Improved Error Accuracy and Range of RFID Based Product Identification for Smart Shopping

Paxal N Shah[1], Jasmine Jha[2]
[1]PG Student, Department of Computer Engineering, L. J. Institute of Engineering and Technology, Ahmedabad, Gujarat, India
[2]Assistant Professor, Department of Computer Engineering, L. J. Institute of Engineering and Technology, Ahmedabad, Gujarat, India

ABSTRACT

Internet of Things (IoT), will create a huge network of billions or trillions of "Things" communicating with one another. Ever since the debut of wireless technology, electronic commerce has developed to such an extent to provide convenience, comfort and efficiency in day-to-day life. In this paper, we discuss a ground breaking concept of RFID based Smart Shopping cart in the field of retail merchandise. Our whole shopping is often marred by the long checkout queue. A system to resolve this problem by replacing existing Barcode technology by smart tags, known as Radio Frequency Identification (RFID) tag is discussed in this paper. The key idea here is to provide assistance in everyday shopping in terms of reduction in time spent, eliminating the daily hassle of locating the right product and standing in long queue. The primary goal is to provide a technology oriented, time saving, hassle free, commercially oriented system for an enhanced shopping experience.

Keywords – *Internet of Things (IoT), Radio Frequency Identification, Smart Shopping*

1. INTRODUCTION

The Internet of Things (IoT) is regarded as a technology and economic wave in the global information industry after the Internet [7]. The IoT is an intelligent network which connects all things to the Internet for the purpose of exchanging information and communicating through the information sensing devices in accordance with agreed protocols [7]. It achieves the goal of intelligent identifying, locating, tracking, monitoring, and managing things [7]. It is an extension and expansion of Internet-based network, which expands the communication from human and human to human and things or things and things [7]. In the IoT paradigm, many objects surrounding us will be connected into networks in one form or another [7]. Radio Frequency identification (RFID), sensor technology, and other smart technologies will be embedded into a variety of applications [7]. Experts estimate that the IoT will consist of almost 50 billion object by 2020 [8].

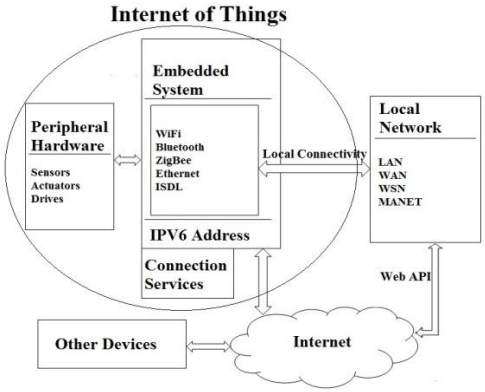

Fig-1: Internet of Things Basic Architecture

The main purpose of IoT is to simplify every day's work faster and much easier. One regular task that human spend considerable amount of time is in Shopping. The current scenario of shopping works in two categories 1) Shopping-in-Person and 2) Shopping-in-Absentia. The Shopping-in-Absentia is facilitated in multiple ways like online shopping or teleshopping whereas in Shopping-in-Person the person buys the product from the shopping place on various parameters like discounts, need, and convenience etc. According to current shopping scenario the customer has to wait for bill payment for a long time in the queue. Thus a solution to this is Radio-Frequency Identification (RFID) based product identification technique.

Radio Frequency Identification (RFID) involves a tag affixed to a product which identifies and tracks the product via radio waves [6]. These tags can carry from 1000 to 2000 bytes of data. This technology has three parts: a scanning antenna, a transceiver with a decoder to interpret the data and a transponder (RFID tag) pre-set with information about the product [6]. RFID tag will be scanned by the scanning antenna through the means of radio frequency signal that interacts with the tags [6]. When the RFID tag is within the field of the scanning antenna, it detects the activation signal and can transfer the information data in holds to be picked up by the scanning antenna [6]. The concept of Smart Shopping highly focuses on minimizing the time spent by the customers as well as intended to aid the store management with real-time updates on the inventory.

