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RFID Modules & Guideline for selecting appropriate RFID Module for Industries

Patel Jignesh[1], Dr.A.R.Patel[2] and Modi Jayesh[3]

Department of Computer Science, Hemchandracharya North Gujarat University,
Raj-Mahel Road, Patan-384265, Gujarat, India

Abstract

Barcode has been used for identification of products since long. It had been successful for identification but as time has gone for barcode now. We do need to move on towards the technology which could work better and easier than barcode. The manual scanning of each product made a gateway for Radio Frequency Identification as a replacement. In this article we will see the possible exploration of RFID technology and necessary information about it. What has been a obstacle for such a technology, why it's been long for implementation. It is very much needed to learn about RFID before it totally replaces barcode in India as well. Not only we explore RFID but along with try to disclose some of the issues you can face, so before implementation of RFID industry could identify and compare that affected factors which can be a disturbance in working of this technology.

Keywords: RFID, Near-field communication, RFID tag, Far-field communication.

1. INTRODUCTION

In last few years RFID technology has been widely adopted by industry. It provides lot boost in handling goods for manufacturer. Compared to barcode it helps manufacturer and retailer to keep track of their inventories without human assistance. It will make your shopping experience free from frustration because it does not even need line of sight communication [1].

RFID is the short form for Radio Frequency IDentification. A RFID system serves to identify,

- People (access control)
- Objects (logistics)
- Places (transport systems)
- Transactions (payment systems)

RFID essentially performs the same tasks as the widespread barcode or magnetic strip, but offers several advantages as a successor technology [2]:

- No direct line of sight required
- Read/Write functionality
- Different memory sizes / technologies available
- Security features available
- Multiple tags can be read simultaneously
- Works in unkind environment

RFID can have unique IDs which can even present information like manufacturer details, expiry date, product weight, storage temperature. We have few examples of such technology implementations by the companies. Air New Zealand Travel Company had a one proposal for consumers. According to system customer has to drop their suitcases at baggage-drop counter. At counter suitcases will be attached with RFID tag and put on to conveyer belt. RFID technology does match suitcases with owner's destination and send it to cargo channel of the right plane. Another example is meat processing industry. Plant uses a network of RFID readers, with tags attached to carcasses. When carcasses are cut, tags are fitted to the plastic trays holding the various meat products. Thus the product can be tracked within company and the process is automated to reduce the amount of human contact with products, which is a primary requirement in such industries.

2. WHY DELAY IN IMPLEMENTATION?

The motivation behind RFID technology is wide acceptance and though cost has been reduced, but still it's not so easy to implement in a cost effective way. So we must be very precise on choosing the right technology for the application to achieve good return on investment. RFID technology is still not cheap enough to compete with traditional labeling technology, but still it has great value added and is now at a critical price point that could enable its adoption for managing consumer goods. Now people see this as an investment that can be recovered elsewhere, such as reduction in effort cost [5].

3. FUNCTION OF RFID

It is functioning on radio waves; mean it uses electromagnetic field for transfer of data. Object information is placed on tag, which is attached to object itself. The tag having an antenna and a chip containing actual data in it. As we discussed before that chip contains object related data or simply a unique serial number that creates the connection to the actual data in a database. As with the barcode, the data carrier is attached to the object and allows the information to be read at any time or altered as desired. To do this, the tag communicates with the read/write station, commonly known as the reader. Following are the basic tag elements which are used in as per the standards.

- Micro chip
- Antenna
- Case
- Battery (for active tags only)

The size of tag totally depends upon antenna; antenna size depends upon the frequency on which it is working. The chip which is included into tag it's a memory area where

actual data foot print lies. Chip may contain erasable or non-erasable data depends upon requirements [3]. Below figure 1displays integration of antenna and chip.

