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# QR Code and RFID Agile Tags Provide Secure Data Extraction

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## ABSTRACT

QR Codes, barcodes, and RFID are all methods for encoding vast quantities of data in a small space. They provide benefits like as speed, labor savings, and cost savings, among others. These codes can be used in libraries as paper-free labels, library ID cards, and for acquiring information from a librarian, library instruction, and also for marketing. The study compares and contrasts barcodes, QR codes, and RFID, as well as their properties, applications, and operating components. A barcode is a machine-readable visual representation of data about the object to which it is attached. The usage of a wireless non-contact technology that employs radio-frequency electromagnetic fields to transport data from a tag affixed to an item for the purposes of automatic identification and tracking is known as radio-frequency identification (RFID). QR codes are a simple technique to show a tiny amount of information that can be read and processed by mobile devices, allowing physical things to virtually become interactive by delivering information that can be scanned like a website URL. It is feasible to develop software-reconfigurable hardware that can identify all prevalent types of EAS labels and RFID tags. Finally, this article will analyse all three technologies on a variety of factors such as durability, functionality, applications, and limits in order to conclude which one is the best.

***KEY WORDS*:** RFID, Barcode, QR-code, Agile Tag Reader, Security of QR Codes

## 1. INTRODUCTION

Sharing information across a communication network has never been easier thanks to tremendous advancements in communication technology. Information is now handled electronically and disseminated over public networks. Because such networks are insecure, sensitive data must be safeguarded in some way. The study of mechanisms that allow us to achieve this is known as cryptography. Various cryptographic algorithms and firewalls are used to protect information from a variety of computer and network assaults. However, no one method can guarantee total safety.

The use of internet and sharing information are growing increasingly across the globe, security becomes a vital issue for the society. Security attacks are classified as passive attacks and active attacks [8, 9]. In passive attacks, attacker monitors network traffic and looks for sensitive information but does not affect system resources. Passive attacks include traffic analysis, eavesdropping, Release of message contents [8, 9]. In active attack, attacker breaks protection features to gain unauthorized access to steal or modify information. Active attacks include masquerade, replay, modification of messages, and denial of service [8, 9].Therefore, security threats (such as eavesdropping, data modification, phishing, website leaks etc.) force us to develop new methods to counter them. Considering QR barcodes as an effective media of sharing information, many researchers have proposed information/data hiding methods as well as online transaction systems [1,2,3,4,5] using QR barcode. In this paper, we describe different information hiding schemes using QR barcode.

## 2. BACKGROUND

Since the barcode scanner was first introduced in 1974 and Wrigley's Gum became the first item to have a barcode on its packaging, barcodes have largely been regarded as the most convenient way for retailers to look up information about an item and keep track of inventory. Barcodes are quick, accurate, and easy to use, leaving little paper waste and little room for human error; it's no wonder that they're so widely used. They are versatile with a large variety of uses especially in retail and manufacturing settings, and in transport and shipping.
We're used to seeing the common barcode printed on packaging at the grocery store or in other retail outlets, when items are passed over the barcode reader at the checkout counter to ring up a sale.

Barcodes not only are valuable at the point of sale, but also for managing inventory and raw materials internally, so that you know what you have in stock. Barcodes have become common in shipping, to enable greater accuracy and speed in getting packages delivered. And barcodes are used to manage large filing systems, library books, and a host of other purposes where large numbers of items need to be tracked efficiently. Barcodes are relatively inexpensive, and help drive speed, efficiency and profitability.

## 3. BARCODES

A barcode is an optical machine-readable representation of data relating to the object to which it is attached. Originally barcodes systematically represented data by varying the width and spacing of parallel lines, and may be referred to as linear or one-dimensional. Later they evolved into rectangles, dots, hexagons and other geometric patterns in two dimensions (2D). Although 2D systems use a variety of symbols, they are generally referred to as barcodes as well. Barcodes originally were scanned by special optical scanners called barcode readers. The different regions of barcode are as follows:


**Fig 3.1: Barcode structure**

### A. STRUCTURE OF BARCODE

1. *Quiet Zone:* The minimum required space for bar code scan-ability, preceding the Start Character of a bar code symbol. The quiet zone should be free from any printing and be the same color and reflectance as the background of bar code symbol. The Quiet Zone should be ten times the width of the narrowest element in the bar code, or 0.25 inch minimum, also known as Clear Area.
2. Start Code: Indicates the start of the barcode. These are special bar code characters & they signify the start of data to the scanner/reader. Start characters are usually stripped-off and not transmitted to the host.
3. Check Digit: Check digit (not always present) is a mathematical sum that is used to verify the accuracy of the other elements of the barcode. It is the extra digit added at the end of a bar code to allow the scanner to confirm that it read the bar code correctly. It is typically stripped from the data and not transmitted to the host.
4. Stop Code: Indicates the stopping point of the barcode. These characters signify the end of data to the scanner/reader. They are also stripped-off and not transmitted to the host.