In this paper, a RFID based shopping technology is described which will help to make customer's shopping experience a better one **.**The rest of this paper is organized as follows. Section-II gives background about Smart Shopping. Section-III describes proposed system, Section-IV shows Experimental result and Section-V covers conclusion and future work.

2. BACKGROUND

The major concern of all the customers in shopping is the long wait in the queue once they have got all their needed products in the cart [1]. This scenario not only wastes the customer's time but also is dragging customers more towards the online shopping era. Thus it is very necessary to make the shopping easier and faster to make customer's buy their needed products in person.

The existing system used for generating the bill is Barcode or QR Code which needs to be scanned manually by the person standing at the billing counter [4]. This makes the process more complex as sometimes the damaged Barcodes or QR Codes are being not able to get scan properly, so the retailer has to enter the barcode serial manually.

Thus a Smart Shopping way is needed to avoid the loopholes of the existing system. In Smart Shopping the product will be automatically scanned while the customer places the product in to his/her cart. As soon as the product is placed in the cart, the RFID reader on the cart uses the RFID tag on the product to retrieve all the product information and display it to the LCD display attached on the cart. Once the product is added the customer is able to see the total amount for the product recently added and for the product that were added before it. The customer can also discard the product from the cart and the amount for the product will be deducted from the total amount displayed on the cart. Once the customer has purchased all the products the total bill can be seen by the customer on the display. Then the customer walks to an isolated area where again a RFID reader scans all the products in the cart and will display the total amount on the display and then the customer can pay for it using any convenient way. Also, when the customer places any product I the cart and if that product is very few in the inventory, then the inventory management is informed about the shortage of product so that product can be added in the market place.

3. PROPOSED SYSTEM

The major drawback associated with the shopping is the customer's time. The customer has to wait in the long queue for the bill payment. The Smart Shopping not only reduces the customer's time by providing them with this wireless system but also makes the shopping experience a way better than existing approach. In the existing system only one RFID scanner has been implemented but for one time scanning there is no information about: 1) No. of items scanned correctly, 2) No. of items not scanned by RFID and 3) No. of false position readings. In

the existing approach the frequency range of RFID tag is not defined. Thus we will try to propose a system to find out limitation of frequency range of RFID reader.

In this paper, we have proposed a product identification system that concentrates on saving customer's time as well as on false readings and miss readings also. Thus it will help the customer to have a better shopping experience. The proposed system is shown in Figure 2.

Fig-2: USB RFID Reader

Fig-3: Prototype for Smart Shopping

The following steps are performed in the proposed system:

1) Create the inventory system and billing system in VB forms
2) Allocate RFID Tag to inventory product
3) Create RFID interface for product identification
4) Scan the products and link them to data inventory
5) Create Billing System
6) Measure the successful reading, miss reading and false positive
7) Calculate efficiency and RFID range
8) Secondary verification in isolated area
9) Final Bill generation

4. RESULT ANALYSIS

Based on the experiments performed, using Barcode and RFID technology we have achieved following results. The Figure 4 shows the results of the RFID technology while first scanning. Next, the Figure 5 shows the RFID

results when doing secondary verification in an isolated area with a high range RFID reader. The Figure 6 shows the experimental results achieved while performing results using Barcode technology. The input for all the results achieved is as follows: Table-1, Table-2, Table-3 and Table-4 is and input for Figure 4, Figure 5, Figure 6, and Figure 7 respectively.

Total Reading	Correct Reading	Miss Reading	False Reading	Accuracy
10	10	0	0	100%
100	98	0	2	98%

