

A survey on barcode RFID and NFC

Thanapal P , Prabhu J and Mridula Jakhar

School of Information Technology and Engineering, VIT University, Vellore-632014 Tamilnadu, India.

E Mail: mridulajakhar@gmail.com

Abstract. Over the recent years, many industries have started implementing new technologies for tracing and tracking their products. These technologies are a kind of blessing to their management system. The technology and management system has to work in parallel to avoid loopholes in the system. We can see so many technologies around us and the most difficult and important part is to choose best out of all these new technologies. The important point which we need to take care while choosing a technology for the system is to make sure the technology can integrate properly with the other parameters in the management system. The industry management system consists of many levels such as initial level, intermediate level, final level and tracking. Nowadays tracking a product from its initial stage is becoming a trend. To cope up with this upcoming trend and also with the company demand, integrating the product with Barcode, RFID tags, NFC tag or any other traceable technology. Many supply chain Management system are also adopting this techniques.

1. Introduction

For preserving the originality of the product details and tracking technology plays great role. There are many products labeling security such as Barcode, RFID tags, NFC tags as we can store details of products in any of these labels [5]. Tracking and security of the product are generally being done when the product is ready to be dispatched, but if we assign the tracking techniques from the initial state of making the product, then the manual work of maintaining the data is reduced and can be utilized in some other task and also complexity is reduced and accuracy is being increase.

The idea behind making this kind of management system in the warehouse is to increase the accuracy, reducing the labor cost for counting the no. of the product, erasing human error. There are various methods to accomplish this problem of maintaining the product data from its initial state. The purpose of this survey is to develop a smart inventory tracking system by using upgraded technology which can be based on RFID or NFC for tracking the products being shipped [5]. As mentioned earlier, the upcoming technologies has great potentials in improving data, better information visibility, reducing Cost, resource planning and conveying and assigning good logistics resource planning [16].

With the movement of globalization, logistic is turning to be the strategic aspects in building competitive advantages in supply chains. There are several technologies which are employed to provide the efficiency and value to the integrated logistics organizations. The new technologies are now a days build up on “Internet of Things” which allows companies to track their goods by wireless through the supply chain and can run many other applications simultaneously [16].



2. Objective

The objective of the study is to have an overview about the new technology being introduced for logistics management system and explain how artificial intelligence techniques increase the proficiency and resource planning of logistic management system [16]. A disorganized warehouse is a pain when it fails to full fill the customer need and requirement and with this, it leads to poor customer experience and hence slows down the whole process. The outcome of the disorganized warehouse can affect the whole system process and also the relation between Customers and Retailers. The Aim and Objective behind this idea are to improve the work efficiency at the Warehouse and to avoid the mismanagement occurring at the warehouse.

3. Technology Aspects

The Barcode technology is the best and most effective form of labeling the products and maintaining the database. The barcode technology comes with different types and sizes depending upon the requirement. To read large quantities of data through optical machine barcodes are being used in a large extent [12].

There are 2 types of barcode: 1D and 2D. 1D stores information in horizontal direction and 2D stores in vertical as well as in horizontal direction by using organized blanks and bars, therefore 2D barcodes are able to solve defects such as low information density, poor, stability, low information capability which are present in 1D barcode. Therefore 2D barcodes are used more in industry community [11]. The barcode scanning has certain limitations on being scanned such as Line of sight (LOS), when the barcode is in LOS then only the product is being scanned. While labeling the product if the barcode is not pasted properly then also it is a problem in scanning the barcode.

The other technique that can be used in tracking a product is RFID technology, this technique is based on radio-frequency technique. The RFID contains antenna transceiver and transponder. The RFID tags are being attached to the products and then products are being tracked, the tags are passive tags they don't need any power supply or battery. The RFID technology has various assistances over barcode technology, such as greater perceptibility in supply chain networks, higher product velocity, more resourceful inventory management; reduced labor cost and reduced human error [2].