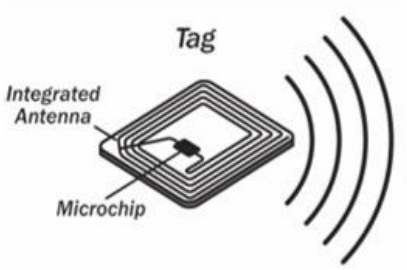

Figure.1 RFID tag with antenna and Chip

The operating principle is based on near-field and far-field communication. Followings let us understand how stuff really works in both.

3.1 Near-field communication

This kind of communication also named as inductive coupled system. The RFID reader generated magnetic field by passing the current through its coil. If a tag comes under the range of this magnetic field, the current passes to tag. So the electric voltage is reform and coupled to capacitor of tag. In figure 2, we can clearly see the capacitor gets charged and will power the chip for operation.

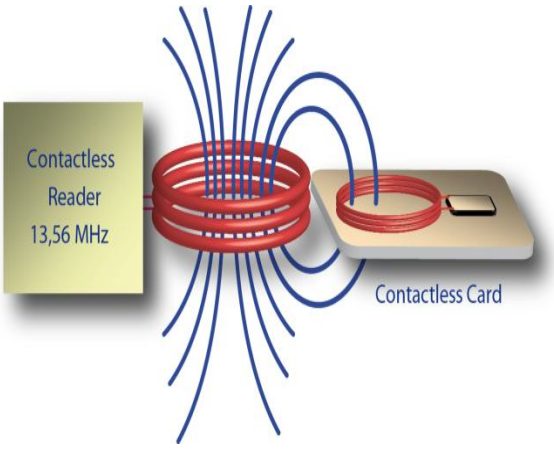

Figure 2 Inductive Coupling RFID System

Near-field RFID system conveys data back using load modulation technique. The voltage generated by inductive coupling in tag, so current into the coil will give grow to own small magnetic field. This magnetic field will oppose the reader's field. Reader will also detect some extra current flow through its coil and this additional current in reader's coil is proportional to the load across the tag's coil, so it's called load modulation. The idea of load modulation is depicted in figure 3. So that means tag can send some encoded signal to RFID reader and reader can easily detect as similar to variation in a current. This technique depends upon the number of bits transmitted, data rate and required redundancy. The operation of system depends upon frequency of operation and radiated energy.

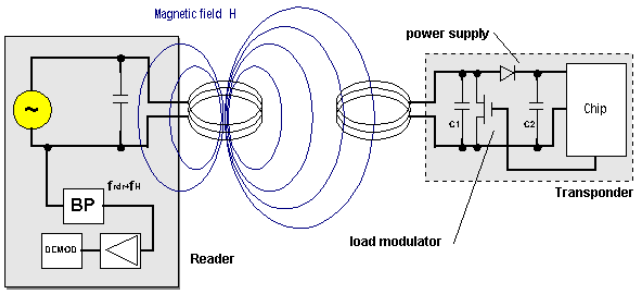

Figure 3 Load Modulation techniques for data transfer

Inductive coupling is the main concept which gave rise to RFID systems. Now we have some concept which has taken an inspiration from RFID like ISO 15693 and ISO 14443. Now all this works well for small and simple applications but things get worst when application needs bias between multiple tag in same area for reading. Each tag has a higher frequency for good data rate, which makes things complicated. So we have a idea called far-field communication.

3.2 Far-field communication

This kind of communication also named as inductive coupled system. RFID backscatter coupling or RFID backscattering uses the RF power transmitter by the tag reader to energies the tag. Essentially they "reflect" back some of the power transmitted by the reader, but change some of the properties, and in this way sends back information to the reader. Using RFID backscatter or RFID backscattering, some tags achieve their data transmission by changing the properties of the tags themselves, while others switch a load resistor in and out of the antenna circuit.