### B. WORKING OF BARCODE

Laser beam is incident on a mirror/prism which is then directed on the barcode from left to right. The dark bars of barcode absorb the incident light but the light is reflected by light spaces. Photodiode measures the reflected light and gives out electrical signal. The analog electrical signal is then converted into digital one. And corresponding barcode is read.

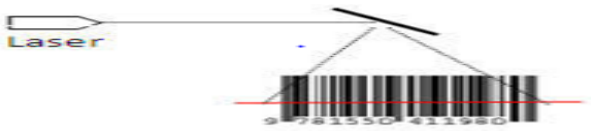


**Fig3.2: Working of Barcode**

## 5.QR CODES

A recent trend among small businesses is the growing use of QR codes. QR codes (pictured below) are similar in one sense to bar codes, in that they contain information which can be read by a QR code reader.

QR codes can be scanned and read by a camera-equipped smart phone when you've downloaded a scanner app, such as i-nigma for the iPhone. What this means is that the average person can now de-code (read) a QR code, without special equipment. You could walk into a place of business, see a QR code on an item, scan it with your smart phone, and immediately have access to a lot of information electronically.


**Fig 4.1 Contain Data**

QR codes have been around for years. But in the last 12 months I've seen usage skyrocket among entrepreneurs as mobile usages has grown. QR Codes are well suited for marketing purposes, among other uses. For example, now it is becoming more common to receive business cards with QR Codes on them. That way, you get access to a lot more information than can fit on a small card. For instance, you might hand out business cards at an event containing a QR code that leads people to a Web page with a special offer for attendees. Or the QR Code on a business card might contain a V-card (digital business card) that you can save without having to manually input the card information.
QR Code, also known as "Quick Response" code, is a two dimensional matrix barcode that can store over 1800 characters of text information.

A QR code can store information [7] such as:

• Website URL
• SMS
• Text message
• Calendar event
• Contact Information
• Phone number
• Geographic location


**Fig.4.2.The formation of QR Code**

The QR (Quick Response) Code is a two-dimensional (2-D) matrix code that belongs to a larger set of machine-readable codes, all of which are often referred to as barcodes, regardless of whether they are made up of bars, squares or other shaped elements. Compared with 1-D codes, 2-D codes can hold a larger amount of data in a smaller space, and compared with other 2-D codes, the QR Code can hold much more data still. In addition, an advanced error-correction method and other unique characteristics allow the QR Code to be read more reliably than other codes.


**Fig 4.3: QR code and Barcode**

**Working of QR-Code**

Step 1: Launch the application on your device.
Step 2: Use the view finder on screen of device to center the QR code inside the scanner then hold the device still until the scanner has captured the image.
Step 3: Perform the action indicated on your phone screen to discover what information the QR code contained. For example, a link to a website could appear on screen prompting you to click the link and be directed to the site of the QR code creator.

## 6. RFID

RFID (radio frequency identification) has likewise been around for decades. However, RFID tends to require more technological hand-holding. RFID involves applying RFID tags to items or boxes or pallets. Tags vary greatly in size, shape and capabilities, but one example is pictured below. The tag with its small antenna emits a radio frequency signal that is picked up and read by a special wireless RFID reader, conveying information from the tag about the item it is affixed to.

RFID, or Radio Frequency Identification, allows the reading and capture of information stored in tags via radio waves. The system consists of two parts- a tag or transponder and a reader- that pass signals to one another.

Currently, RFID tags are used a wide variety of industries, ranging among mobile payment, healthcare, retail, amusement parks, casinos, Redbox, gun control, and car rental. You've probably most commonly seen RFID tags used in theft prevention in retail (cashiers must deactivate tags before you pass through the scanner by the entrance to the store). RFID tags are also used to track animals, to open security-locked doors, to pay freeway tolls electronically, and to track things like shipping containers, heavy machinery, trucks, and railroad cars.