The other method is NFC technology and it is open platform, it has NFC tag which works in the electromagnetic field. The tag is passive tag doesn't require a battery or power supply. The tags can be re-written or read using a reader module. The scanning range of NFC is up to 10cm and its data transmission rate is 106kbps, 212kbps and 424kbps [5]. It full fills the upcoming modern warehouse/logistics management, and creates benefits for enterprise, and has great significance to endorse the development for logistics industries [13].

Table 1. Comparison of Technology

Tags	Range	Technique	Assemble With	Frequency	Data Retention
Barcode	3-5cm	Line of Sight	Single Product	-	Good
RFID	1 meter	Radio frequency	Bulky product	850~970 MHz	Good
NFC	2-3cm	Electromagnetic field	Single Product	13.60MHz	Good

Table 2. Comparison between NFC and RFI

Characteristics	NFC	RFID
Worked in	Electromagnetic field	Radio frequency
Constituents	NFC tags and reader	Antenna, Transceiver, Transponder
Range	Short range	Long range

Communication	Peer-to-peer,2-way communication	One way communication
Limitations	Single tag is being scanned at a time	Multiple tags can be scanned at a time
Protocols	Simple NDEF Exchange format NFC (LLCP)	ISO and EPC global
Applications	Payment can be made contactless; NFC is being embedded in Android smartphones.	Warehouse inventory, scanning baggage at Airport.

Table 3. Comparison with other Technologies [23]

	NFC	BLUETOOTH	RFID	Infrared
Set-up Time	<0.1 msec	~6 sec	<0.1 m sec	~0.5 sec
Range	Up to 10cm	Up to 30 cm	Up to 3 cm	Up to 5 cm
Speed	424 kbps(1 Mbps soon)	721 kbps	424 kbps	115 kbps
Network Type	Point to Point	Point-to-Multipoint	Point to Point	Point to Point
Mode	Active-Active, Active -Passive	Active-Active	Active-Active	Active-Active
Selectivity	High	Low	Partially Selective	Line of Sight
Usability	Human Centric, Easy	Data Centric, Medium	Item Centric, Easy	Data Centric, Easy
Price Value	Affordable	Medium	Costly	Low

4. Methodology

The methodology is the process of describing the whole process of the working from starting till the end of the process. The methodology has a great contribution while processing any system. The methods involved are: writing on tags, scanning of tags, and display data in any local host, retrieving all information of products.

The methodology Comprises of Hardware and Software Implementations and how they both integrate to perform the process.

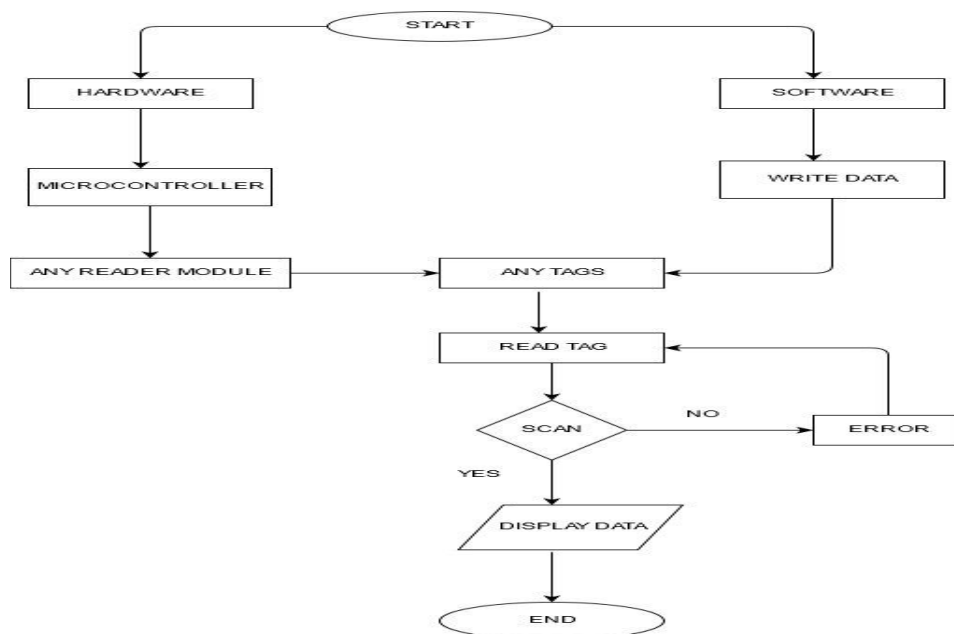


Fig. 1. System flow [5]