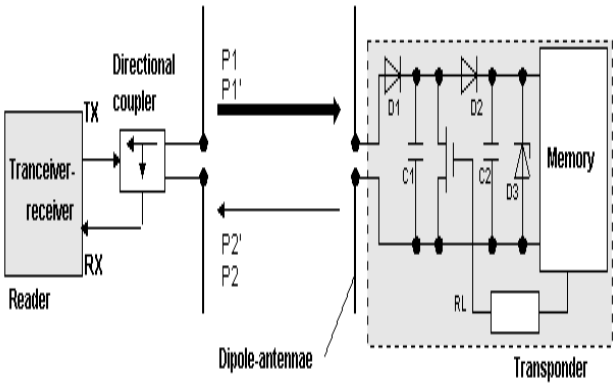

Figure 4 Load Modulation techniques for data transfer

We can see in figure 4 dipole antenna of tag captures energy generated by reader, which power the capacitors and circuit of tag. Normally far field operates at greater than 100 MHz

4. ACTIVE AND PASSIVE TAGS

Finally there are only two types of tag which are compatible to RFID, active and passive tag.

4.1 Active tag

Active tags need a power supply for the operation. Power supply can be provided with inbuilt battery backup source. Due that reason their life time is also less. They can be particularly useful for goods which need to be tracked from long distances like cargo.

4.2 Passive tag

Passive tag does not need any battery backup power. They induce energy from the reader itself, which is reason for long life tag. So it does effect on footprint of tag, which make it small parcel.

5 FREQUENCY RANGE COMPARISON FOR RFID & CRITERIA FOR SELECTION OF RFID MODULE

Now this is the section which gives us idea about which RFID frequency is suitable to us and accordingly we need the implementation.

Low frequency RFID: These systems are particularly well-suited to industrial use, like manufacturing. They have very well-defined magnetic field, which works well near metal also. Low RFID technology is also able to read through materials and unaffected by water. It has a low data rate which is not an issue with all such requirements. In this category the frequency range on to which it operates is generally varying between 120 ~ 134 kHz. ISO11784/5 and ISO14223 is a certified for short communication. Low frequency RFID tag is costly compare to high frequency RFID tag.

High frequency RFID: These systems are particularly well-suited to cargo industry. They have long range compare to low frequency RFID and have great data reading speed. It also has well-defined magnetic field and signal does passes through most materials, except some metals due to attenuation. It is capable of simultaneous reading of multiple tags. They are cheaper to produce. Such tags are in label/ticket (flat) format. The frequency range of working is 13.56 MHz. ISO15693, ISO14443, and ISO18000-3 is a certified for such communication.

Ultra High frequency RFID: *S*uch systems are primarily used in goods tracking, because of their very high data transfer rates and long ranges of up to six meters. Due to the low amount of space required for the dipole antenna, this technology is also ideal for tracking circuit boards. Formats in a miniature IC housing can be attached directly to the PCB. Operating frequency range of such RFID technology is 850 ~ 960 MHz

Following table 1 gives summary about all RFID technology,

Frequency	LF 120 ~ 134 kHz	HF 13.56 MHz	UHF 850 ~ 960 MHz
Read Range	0.5 ~ 1 m	< 1 m	> 3 m
Cost	Relatively expensive	Less expensive	Least expensive
Penetration of Materials	Excellent ← → Poor		
Affected by Water?	No	To some extent	Yes
Antenna	Coil	Coil	Dipole, Slot
Data Rate	Slower ← → Faster		
Reading Multiple Tags	Poor	Good	Very Good
Applications	Immobilisers, industrial-identification	"Pharma", libraries brand protection, tickets, payments, passports	Pallet/case tracking, tolls bag-gage tracking, PCB tracking

Table 1 Comparison of All RFID frequency Range with their characteristics

Finally, the points which we should keep while selecting proper RFID module are frequency range, memory requirement of tag, material, reading distance, and security.

6 RFID PITFALL

RFID has lots of potential as future technology, but nothing is perfect. It also suffers from few aspects.

