

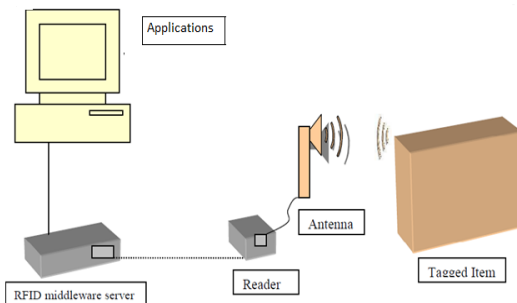
RFID Technology: The cutting frontier in wireless monitoring and control

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Abstract- In This paper we investigate about RFID technology. RFID stands for radio frequency identification. As the term itself denotes that, it is a system of identification which uses radio frequency to communicate. The basic components of RFID system are the tag and reader. Tag is the device used to identify the object which is to be tracked. The device that identifies the Tag and reads the information stored on it is called Reader. This information is further carried to a system which acts as an interpreter between the reader and applications. This is called RFID middleware. RFID is a technology that employs a microchip with an antenna that broadcasts its unique identifier and location to receiver. In this technology, radio frequency electromagnetic fields are used to transfer data to identify and track automatically the tags attached to various objects. These tags usually contain electronic information. RFID system can be used just about anywhere, from clothing tags to missiles to pet tags of food- anywhere that a unique identification system is needed. The tag can carry information as simple as a pet owner's name and address to as complex as instructions on how to assemble a car. Some auto manufacturers use RFID system to move cars through assembly line. At each successive stage of production, the RFID tag tells the computer what the next step of automated assembly is.

Index Terms- RFID, RFID tags, Bar code, rfid system.

I. HOW RFID WORKS?



An RFID system

The RFID system has three components, these are:

- Scanning antenna
- A transceiver with decoder to interpret the data.
- A transponder- a RFID tag – that has been programmed with information.

The RF radiation does two things:

- It provides a means of communicating with the transponder, and
- It provides the RFID tag with the energy to communicate (in case of passive RFID tags).

The scanning antennas can either be affixed to one place or they can be used as handheld antennas. For example, we can build them into door frames and accept the data from the persons or objects passing through the door. When RFID is brought in the field of antenna, it detects an activation signal from antenna and then it transmits the information on its microchip that is received by scanning antenna.

The signalling between reader and antenna depends on the frequency band used by the tag. The tags which operate on LF and HF are small percentage of wavelengths away from reader antennas. In this region, the tag gets coupled electrically with the reader and it modulates the field produced by reader by changing the electrical loading (represented by tag). Then because of switching in relative loads, the tag produces the change which is then detected by reader. In case of UHF and higher frequencies, the approaches are different as the tags and readers are more than one radio wavelengths away. So, the tag may backscatter a signal. Active tags may contain separated transmitters and receivers and the tag need not respond on a frequency related to the reader's interrogation signal.

II. TYPES OF RFID TAGS

The RFID tags can be of following types:

- Active Tags: these tags have their own internal power sources. Many active tags operate at fixed

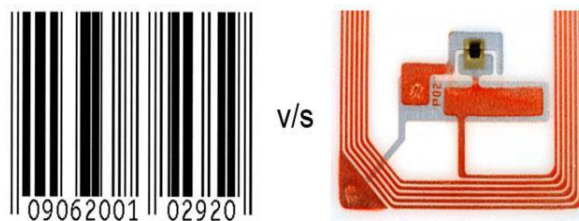
intervals. These tags are also called beacons as they broadcast their own signals. These tags have an advantage that the reader can be far away from the tag and still get signals. They have limited life spans, say upto 10 years.

- **Passive Tags:** these tags have no internal power supply. These tags, however, do not require any batteries and can be much smaller and have a virtually unlimited life span. In these tags, electrical current induced in antenna by the incoming signal provides power for integrated circuit in tag to power up and transmit response.
- **Semi-passive Tags:** these tags are similar to passive tags, with addition of a small battery. The external battery provides power to integrated circuit. They have longer range but limited lifespan.

The following table explains more about the difference between these types of tags:

Tags and Features	Passive Tag	Active Tag	Semi Passive Tag
Internal Power Source	No	Yes	Yes
Signal by backscattering the carrier wave from the reader	Yes	No	Yes
Response	Weaker	Stronger	Stronger
Size	Small	Big	Medium
Cost	Less expensive	More expensive	Less
Potential Shelf life	Longer	Shorter	Longer
Range	10 centimeters to few meters	Hundreds of meters	Hundreds of meters
Sensors	No	Yes	Yes

III. RFID V/S BAR CODES



With the different sectors using the two forms of automated data collection i.e. barcode and RFID systems, there is much hype as to whether RFID will take over to barcode system. It is not compulsory that new methods are always essentially better than old ones. These two both carry product information however they both differ a great amount.

To know the difference between barcode and RFID system, first we should discuss what is a bar code.

What is a bar code?

A barcode is visual representation of data that is scanned and interpreted for information. Each bar code contains a certain code which works as a tracking technology for products. Originally this technology used the difference in width and spacing in parallel lines and its considered as one dimensional. Later it evolved into other two dimensional shapes like hexagonal and rectangular shapes. These barcodes can be scanned by barcode readers or by smartphones also.

Now, the difference between the two technologies is explained below:

Barcode	RFID
Require line of sight to be read	Can be read without line of sight
Can only be read individually	Multiple tags can be read simultaneously
Cannot be read if damaged or dirty	Can cope with harsh or dirty environments
Can only identify the type of item	Can identify a specific item
Cannot be updated	New information can be over-written
Require manual tracking and therefore are susceptible to human error	Can be automatically tracked removing human error

IV. HISTORY OF RFID

This technology was first used in world war II by american forces to identify enemy aircrafts and tanks. The systems deployed at that time are still being used in defence sector.