The above fig.1 describes the methodology of the process. The hardware side of the process consists of any microcontroller such as 8051, Arduino Uno, etc. The software part consists of the platform to write a program for tags or barcodes depending upon the requirement. The reader module will read the data written on tags or barcode. If the reader is unable to scan the data written on the tag then it will show error and will again read the tag. The data were written are being scanned by the device either phone or scanner or any reader module and display the content written on it. The data obtained from tags has to be maintained in a proper way via database management system.

5. System Architecture

A System Architecture is a theoretical model which defines the activities, arrangement and more over visions of a system. One can consider framework design as an arrangement of descriptions of a current (or future) framework. These portrayals at first depict a general, abnormal state useful association, and are logically refined to solid descriptions.

Framework trade passes on the illuminating substance of the components containing a framework, the connections among those components, and the guidelines representing those connections. The compositional parts and set of connections between these segments that an engineering description may comprise of equipment, programming, documentation, offices, manual systems, or parts played by associations or people.

A Framework engineering principally focuses on the inner interfaces among the framework's segments or subsystems, and on the interfaces between the framework and its outside condition, particularly the client.

The system architecture tells how the system is integrated with different components and how they work together to give the output. The Customer plays an important role in this scenario. The fig.2 explains the architecture of the warehouse.

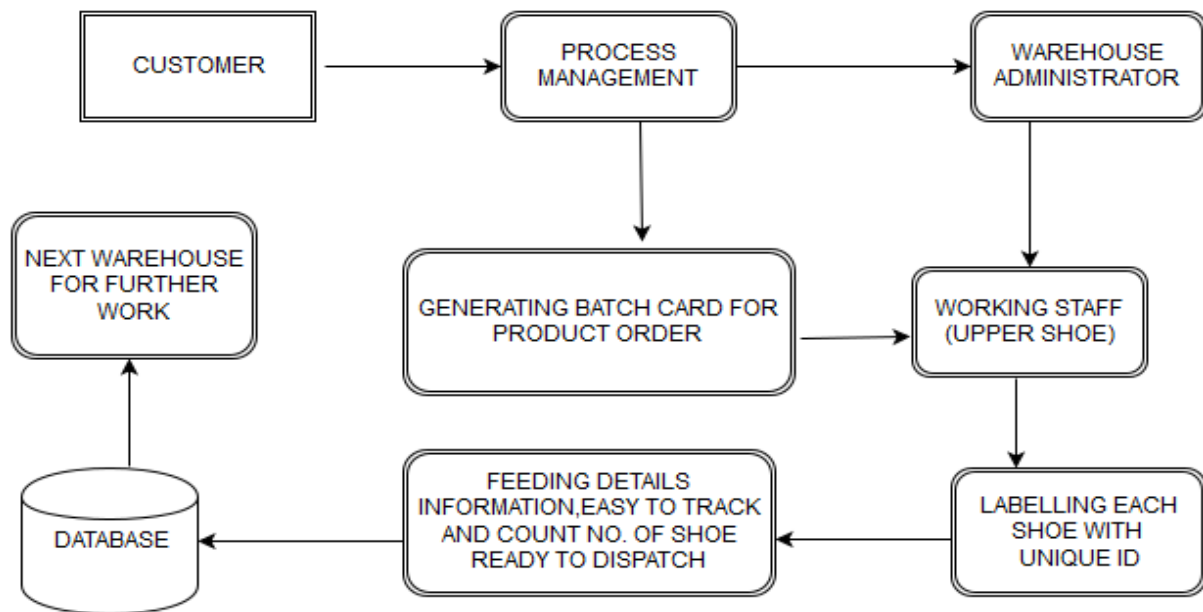


Fig. 2. System Architecture for warehouse

6. Result and Discussion

6.1 Barcode Technology

The barcode scanners are the one which are being used since long time and in coming years the hand handle scanners are being replaced by the mobile scanner device.

