

A Review on RFID Technology and Applications

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Abstract:

RFID is a stimulating, rapidly mounting, multidisciplinary technology, which is capable of automatically and exclusively identifying object or persons by radio frequency within certain proximity. RFID (Radio Frequency Identification) systems are emerging as one of the most persistent computing technologies in times past due to their low cost and their broad applicability. RFID systems distribution is hastily evolving and has the feasibility to affect various industries and applications. This paper primarily focuses on RFID technology with its hardware components, basic system and applications.

Keywords: RFID, Components, System, Applications.

1. Introduction

In recent years, automatic identification measures [1] [2] [5] have become very popular in many service industries, purchasing and distribution logistics, industry, manufacturing companies and material flow systems. Automatic identification measures exist to make the information about people, animals, goods and products in shipment available. The omnipresent barcode labels that triggered an uprising in identification systems some significant time ago are being erect to be inadequate in rising number of cases. Barcodes may be very inexpensive, but their tentative obstruct is their near to the ground storage capacity and the reality is that they cannot be reprogrammed [5].

The data storage in a silicon chip is an optimal solution. In everyday life, the most used general form of electronic data-carrying devices is the smart card based on a contact field (telephone smart card, bank cards). The smart card uses the

mechanical contact which is not viable. A contactless data transmits between the data-carrying device and its reader is far more flexible. In the optimal case, the power requisite to function the electronic data-carrying device would be transferred from the reader by means of contactless technology. As the measures used for the transmission of power and data, contactless ID systems are called RFID (Radio Frequency Identification) systems.

Many companies enthusiastically concerned in the expansion and sale of RFID systems indicates that this is a market that should be taken critically. Whereas global sales of RFID systems were relatively 900 million \$US in the year 2000, 2650 million \$US in the year 2005 [2] [5] and it is anticipated that this figure will reach even more in the next coming years. Therefore the RFID market goes to the fastest rising segment of the radio technology industry, including mobile phones and cordless telephones. Understanding

the RFID technology and its applications is the key objective of this paper. In the following sections this paper describes RFID history, RFID technology with its hardware components, basic system and applications.

2. What is RFID?

RFID is a contraction for “Radio Frequency Identification” and refers to a technology whereby digital data encoding in RFID tags or smart labels are conquered by the reader using radio waves [2] [3]. RFID implies to minute electronic gadgets that encompass a small chip and an antenna. It is parallel to barcodes on a smart labels or tags from where data is captured by a device that stores the data in database. RFID however has several assets over system that use barcode asset tracking software. The major prominent is that RFID tag data be able to read outside the line-of-sight, whereas barcode must be allied with an optical scanner.

3. RFID History

RFID is not a new technology. Already during World War II, the British pioneered RFID to recognize their own planes when they returned from attacks over Euro. The early radar techniques could spot airplanes, but not determine whether they were friendly or not. To improve the system the British tagged their airplanes, and thus identify them using RFID. This system was recognized as “Identification, Friend or Foe”[4]. Since World War II, RFID has developed quite far. During the 1960s, the first commercial activities relating to RFID were launched. The 1970s were primarily characterized by developmental work, and notable advances were made at research laboratories and academic institutions. In 1977 one of the first RFID systems introduced to the market was launched by Los Alamos Scientific Laboratories in form of an access control system. The 1980s were distinguished by execution of RFID systems. Collecting tolls for toll roads was implemented by the first RFID system in Norway in 1987, and numerous other systems for transportation,

personnel access and animal identification were also launched during this decade.

During the 1990s, large range employment of automatic toll collection using RFID was seen. Other applications such as applications for supply fuel, access control for vehicles, sky passes etc. were also widely used. With the expansion of the 13.56 MHz RFID systems in the first half of the 1990s it became, for the first time, potential to include a transponder system in the 0.76 mm thick ID-1 format. This made many RFID systems much more practical. In the recent years, execution of RFID has relatively exploded. Countless number of appliances has been launched, and the technology is flattering an essential part of more and more people’s daily lives. The RFID’s security aspect is also gradually gaining additional attention.

