags. Though the system seems to be like the RFID system, the tags provided here are rewritable. So the mall management can decide the data to be written on the cards which will then be scanned by the card reader fitted on the trolley by the user in order to bill the product. A sound notification will help the user be sure that the product has been scanned and billed successfully. This will ensure that the billing is correct. A constant display of the billed items will help the customer have an idea about the total amount. Till the time customer reaches the billing counter, bill will be ready and it will just be a matter of printing the invoice, paying the bill and removing the attached tags.

II. BARCODE SCANNER [2]

J.S.Awati and S.B.Awati proposed a smart trolley for mega malls using barcode scanner. According to their design the trolley will be fully automatic. The customers won't need to carry the trolley along with them but the trolley itself will follow the customer maintaining a safe distance from the customer with the help of obstacle

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 7, July 2016

detection. The way for customer to use the smart trolley is just to hold the barcode side of the product in front of the barcode scanner fitted on the trolley and then put it into the trolley. The system would ultimately facilitate the customer to shop a large number of products within a short time span. At the end of shopping the customer will just have to take the trolley to the counter i.e. he has to just walk to the counter and trolley will follow. At counter, the bill generated on the trolley will be verified and the customer will be allowed to take away the shopped products after bill payment.

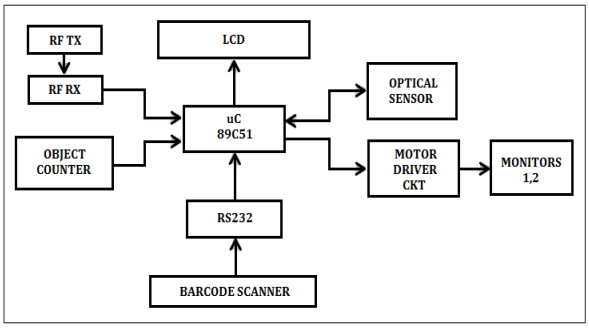

Fig. 1. Block diagram of Smart Trolley using barcode scanner [2]

Figure 1 shows the block diagram of the system proposed by J.S. Awati and S.B. Awati. The heart of the system is a microcontroller, 89C51. A barcode scanner is connected to the microcontroller through a serial interface RS232. There is an object counter which gives the input the microcontroller counting the number of products entering into the trolley. There is an optical sensor which measures the distance of the trolley from the customer. According to the distance measured, the microcontroller gives a signal to the motor drivers in order to move the trolley in the expected direction. Apart from this there is RF transceiver module connected to the microcontroller which will help the controller communicate to the server and bill the products properly. There is an LCD also fitted on the trolley which will continuously keep updating the billing data for customer's information.

III.BARCODE SCANNER WITH CAMERA[3]

Udita Gangwal, Sanchita Roy and Jyotsna Bapat proposed a system for smart trolley including camera and a barcode scanner in the design. It was basically a modification to the design suggested by J.S. Awati and S.B. Awati. This design added a camera to the design in order to keep a watch on proper billing of the products as the previous method depended heavily on the proper use of it by customer. The camera will keep recording the events and ultimately make sure that the bill generated on the trolley is the correct one. It will make sure that the product that is scanned will only be put inside the trolley thereby avoiding any false billing. A bill will be generated with an indicator either green or red. Green indicated correct billing while red indicates false billing. According to the indicator, at the end of shopping bill can be verified again and then the customer can make the payment and take away the shopped items.

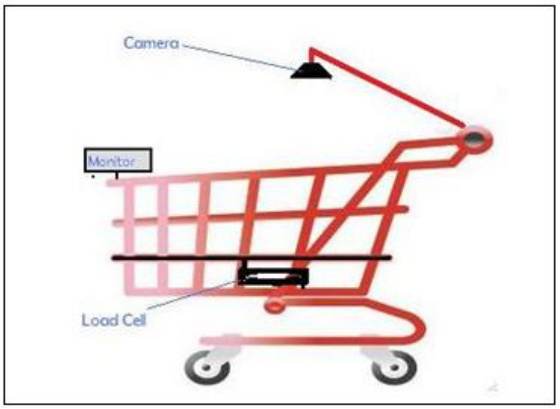

Fig. 2. Model of smart shopping cart using barcode scanner and camera [3]

Figure 2 shows an operative model of the system for smart shopping cart proposed by Udita Gangwal, Sanchita Roy and Jyotsna Bapat. The camera is used for surveillance. A load cell is nothing but a weight sensor which will keep a check upon the weight of products coming into the trolley. A monitor is used to provide a display of bill and accuracy of the same using the red or green indicator to the customer.