In addition to their versatility, RFID tags are helpful because the scanners can communicate with multiple tags at once and they don't need to be pointed directly at a tag or in a direct line of sight in order to receive a signal. RFID tags are small and less invasive, yet they're also tough enough to withstand damage. Interestingly enough, the seeds of RFID technology were developed by the Russian military in the latter stages of WWII as a listening device, and one concern with the technology now is its potential to be used as a corporate espionage tool. Furthermore, the fact that the signal can be read by any nearby reader can pose security risks, and people can also remove the tag so that it doesn't trigger the security system. The final, and perhaps most commonly cited downside, is that RFID tags also require high startup costs.

For the moment, companies don't seem to be moving away from barcodes and QR codes- especially smaller businesses without the funds to spend high startup costs on RFID tags and scanners.

But while mobile barcode scanning seems to be increasing, the advantages of RFID technology (its versatility, the fact that it's more easily secured from data breaches, and the technological improvements that are closing the price gap) are making RFID more viable in manufacturing and retail settings – and paving the way for it to be the wireless tracking technology of the future.

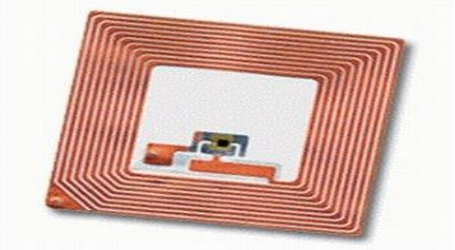

**Fig 5.1 RFID example**

RFID is adaptable to many of the same uses that barcodes are good for. But RFID is especially useful in situations where vast quantities of goods must be moved or tracked, or where tracking of item-specific information is necessary. RFID has been mandated by some customers, such as Wal-Mart and the Department of Defense, to track the vast quantities of items they require in their supply chains and to supply much more

detailed information. In such situations, RFID may be able to do it more quickly, effectively and efficiently than barcodes.

A tag consists of a microchip that stores a unique sequence identifier that is useful in identifying objects individually. The sequence is a numeric serial, which is stored in the RFID memory. The microchip includes minute circuitry and an embedded silicon chip [16]. The tag memory can be permanent or re-writable, which can be re-programmed electronically by the reader multiple times. Tags are designed specific to its applications and environment. For example, paper-thin tags are attached to books in a library management system].

**Types of RFID**

1. **Active tags:** Because they have their own power source, active tags transmit a stronger signal, and readers can access them from further away. The on-board power source makes them larger and more expensive, so active RFID systems typically work best on large items tracked over long distances. Low-power active tags are usually slightly larger than a deck of playing cards. Active tags can remain dormant until they come in range of a receiver or can constantly broadcast a signal. Because of their on-board power source, active tags operate at higher frequencies—commonly 455 MHz, 2.45 GHz, or 5.8 GHz—depending on the application‘s read range and memory requirements. Readers can communicate with active RFID tags across 20 to 100 meters.

2. **Passive tags:** Passive tags, on the other hand, are very inexpensive; they can cost as little as 20 cents apiece, and new technologies are constantly making them cheaper to integrate into common materials and products. In addition to their low cost, passive tags can also be quite small. Current antenna technology limits the smallest useful passive tag to about the size of a quarter. The larger the tag, the larger the read range. Currently, passive RFID tags contain about 2 Kbits of memory. This is too small to hold much more complex information than identification and history information. The technology behind RFID is constantly improving, so the amount of information and capabilities of RFID tags will increase over time, allowing RFID tags to eventually contain and transmit much more information.

## Working of RFID

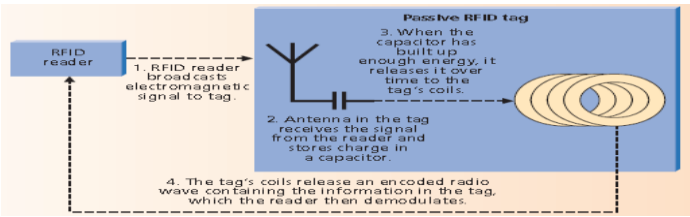


**Fig5.2. Working of RFID**

A passive-tag reader can constantly broadcast its signal or broadcast it on demand. When a tag comes within the reader‘s range, it receives an electromagnetic signal from the reader through the tag‘s antenna. The tag then stores the energy from the signal in an on-board capacitor, a process called inductive coupling. When the capacitor has built up enough charge, it can power the RFID tag‘s circuitry, which transmits a modulated signal to the reader. That return signal contains the information stored in the tag. The communication between the reader and passive tag uses one of two methods to modulate the ID signal.