4. RFID Technical Background: Hardware Basics

The most essential Radio Frequency Identification solution is made up of three main hardware components such as the Transponders/ RFID tag, the RFID reader and an antenna [1]-[6]. This is of course, an over simplification of what it takes to apply today’s RFID technology to real world problem, but these are the fundamental building blocks as shown in the fig:1.

There are two types of transponders, which associate to the two major types of RFID tags. Passive RFID transponders/tags [3] have no power source of their own; they depend on the energy given off by the reader for the power to react. Cheaper, passive RFID tags are used for consumer goods.

Passive tags encompass of three key components, which is an intrinsic chip, a substrate and an antenna [3] [4]. The intrinsic chip is also identified as a circuit and is exploited to perform some precise tasks along with accumulating data. Passive RFID tags consist of a variety of micro-chips depending on the structural design of a particular tag. Passive tag contains an antenna which is appended to the micro-chip. This antenna is employed for transferring data by means of radio waves. The passive tag’s performance is

contingent on the size of the antenna. In the performance of tags the shape of the antenna also plays a important role. The third part of the tag is the substrate, a plastic coating or Mylar which is utilized to unite the antenna & the chip [10]. Passive RFID tags are smaller in size and cheap on pockets too.

An active RFID transponders/tag contains an interior power source used to generate a signal to respond to a reader. Active transponders/tags are more expensive than passive one's. They can communicate over miles like ordinary radio communications. They are commonly used in navigation systems for commercial and private aircraft. Active tags include equivalent components that exist in passive tags. They too encompass of a micro-chip and an antenna but the only contrast between the two is that the size of the micro-chip in active tags is superior to passive tags' chip. An active tag is integrated with a built-in power supply. Maximum active tags make use of batteries whereas some of them work on solar cells. The inherent power system facilitates the tag as an autonomous reader which is experienced of transferring information barren of outer aid. Active RFID tags are accessible with some extra features such as microprocessors, serial ports & sensors. The extremely developed technology existing in active RFID tag formulates it more capable in comparison to passive tags as the active tags be able to employed easily for a immense array of responsibilities [1]-[6].

RFID tags may broadcast numerous different pieces of data, but the most primary piece of data is the tag's distinctive identifier. The distinctive identifier is, in most cases, associated with a real world asset that is to be tracked. In most of the appliances, the distinctive identifier is used to identify the information about an asset in a database. Tags may also broadcast state information or telemetry such as temperature or

humidity if they have the sensors to collect this type of information. Most of the passive tags do not contain peripheral functionality owing to the power limitations of not having an involved battery.

The RFID reader, referred as the interrogator, receives all of the data that the tags are transmitting [10]. Then the data is conceded to software which utilizes the data. The tags that are in close enough proximity to a reader are referred to as the reader's "tag population". As a reader's tag population grows, the compactness of tags around the reader also grows, and the reader might require more time to read all of the tags in its locality. This is because that if all the tags transmit at the same period of time, the reader will not be able to separate their data into tactful transmissions, so it is important that the tags do not accomplish all the transmissions at once.

Antenna emitting radio signals make active the tag to read and write data to it. It pick-up the information from tags through radio waves, then that information is send to the reader. Based on its supremacy output and the radio frequency used, the reader emits radio waves in the range of one inch to 100 feet or even more. The transmission of reader's activation signal through the electromagnetic zone makes the RFID tag to detect it. The reader decodes the data and then is encoded in the tags integrated circuit (silicon chip) and the host computer process the resulting data. [5] [6].

For transmission of power from reader to tag, two RFID design approaches such as magnetic induction and electromagnetic (EM) wave capture are developed. These two designs obtain advantages of the EM properties allied with an RF antenna, the near field and the far field [4]. Both can transfer sufficient power to a remote tag to maintain its operation.