1st Qtr. Currently evaluating

2nd Qtr. No plans for Replacements

3rd Qtr. Will replace

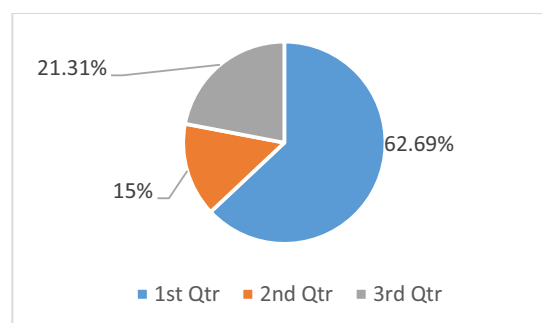


Fig. 3. Plan to replace purpose built scanner with mobile scanner device [7]

Some survey happens for VDC's regarding the mobile scanner evaluation and its users, and we found was that 62.69% of Organization are planning to replace their investments from built scanner to the mobile scanner [7]. The person who surveys about this went to places like warehouse inventory, hospitals, logistics etc.

Retailers are now trying to deploy mobile scanning to provide them a solution for their daily operations.

6.2 RFID in retailer Industry

From the study, we can see that the main reason for implementing this technique is just the Benefits. The Experts from the RFID software designing said that it is due to the reducing cost of reader and RFID tags, but some told that the security is the main reason of implementation [8].

1st Qtr. Big firms mandate

2nd Qtr. Decreasing price of tags and readers

3rd Qtr. Security reasons

4th Qtr. Benefits

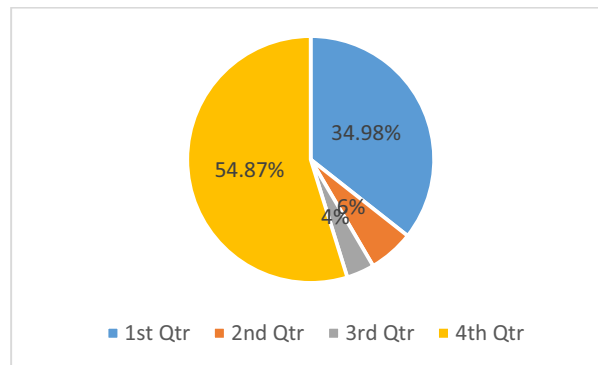


Fig. 4. Key features for adopting RFID technology in retail industry [8]

6.3 RFID vs. BARCODE

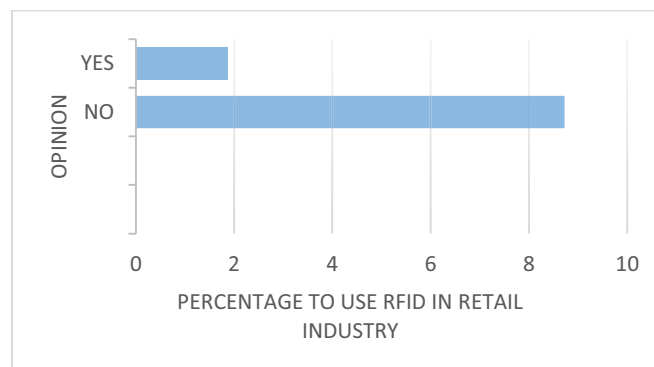


Fig. 5. Voting for RFID technology to be used in retail industry [8]

A person went to Sweden to survey about the adoption of techniques in retail supply chain, and table above tells about it. Thought 79.98% of the people said 'NO'. The majority of the people in Sweden agreed on the fact that RFID Technology has the brightest future but needs to be implemented completely [8].