IV.RFID TAGS

One more technique involves RFID tags. A number of people suggested different designs for smart trolley using RFID tags. Satish Kamble, Sachin Meshram, Rahul Thokal and Roshan Gakre proposed 'Developing a Multitasking Shopping Trolley Based On RFID Technology'. [4] Aboli Hanwate and Poonam Thakare proposed 'Smart Trolley Using RFID'. [5] Galande Jayshree, Rutuja Gholap and Preeti Yadav proposed 'RFID Based Automatic Billing Trolley'. [6] Mr. Yathisha L, Abhishek A, Harshith R, Darshan Koundinya S R and Srinidhi K M proposed 'Automation of Shopping Cart to Ease Queue in Malls by Using RFID'. [7]
Figure 3 shows a general block diagram of smart trolley using RFID tags. It mainly consists of an RFID card reader, a microcontroller, a display and a xbee transceiver to communicate with the server.

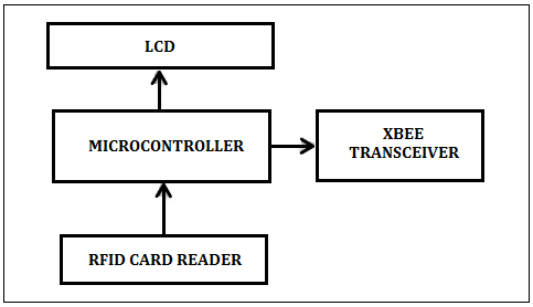

Fig. 3. Block diagram of Smart Trolley using RFID card reader

In this method, each product is identified with a unique RFID tag. An RFID card reader is fitted on the trolley. As the product enters the trolley the RFID tag attached to the product comes within the reader's range. The card reader

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 7, July 2016

reads the id of tag and sends it to the microcontroller. The microcontroller then sends the card details to the xbee transceiver which forwards it to the server. The server then fetches the related information and sends it back to the microcontroller through the same xbee transceiver. According to the received information, the microcontroller displays the billing information on the LCD fitted on the trolley.

V. RFID TAGS WITH SMART CARD

Sonali S. Dhokte, Bhagyashree S. Patere, Megha T. Magar, Vaidehi S. Kulkarni , Prashant S. Patil and Prof. Rajesh A. Patil proposed 'Smart Shopping Trolley Using Rechargeable Smart Card' [8], an extension to the smart trolley using RFID tags as noted above. The system includes a smart card in addition to the existing system using RFID tags.

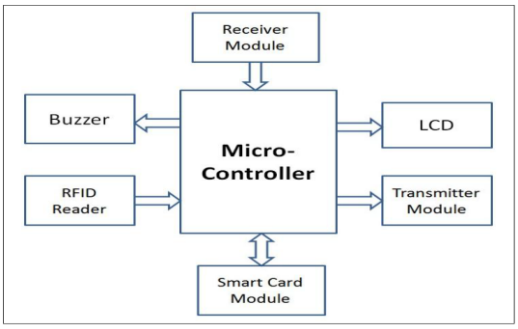

Fig. 4. Block diagram of Smart Trolley using RFID card reader along with smart card [8]

Figure 4 shows the block diagram of smart trolley using RFID card reader along with smart card. The system is almost similar to the one using RFID card reader only except for the addition of a smart card to each trolley. The system provides the customer with two options of payment namely through cash and/or through the smart card. The smart card works like a prepaid card. When the customer chooses the trolley, respective smart card will be pre-recharged with a certain amount of money. At the end of shopping, the customer can easily make the payment through the smart card.

VI. QR CODE SCANNER

One more method to design smart trolley is using QR (i.e. Quick Response) codes. A number of people proposed different designs of smart trolleys using QR code. Mira Almehairi and Tariq Bhatti proposed 'Adoption of virtual shopping: Using smart phones and QR codes' [9]. Rajat Lutade, Ankoor Tathe, Pankaj Kulkarni, Prabhakar Guttargi and Prof. V.V.Dakhode proposed 'Cut Checkout Waiting Time in Supermarket Using QR Code Technology [RAPP KART]' [10]. P. Sathishkumar, A. Selvaganesh and Mr.M. RameshKumar proposed 'Smart Shopping Using QR Code' [11]. One more design was proposed by Arbaaz Khan, Aadil Siddiqui, Zeeshan khan, Jasmine khan and Prof. Amit S Zore named 'Smart Trolley Using QR Code' [12]. The smart trolley using QR code technology basically involves a mobile application to read the QR code of a product which contains the information regarding that product. Here, every product is identified with a unique QR code assigned to it. A mobile application for smart shopping cart is developed through which this QR code is scanned at the time a product is selected by the customer for purchase. The application then decodes the QR code, communicates to the server and fetches the information related to the product. With the help of this information, billing procedure is conducted. The billing information can directly be received on the GUI of the application. Further, the transaction and billing system can be linked to the bank account details in order to make the payment easier for the customer.