Table-1: Input for RFID first scan

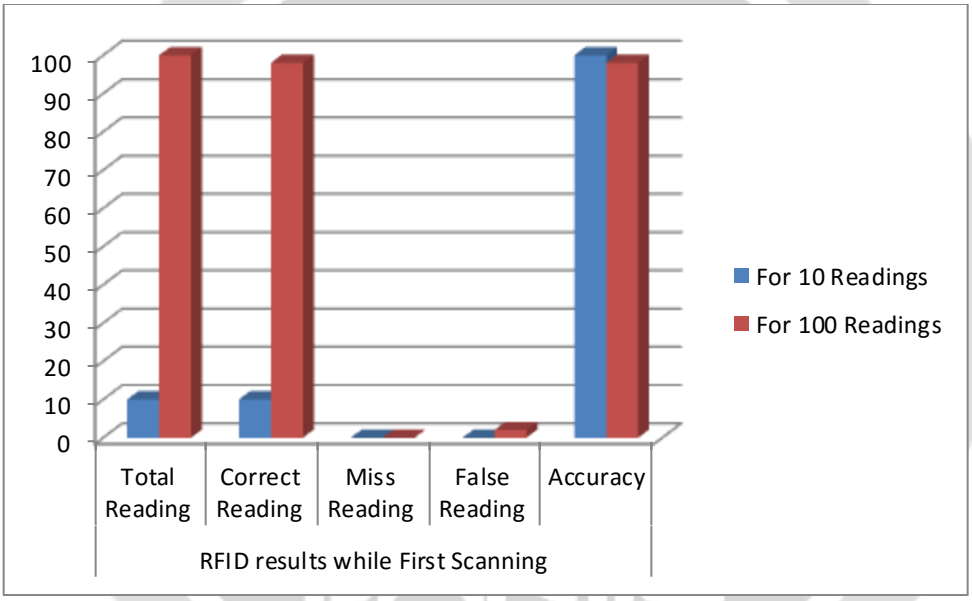

Fig-4: RFID results while First time scanning

Total Reading	Correct Reading	Miss Reading	False Reading	Accuracy
10	10	0	0	100%
100	99	0	1	99%

Table-2: Input for RFID secondary verification

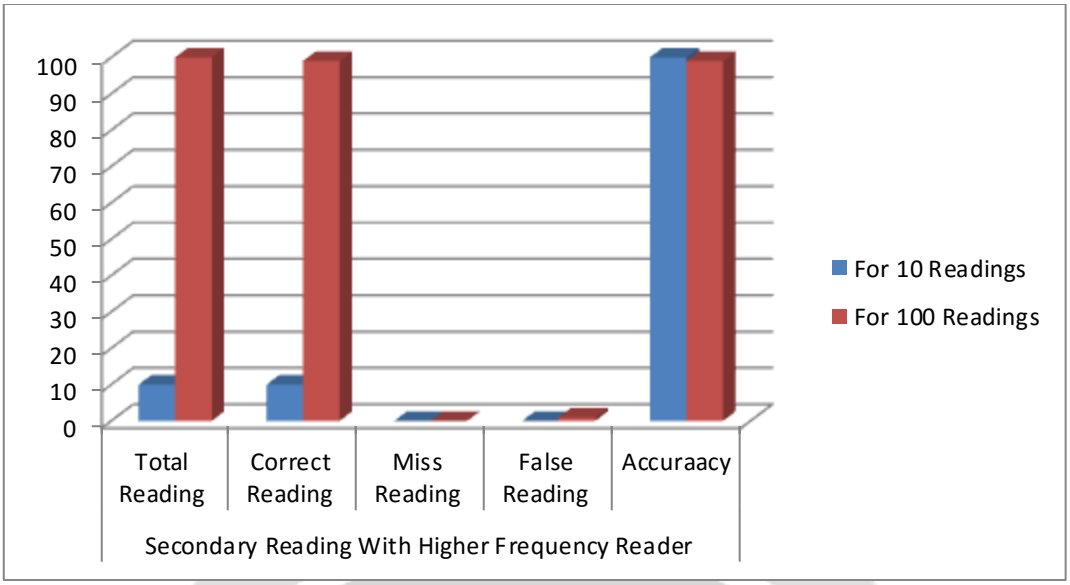

Fig-5: RFID results while Secondary verification

Total Reading	Correct Reading	Miss Reading	False Reading	Accuracy
10	10	0	0	100%
100	89	0	11	89%