6.4 Comparison of NFC with Barcode:



Fig. 6 Barcode/QR and NFC

Barcode Vs. QR	NFC Tgas
<ul style="list-style-type: none"> -Needs orientation for proper reading -User must select BP through app -Eco-friendly lighting questions -lower output -Storage in phone memory 	<ul style="list-style-type: none"> -ease of reading -No app reading -Not conditioned by environment -high performance -protected element storage option

Table 4. NFC vs. Barcode/QR [9]

7. Conclusion

The conclusion made from this survey is that tracking a product from its initial state to final state will reduce the human error and increase the efficiency of work at the Warehouse. There are several methods of tracking a product. The NFC and RFID tags have replaced the barcode technology, but still barcode technology are cheaper and hence can reduce warehouse cost [15]. This system is expected to track the product details from the tags and provide security from the third party fraud [5]. This method can be introduced in any of the warehouse and with any product type and even for supply chain management system [14]. The system architecture which is being presented is for building the management for tracking tags and also this architecture is not only built to provide a framework but also to achieve a uniform management system.

8. Future Scope

This can make can be implemented in various places except for the Warehouse such as Stationary shops, Shopping Complexes and even in a movie theater on the printed tickets and the security measures can be increased by placing high electromagnetic field on the gates so that if somebody tries to steal the tags they can be caught easily. The data stored in NFC tags can be made more secure by providing encryption and decryption key such as when somebody tries to change the data or some unauthorized person tries to read the data it will show some garbage value, but when an authorized person tries to read it he will use a decryption key to read the useful information, therefore in this way we can make it secure and can avoid it from attacks.

Table 5. Benefits and Future scope

	Card –emulation mode	Read/Write Mode	Peer-to-Peer mode
Benefits	<ul style="list-style-type: none"> -Physical objects Elimination. -Access Control through mobile devices. -All day objects combined at once place. 	<ul style="list-style-type: none"> -Increases mobility. -Decreases physical effort. -Ability to be adapted by many scenarios. -Easy to implement. 	<ul style="list-style-type: none"> -Easy data exchange between devices. -No devices pairing. Increased security.
Future Scope	<ul style="list-style-type: none"> -Integration of Id-card, passports, finger prints, driver license. -Storage area for critical information to provide user's privacy and authorizing people to access those information. 	<ul style="list-style-type: none"> Some data need to be read from an NFC tag and additional jobs will be done by NFC –enabled mobile phone. 	<ul style="list-style-type: none"> -Secure exchange of critical data. -Chatting -Psychological efforts need to be studied.