With time, the systems were further developed leading to technology expansion. For e.g. in 1970s RFID technology was being used to identify railroad cars or automobile parts in paint shops. Afterwards, electronic article surveillance appeared that was first large scale system of its kind in the market. The main function of this system was to guard against thefts in goods and clothings. The technology became known to a wide public a few years ago when large supermarket concerns decided to document the delivery chain of their goods by means of RFID. Since then there have been many reports on RFID in the media, and its use has also frequently been the subject of controversy.

V. APPLICATIONS OF RFID

There are various applications of RFID technology emerging nowadays. Some of these are explained as follows:

- **ASSET TRACKING:** Earlier, static or in motion asset tracking or locating was not an easy task. But now, user can instantly determine general locations of tagged assets anywhere within the facility with the help of active RFID technology. Control point detection zones at strategic locations throughout the facility allow the user to define logical zones and monitor high traffic areas. Tagged assets moving through these control points provide instant location data. Asset tracking applications will see an almost vertical growth curve in the coming years and the growth rate in this area will be much higher than the growth rate of general RFID market.
- **PEOPLE TRACKING:** this is similar to asset tracking system. Hospitals and jails can be the most required places for this type of tracking. Hospitals employ this technique in tracking some special patients, emergency cases and essential equipments. Mental hospitals can also use this to keep an eye on every patient. This technology can be used best in jails, where every inmate can easily be tracked and located and then no jail inmate will try to escape.
- **DOCUMENT TRACKING:** with the availability of large amount of data and documents, it becomes difficult to keep manual records and locations of that data and documents. With introduction to RFID technology, both time and money can be saved because this will save: 1) time spent to search the lost documents and 2) the financial and legal impact related with document losses.
- **GOVERNMENT LIBRARIES:** this technology can also be used in various libraries. RFID technology can read multiple items or assets simultaneously which helps in reducing queues and increase the number of customers using self check. This result in reduction of the staff required at circulation desks.
- **MANUFACTURING AND PRODUCTION:** this technology gives out an easy way to manage huge manufacturing and production processes. This offers all benefits of small production parts to batch, processing and manufacturing. This helps in reducing time to locate parts and products, reduce and eliminate bottlenecks, and results in better analysis.

Some of the Advantages of RFID over other Technologies:

They are many technologies to identify objects other than RFID. The barcode is the most commonly used computer readable technology, but the reader has some limitations. Most important is the source should exactly face the reader with no obstacle in between the laser and the bar code. Magnetic strips on credit cards, also must line up correctly with the readers. RFID tags provide a mechanism for identifying an item at a distance and able to track numerous objects at a time. One cannot add information to a barcode after it is printed, whereas some type of RFID tags can be written and rewritten many times. Some of the benefits of RFID include the following:

- **Alignment is not necessary:** While scanning an RFID tag it does not require line of sight. This is convenient where you lineup huge amount of goods that are to be traced.
- **High inventory speeds:** Numerous amounts of assets can be scanned at the same time. As a result time factor for manual counting can be cut down.
- **Variety of form factors:** As previously mentioned RFID tags and readers are available in variety of range both in size and frequency.
- **Data rewritable:** Some type of tags can be written and rewritten many times. This makes data change simpler.

VI. LIMITATIONS OF RFID

Even though this technology has been developing over the years, but it has certain barriers or limitations that still need to be neutralised to make effective and easy use of this technology. These problems may be related to investments, security risks and some others. These are as follows:

- **COST:** although there is great potential in RFID technology, but its relative high cost is a drawback. RFID tag is comparatively costlier than barcode system. Besides the initial cost, there is a cost to be invested in maintainence of the system also. In future, when prices are reduced then more retailers and manufacturers can implement this technology and then it will overcome the barcode system completely.
- **SECURITY AND PRIVACY:** this limitation has been a part of debate from the beginning. It will certainly violate the customer privacy as it can easily the person using the product. The tags(RFID tags) when used, may broadcast the EPC(electronic product code). For example, the size

of the dress a woman wants to wear will be sent publically to the nearby reader by RFID tag. Many suggestions are being given to overcome this problem, simplest is “kill tag” in which the tag is electronically deactivated after the sale of the item. Some other solutions are cryptographic approach, hash function approach, faraday cage approach, active jamming approach, regulation approach etc.

- **INTERFERENCE:** since RFID is based on radio frequency technology, it can be easily interfered with some other radio wave transmissions occurring over the same place, or it can be interfered with some metals, liquids etc. the degree of interference depends on the frequency of tag and usage environment.
- **LACK OF STANDARDISATION:** RFID is still in initial stage and there are many hurdles ahead of it. At present, there are many different RFID systems that operate upon different frequencies and need different softwares and readers. So, the need is to be agreed upon that only one or group of frequencies have interoperability between the manufacturers, retailers and distributors.

VII. THE FUTURE OF RFID

- More development of tags in near future. Can see a tag which powers its own communication and may even be capable of communicating with other tags without the help of reader.
- RFID system can be coupled with GPS to track the item directly using a wireless application device.
- Can be used in medical applications for the logistics of blood in blood bank centers.
- Active tags could be available for much low costs.
- Tag readers could become more advanced which could directly communicate with enterprise application.

VIII. CONCLUSION

For now, RFID technology can't overcome barcode technology completely because of its accuracy, cost and other limitations. Some large companies like tesco, prada, benetton, wal-mart etc are making use of this technology and they are exploring the impact also. Other industrialists can also use this technology. The base of success of this technology lies in understanding the technology and its features deeply to overcome its limitations and potential problems.

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