Table-3: Input for Barcode

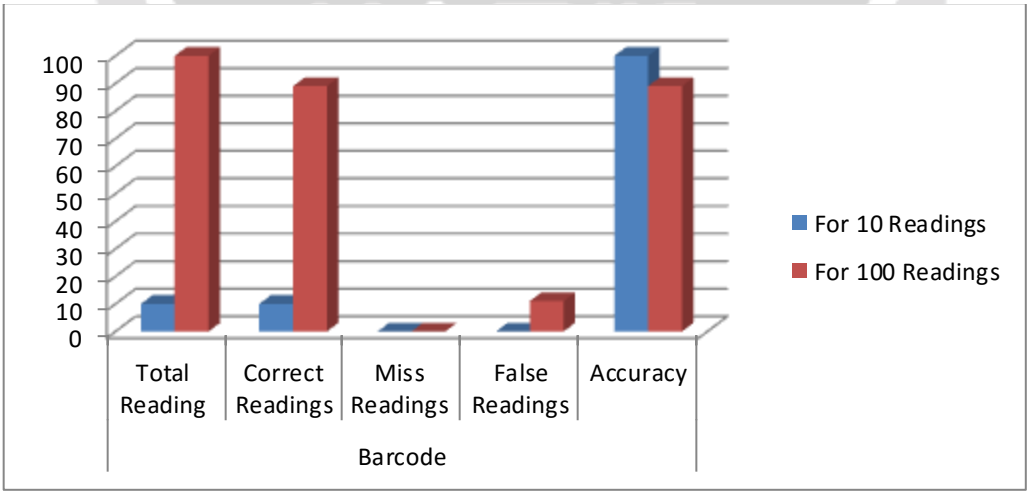

Fig-6: Results achieved for Barcode technology

From the experiments we come to know that RFID tag has higher accuracy than barcode results. Because in RFID we have unlimited frequency range. Barcode reader requires Line of sight while RFID does not need it. RFID has 360 degree capacity. Also, RFID has longer life span compare to Barcode.

5. CONCLUSION AND FUTURE WORK

The approach we applied will improve the shopping experience by making the shopping a wireless system which in turn will save the customer's time, energy and money; also helps him/her to easily pay the bill by not waiting in the long queue. The present trend points towards the fast growth of RFID in the near future. The proposed system will be implemented and the RFID will be created for different products. We have implemented RFID to inventory connection by data cable in future we can implement some wireless protocols and technologies like Zigbee and ANT+, this technology can also be implemented for any smart tag reader application like security and data transfer application.

6. REFERENCES

[1] Mr. P. Chandrasekar and Ms. T. Sangeetha, "Smart Shopping Cart with Automatic Billing System through RFID and ZigBee", ICICES2014, IEEE, 2014
[2] Chihhsiong Shih, Bwo-cheng Liang, Cheng-zu Lin, Nien-Lin Hsueh and Pao-Ann Hsuing, "An Automatic Smart Shopping Cart Deployment Framework based on Pattern Design", IEEE 15th International Symposium on Consumer Electronics, pp. 121-127, 2011
[3] Chonggang Wang, Bo Li, Mahmoud Daneshmand, Kazem Sohraby, Rittwik Jana, "On Object Identification Reliability Using RFID", Mobile Network Application, pp.71-80, Springer 2011
[4] Zeeshan Ali and Reena Sonkusare, "RFID based Smart Shopping: An Overview", International Conference on Advances in Communication and Computing Technologies, IEEE 2014
[5] Trupti Lotlikar, Rohan Kankapurkar, Anand Parekar, Akshay Mohite, "Comparative Study of Barcode, QR-code and RFID System", International Journal of Computer Technology and Applications vol. 4 no. 5 pp. 817-821, 2013
[6] Norsuzila Ya'acob, Mohd Mikail Mohd Efendy Goon, Mohd Zikrul Hakim Noor, "RFID (NFC) Application Employment on Inventory Tracking to Improve Security", IEEE Symposium on Wireless Technology and Applications, pp. 176-181, 2014
[7] Shanzhi Chen, Hui Xu, Dake Liu, Bo Hu and Hucheng Wang, "A Vision of IoT: Applications, Challenges, and Opportunities", IEEE INTERNET OF THINGS JOURNAL, VOL. 1, NO. 4, AUGUST 2014, pp.349-359
[8] Internet of Things, "https://en.wikipedia.org/wiki/Internet_of_Things", browsed on 19 Nov 2015 21:08