A survey on barcode RFID and NFC

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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. |

| NFC          | BLUETOOTH           | RFID             | Infrared         |
|--------------|---------------------|------------------|------------------|
| **Set-up Time** | ~0.1 msec | ~6 sec | ~0.1 m sec | ~0.5 sec |
| **Range**     | Up to 10 cm | 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 |

**Table 3. Comparison with other Technologies [23]**

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.
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.
6. Result and Discussion

6.1 Barcode Technology

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

1st Qtr. Currently evaluating
2nd Qtr. No plans for Replacements
3rd Qtr. Will replace

![Pie chart showing the distribution of scanner replacement plans]

Some survey happens for VDC’s regarding the mobile scanner evaluation and its users, and we found was that 62.69% of organizations 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]](image)

6.3 RFID vs. BARCODE

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

A person went to Sweden to survey about the adoption of techniques in retails 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](image)
### Table 4. NFC vs. Barcode/QR [9]

| Barcode Vs. QR                                      | NFC Tgas                                               |
|-----------------------------------------------------|--------------------------------------------------------|
| -Needs orientation for proper reading               | -ease of reading                                       |
| -User must select BP through app                     | -No app reading                                        |
| -Eco-friendly lighting questions                     | -Not conditioned by environment                        |
| -lower output                                       | -high performance                                      |
| -Storage in phone memory                             | -protected element storage option                      |

#### 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

| Benefits | Card –emulation mode | Read/Write Mode | Peer-to-Peer mode |
|----------|----------------------|-----------------|-------------------|
|          | -Physical objects Elimination. | -Increases mobility. | -Easy data exchange between devices. |
|          | -Access Control through mobile devices. | -Decreases physical effort. | -No devices pairing. |
|          | -All day objects combined at once place. | -Ability to be adapted by many scenarios. | Increased security. |
| Future Scope | -Integration of Id-card, passports, finger prints, driver license. | Some data need to be read from an NFC tag and additional jobs will be done by NFC –enabled mobile phone. | -Secure exchange of critical data. |
|          | -Storage area for critical information to provide user’s privacy and authorizing people to access those information. | -Easy to implement. | -Chatting |
|          |                                                                 | -Psychological efforts need to be studied. |
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