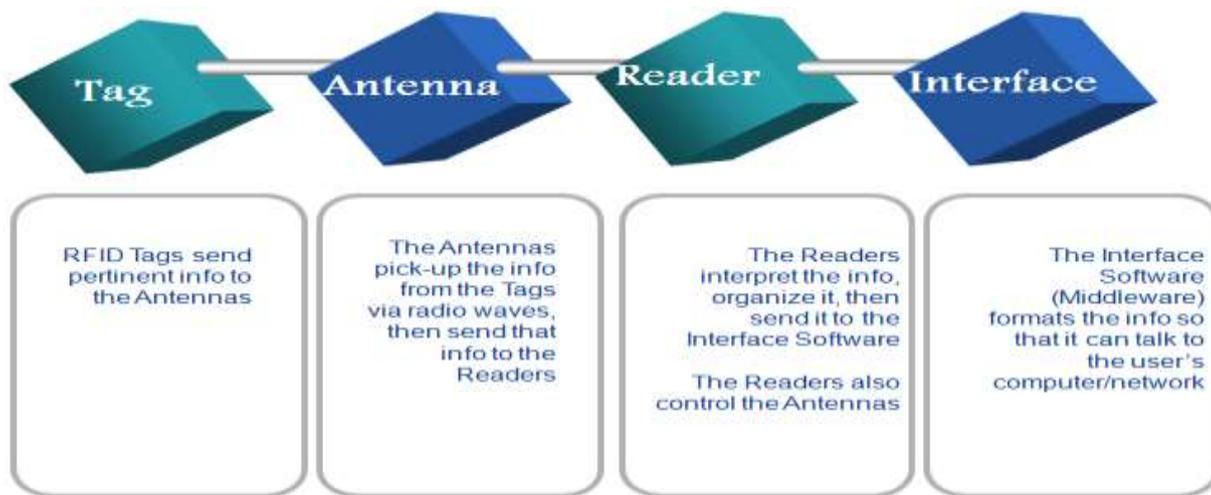


Fig: 1 RFID Components

5. Basic RFID Systems

In RFID technology the reader and a few tags are in common of little use. The information for the user is not presented by retrieving the serial number nor does it help to keep track of items in a production chain. The actual power of RFID arrives in amalgamation with a backend so as to store added information like metaphors for products where and when a definite tag was scanned. Normally, RFID system has a framework as signified in fig: 2. tags are scanned by RFID readers, and then the information is forwarded to the backend. Generally, the backend comprises of a database and a well defined application interface. When new information is received by the backend, it adds it to the database and if

needed performs some computation on associated fields. The data is retrieved from the backend by the application. In many cases, the application is collocated with the reader itself. Here the checkout point in a supermarket is taken as an example (Note that in this example we used Barcodes/ RFID tags). When the barcode/tag is scanned by the reader, the appliance employs the resulting identifier to search for the current price. Additionally, the discount information for qualifying products is also being provided by the backend. The backend besides diminishes the various existing products of such kind and notifies the supervisor if the amount falls below a certain threshold [6].