Low-frequency (less than 100 MHz) tags pass information by releasing energy from the capacitor to the tag coils in varying strengths over time, which affects the radio frequency emitted by the tag. The reader detects these varying waves and can use these variances to demodulate the code. Figure 5.2 shows this load modulation. In higher-frequency (greater than 100 MHz) tags, the tag transmits the signal using backscatter, in which the tag‘s circuit changes the resistance of the tag‘s antenna. This change in resistance causes a transmission of RF waves, which the reader can pick up and demodulate. Passive tags typically operate at frequencies of 128 KHz, 13.6 MHz, 915 MHz, or 2.45 GHz, and have read ranges of a few inches to 30 feet. Frequency choice depends on the system‘s environment, what material the signal must travel through, and the system‘s required read range. RFID tags can be encased in many materials. Plastics are a very common material for RFID, forming identification cards for building access, credit cards, or bus fares. Tags can also go on the back of labels printed on standard ink jet printers, for placement on inventory.

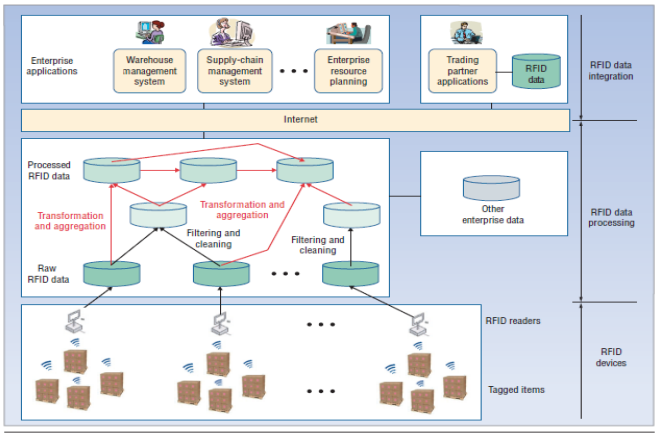


**Fig 5.3 A Generic RFID framework**

Figure 5.3 shows a generic RFID framework. Interactions in RFID applications occur at three layers. The devices layer consists of RFID tags and readers as well as RFID protocols.

The data processing layer consists of several software components for communicating with RFID readers, filtering and cleaning RFID data, and adapting such data for high-level applications including semantic filtering and automatic data transformation and aggregation. The data integration layer consists of applications that exploit local RFID data as well as RFID data coming from outside business entities.

## 7. COMPARISONS BETWEEN QR CODES, BARCODES, AND RFID

In the same way that RFID, Barcodes, and QR codes are data gathering technologies, they all automate the data collection process. They do, however, differ dramatically in a number of areas. Although the focus of this comparison is on the benefits of RFID over barcodes and QR codes, barcodes do have certain advantages over RFID, such as their low cost. [6]. To be read by a scanner, QR codes and barcodes must be in line of sight; however, this is not needed in the case of RFID. Because radio signals may pass through things, they can be used to scan a large number of RFID-tagged objects at once, and orientation is not an issue. Barcode and QR code accessibility ranges from a few feet to a few inches, but RFID accessibility ranges from a few metres to a few metres. The most crucial advantage of an RFID tag is that it can be reused, and the contents on it may be changed as many times as needed, which is not feasible with a barcode or RFID. RFID tags are also more durable than barcodes and QR codes; even if they are damaged, the information inscribed on them may be read. Barcodes hold the least amount of data, followed by QR codes, while RFID may store a lot of data.


**Fig 5.4 Comparative example of barcode, QR code and RFID**

## 8. CONCLUSION

This paper compares the implementation of bar code, QR code, and RFID technologies. It demonstrates that RFID can provide faster scanning speeds than barcode QR scanning. One of RFID's numerous advantages,

according to the literature, is that tags may be read without being in the user's line of sight. This makes it instantly preferred to barcode and QR code technology in the vast majority of operating scenarios where product flow is critical, such as entering and exiting refrigerated warehouses. New advances in two-dimensional barcodes and laser scanning equipment, on the other hand, may be able to reduce the time it takes to scan barcodes, and further empirical research into this technology is needed. As a result, RFID stands out as a promising technology when compared to other commonly used technologies. RFID, barcodes, and QR codes all have their place for different reasons and in different situations. The cost of acquiring and using it continues to decrease with each passing year, as it does with most other technologies. So there's no reason not to use technology to run your business more efficiently and effectively; it's just a matter of deciding which technology is best for your requirements and budget. Although barcodes are simple to use and affordable, the amount of information they can encode is restricted.

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