- Still RFID tag components are not 100% failure free, they even don't comes with proper warranty so you may get replacement. Defect percentages are very high.
- RFID software can be malicious by DoS attacks, man-in-middle attacks. Technically various problems have already been identified in some studies. [9]
- Still RFID technology is going through reinvention phases where day by day some intercept problems we are facing, which cause privacy issue.
- Anti-collision methods are needed to differentiate multiple tag signals. That is one more cost effective area and also a strong contender for cost of technology.
- There is still confusion about the proper RFID standard, people still gets confuse about following standards. Choice between RFID technologies is still very difficult because there is very thin line between all RFID applications.
- Goods contain water or metal may becomes obstacle to RFID application at respective frequency. So data transmission may get corrupted.
- The technologies are changing rapidly day after day. So may happen that RFID technology which is recently adopted may just gets wear out.

5. CONCLUSION

RFID does have power to impact on human routine life as well as business too. In the last part of paper we discussed some issue with the technology and little natural effect. Though many of it can be cured by further study on such

point, major research is needed in part of security and authentication. Wireless medium always attracts psycho people to do harmful things. Recently, Near Field Communication has been new technology flavor of RFID, which has attracted many tech-companies. They are also working on the security issue with it and that is also one reason for late implementation for such technology in market.

REFERENCE

[1] "RFID module" article available online at www.efymag.com
[2] "Introduction to RFID " available online at http://www.adafruit.com/datasheets/rfid%20guide.pdf
[3] "Introduction to RFID " available online at http://www.cse.wustl.edu/~jain/cse574-06/ftp/rfid.pdf
[4] "Research trend in RFID " available online at http://www.lonworks.org.cn/en/RFID/RFIDResearchTrends.pdf
[5] "The costs of an RFID implementation" available online at http://www.wmrfid.org/index.php/what-is-rfid/the-costs.html
[6] John Curtin, Robert J. Kauffman, Frederick J. Riggins "Making the `MOST' out of RFID technology: a research agenda for the study of the adoption, usage and impact of RFID", Journal Information Technology and Management Volume 8 Issue 2, June 2007, Pages 87 – 110, Kluwer Academic publishers Hingham, MA, USA.
[7] Mikko Kärkkäinen "Increasing efficiency in the supply chain for short shelf life goods using RFID tagging ", International Journal of Retail & Distribution Management ISSN: 0959-0552 online.
[8] Juels, A. "RFID security and privacy: a research survey ", Selected Areas in Communications, IEEE Journal on (Volume: 24, Issue: 2) Feb. 2006, Page(s): 381 – 394, ISSN: 0733-8716. Online
[9] T. van Le, M. Burmester, and B. de Medeiros, Universally composable and forwardsecure RFID authentication and authenticated key exchange, Proc. of the ACM Symp. on Information, Computer, and Communications Security (ASIACCS 2007), ACM Press, 2007.
[10] HangRok Lee and DoWon Hong, "The tag authentication scheme using self-shrinking generator on RFID system", Transactions on Engineering, Computing, and Technology 18 (2006), 52–57. ISO/IEC, Standard #18000 RFID air interface standard, http://www.hightechaid.com/standards/18000.htm

AUTHOR

Patel Jignesh received the B.C.A. and M.C.A. degrees in Computer science from Hemchandracharya North Gujarat university in 2004 and 2008, respectively. Now, working in Department of Computer Science at Hemchandracharya North Gujarat University as an Assistant Professor and pursuing Ph.D from same organization.

Dr.A.R.Patel received Ph.D and MS degree in computer science from Hemchandracharya North Gujarat University, GSW State University Americus, GA, USA in 2002 and 2013 respectively. Apart from this he has also done PGDCA (Computer Science) and M.Sc (physics). Now, working in Department of Computer Science at Hemchandracharya North Gujarat University as Professor & Head.

Modi Jayesh received the B.E.I.T. and M.Tech. degrees in Computer science from Hemchandracharya North Gujarat university & Jaipur National University in 2004 and 2013, respectively. Now, working in Department of Computer Science at Hemchandracharya North Gujarat University as an Assistant Professor and pursuing Ph.D from same organization