9. References

- [1] Olutayo Boyinbode and Olufemi Akinyede, April 2015 “A RFID based Inventory Control System for Nigerian Supermarkets” *International Journal of Computer Applications* (0975 –8887) Vol.116 –No. 7
- [2] Sanpechuda T, Wisanmongkol J, Kovaviraruch L, Wisadsud S, Wongsatho T, Chaiwongyen A and Charoenporn T, 14 October 2010 “A Case Study of RFID Data Management in Steel Transform Company”, *IEEE*
- [3] Sun Hong-ying, 26 May 2009 “The Application of Barcode Technology in Logistics and Warehouse Management”, *IEEE*, Vol.3:732-735
- [4] Jie Cui, Dong She, Jinyi Ma, Qingxin Wu and Jiaqiang Liu, 14 January 2016 “A New Logistics Distribution Scheme Based on NFC”, *IEEE*
- [5] Norsuzila Ya’acob, Mohd Mikail Mohd Efendy Goon, Mohd Zikrul Hakim Noor , Azita Laily Yusof, and Azlina Idris, 11 December 2014 “RFID (NFC) Application Employment on Inventory Tracking to Improve Security”, *IEEE*
- [6] Jonghyng Baek and Heung Youl Youm, 13 July 2015 “Secure and Lightweight Authentication Protocol for NFC Tag Based Services”, *IEEE*
- [7] <http://blog.vdcresearch.com> (21st April 2017)
- [8] Mostafa Aljawaheri, Syed Muhammad and Waqar Azeem, 2009 “Analysis of Implementation of RFID Technology in Retail Industry”, *IEEE*
- [9] <http://nfc-forum.org/newsroom/near-field-communication-forum-and-iata-publish-nfc-reference-guide-for-air-travel>. (21st April 2017)
- [10] Jiirgen Miiller ,Vadym Borovskiy, oleksandr Panchenko, Anja Bog and Alexander Zeier Hasso Plattner, 4 December 2009 “NFC at the Workplace - Simplify Enterprise Work Flows with NFC Urgent Muller”, *IEEE*
- [11] Jianhua Li, Yi-Wen Wang, Yi Chen and Guocheng Wang, 10 October, 2013 “Adaptive Segmentation Method for 2-D Barcode Image Base on Mathematic Morphological”, *Research Journal of Applied Sciences, Engineering and Technology* Vol.6 (18):3335-3342
- [12] Romulus TEREBES, Otmene LAHLOU, Romania and ENSEIRB, 2008 “Camera Phone Based Barcode Decoding System”, *ACTATECHNICA NAPOCENSIS Electronics and Telecommunications*, Vol.49,
- [13] Liu Ye, Yuhuan Wang and Jia Hui Chen, 2016 “Intelligent Warehouse Management System Based on Near Field Communication (NFC) Technology”, *International Journal of Advanced Pervasive and Ubiquitous Computing (IJAPUC)*
- [14] Ralph L. Harper, 15 April 2010 “Warehouse Technology in the Supply Chain Management Systems “, *IEEE*,
- [15] <http://multichannelmerchant.com/opsandfulfillment/barcodes/how-barcode-use-can-help-reduce-warehouse-costs14092010> (21st April 2017)
- [16] Yin Huang, Ying Xu, Shan Qi, Xiaoping Fang and Xin Yin, 1 February 2016 “Recent Patents on RFID-Based Logistics Management Systems “, *Bentham Science Publishers*, Vol.9
- [17] Olutayo Boyinbode and Olufemi Akinyede, April 2015 “A RFID based Inventory Control System for Nigerian Supermarkets”, *International Journal of Computer Applications* (0975 –8887) Vol.116 –No. 7
- [18] Aswin Chandrasekharan and Nikhail Venkat, 11 November 2013 “Barcode Enabled Event Management System for Logistics and Consumables Management”, *International Journal of Advance Research in Computer and Communication Engineering*, Vol. 2 (11)
- [19] Trupti Lotlikar, Rohan Kankapurkar, AnandParekar and Akshay Mohite, Sept-Oct 2013 “Comparativ study of Barcode, QR-code and RFID System”, *International Journal of Computer Technology and Applications (IJCTA)*, Vol.4 (5)
- [20] Hashim N M Z, Ibrahim N A, Saad N M, Sakaguchi F and Zakaria F, 4 July – August 2013 “Barcode Recognition System”, *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)*, Vol.2 (4)
- [21] <http://near-field.blogspot.in/p/pros-cons.html> (20th April 2017)

- [22] [http://nfc-bbysfu.blogspot.in/2012/07/advantages-and-disadvantage of nfc_ 22 .html](http://nfc-bbysfu.blogspot.in/2012/07/advantages-and-disadvantage-of-nfc_22.html) (20th April 2017)
- [23] Garima Jain and Sanjeet Dahiya, "NFC: Advantages, Limits and Future Scope"
- [24] Corn   Rentrop, Erik Rubinghb, Ruben Lelieveldb and Henrik Sandberg, 24 November 2014 "Roll-to-Roll Paper Sensors (RoPAS)" *Wireless communicating sensors on paper in the logistic chain*, *IEEE*
- [25] Jonghyng Baek and Heung Youl Youm, 13 July 2015 "Secure and Lightweight Authentication Protocol for NFC Tag Based Services", *IEEE*
- [26] Huijing Zhan, Sheng Li and Alex C. Kot, 10 September 2015 "Tagging the Shoe Images by Semantic Attributes", *IEEE*