VII. MIFARE TAGS

MIFARE being a well-known NXP brand for wide range of contactless IC products supporting read/write distance, typically 10cm are proven and reliable more than any other interface technologies in the market. These tags operate on a frequency of 13.56MHz. Backward compatibility within MIFARE product family ensures a smooth upgrade of infrastructure to higher security and feature levels. The leading products available are MIFARE Ultralight, MIFARE Classic, MIFARE Plus, MIFARE DESFire and SmartMX. Typical features of MIFARE can be listed down as follows:

- Compatibility with all current and future product families (proven by an independent Certification Institute)
- Highest security available via contactless interface (certified by Common Criteria)
- Broad product portfolio covering reader components as well as contactless and dual interface smart card ICs
- Multi-application memory to store several services on the same card
- Fast transaction speed (typical ticket transaction in less than 100ms)
- Multiple sourcing on all levels of the value-chain (ICs, readers, cards)
- High reliability - no moving parts, no battery

[13]

VIII. PROPOSED SYSTEM

The proposed system will basically involve self-billing upon the trolley in order to save the time and skip standing in long queues. The products will be identified uniquely with the Mifare tags attached to them. The products will be put into the trolley after scanning which will simultaneously generate the bill and also display the billed amount on the LDC fitted on the trolley.

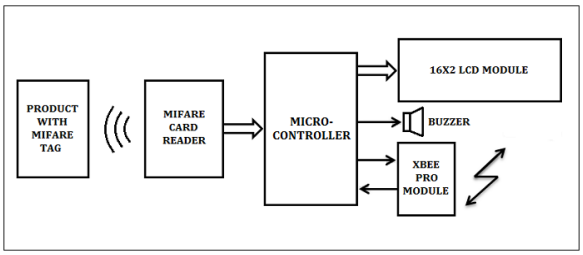

Fig. 5. Block diagram of Smart Trolley: Trolley side

Figure 5 shows the block diagram of the self-billing system for the proposed smart trolley. The system will be fitted on the trolley. Each and every product will have a Mifare tag attached to it. If the customer opts for the smart trolley, he needs to take the product and hold it in front of the reader system. The Mifare reader will read the tag and send its unique code to the arduino board through serial communication. The microcontroller interface is provided with the use of an Arduino module. Arduino module will give a signal to buzzer which will provide the sound notification (single beep) for successful read of the card to the customer. Arduino module will then send the same code to the server wirelessly through a xbee module. The xbee module will receive the details of total amount according to the price for the tag from the server and feed the same back into the arduino module. The arduino module will then display the total bill amount and the count of products purchased on the LCD. The data from server will also contain the trolley number so that the information related to the specific trolley only will be displayed and rest will be discarded. After successful reception of data from server, buzzer will get another notification from controller and beep twice indicating that the product is billed successfully. If the customer wants to cancel some products, he needs to scan them again while taking them out of the trolley so that the price is subtracted from the total.

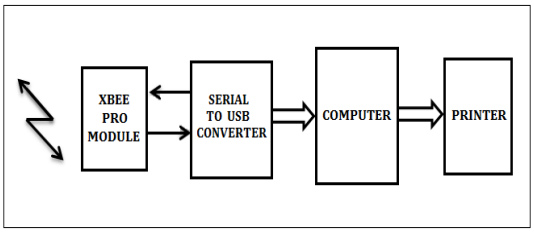

Fig. 6. Block diagram of Smart Trolley: Server side

Figure 6 shows the server side of the self-billing system using the smart trolley. The xbee module will initially receive the tag number scanned by a trolley and send it to the computer which will have the database for all the products. The tag number will be searched in the database and corresponding pricing information will be fetched.

An application will calculate the total by adding the price for that particular tag in the previous total. The details of all products, their prices and total will be displayed on the application. While doing this the existing list will be scanned first to check whether a tag is scanned for the second time which indicates the removal of a product from the trolley. In this case, the respective amount will be subtracted and total amount will be modified. The same total will be sent back to the trolley wirelessly through the xbee module. This is how till the customer finishes shopping the bill be ready. When the customer will reach the smart trolley counter, an employee of mall will give a command from the application GUI to generate the invoice and print the same. If the number of tags recovered and number of products displayed on the trolley matches customer will just need to pay the bill and get the shopped products home. If it doesn't, he will have to go back stand in a normal queue and get the products billed properly.

IX. CONCLUSION

There have been a number of systems designed for smart shopping carts in order to make shopping easier for the customers in malls and save the time of customers by avoiding the requirements to stand in long billing queues. These systems mainly use the techniques such as barcodes, QR codes, RFID tags, smart cards etc. The newly proposed system with the technique of MIFARE tags can prove to be a better solution to the problem of longer waiting time in billing queues by facilitating billing on trolley and keeping the invoice ready by updating it simultaneously. The system seems similar to the system using RFID tags but differs in operating frequency, scanning distance and mainly the availability of tags. MIFARE tags are available in different shapes and sizes so that they can be fitted to any kind of products easily.

REFERENCES

[1] Prof. S.H. Patil, Mayur Chaudhari, Amit Gore, Rajendra Kale, Prof. H.A. Hingoliwala, "A Survey on Technologies Used for Billing System in Supermarkets", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) ISSN(Online) : 2319-8753, ISSN (Print) : 2347 -6710, Vol. 4, Issue 10, October 2015.

[2] J.S.Awati, S.B.Awati, "Smart Trolley in Mega Mall", International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 3, March 2012).

[3] Udita Gangwal, Sanchita Roy, Jyotsna Bapat, "Smart Shopping Cart for Automated Billing Purpose using Wireless Sensor Networks", SENSORCOMM 2013 : The Seventh International Conference on Sensor Technologies and Applications.

[4] Satish Kamble, Sachin Meshram, Rahul Thokal, Roshan Gakre, "Developing a Multitasking Shopping Trolley Based On RFID Technology", International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-6, January 2014

[5] Aboli Hanwate, Poonam Thakare, "SMART TROLLEY USING RFID", International Journal of Research In Science and Engineering e-ISSN: 2394-8299 Volume: 1 Special Issue: 1.

[6] Galande Jayshree, Rutuja Gholap, Preeti Yadav, "RFID Based Automatic Billing Trolley", International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 3, March 2014).

[7] Mr. Yathisha L, Abhishek A, Harshith R, Darshan Koundinya S R & Srinidhi K M, "AUTOMATION OF SHOPPING CART TO EASE QUEUE IN MALLS BY USING RFID", International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, p-ISSN: 2395-0072, Volume: 02 Issue: 03 | June-2015.

[8] Sonali S. Dhokte, Bhagyashree S. Patere, Megha T. Magar, Vaidehi S. Kulkarni , Prashant S. Patil , Prof. Rajesh A. Patil, "Smart Shopping Trolley Using Rechargeable Smart Card", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 5, May 2015.

[9] Mira Almehairi, Tariq Bhatti, "Adoption of virtual shopping: Using smart phones and QR codes", Journal of Management and Marketing Research Volume 17 – October, 2014.

[10] Rajat Lutade, Ankoor Tathe, Pankaj Kulkarni, Prabhakar Guttargi,Prof. V.V.Dakhode, "CUT CHECKOUT WAITING TIME IN SUPERMARKET USING QR CODE TECHNOLOGY [RAPP KART]", ISSN:2348 – 6953, Multidisciplinary Journal of Research in Engineering and Technology, Volume 3, Issue 1, Pg.911-915.

[11] P. Sathishkumar,A. Selvaganesh ,Mr.M. RameshKumar, "SMART SHOPPING USING QRCODE", International Journal of Advanced Research in Computer Science Engineering and Information Technology, ISSN_NO: 2321-3337 Volume: 4, Issue: 3,Special Issue: 2 ,Apr,2016.

[12] Arbaaz Khan, Aadil Siddiqui, Zeeshan khan, Jasmine khan, Prof. Amit S Zore, "Smart Trolley Using QR Code", International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online) Vol. 3, Issue 4, pp: (218-224), Month: October - December 2015. https://www.mifare.net/en/aboutmifare/