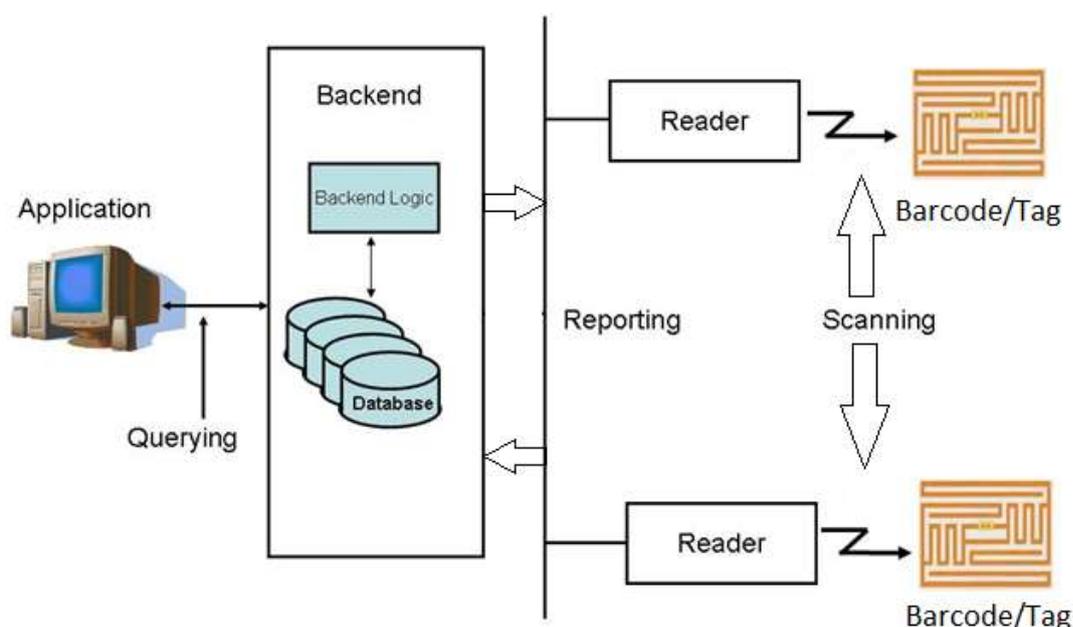


Fig: 2 RFID System

6. Applications of RFID

Uses of RFID span a wide spectrum of application areas shown in fig: 3. Applications of RFID are very broad and open in nature. Principal areas of application for RFID that can be currently identified include:

E-Passports: A relatively recent development is the use of biometric data in passports. If digital image of the passport holder is stored in the passport, automatic facial recognition is able to use at the border. A new image taken at the border

is automatically compared to the one stored in the passport and the person is allowed to pass only if both images matches. This increases the passport system security as automatic facial recognition is much more precise than manual facial recognition. However, there be required to a few means of transferring the picture stored in the passport to the border control so that the comparison can be performed. This is able to done by RFID, and the passports make use of this technology are often known as e-passports.

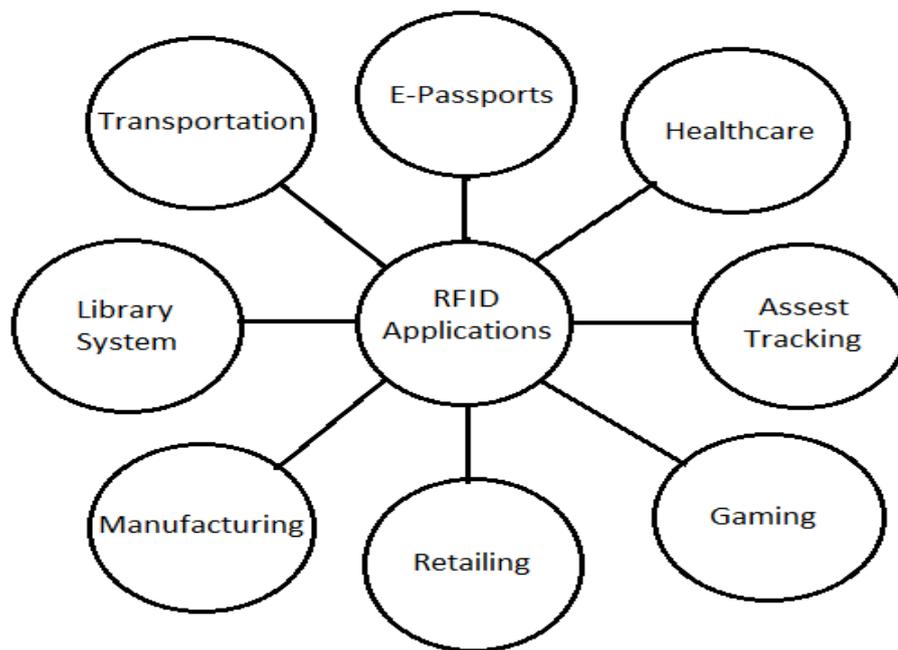


Fig: 3 RFID Applications

Healthcare: RFID systems are widely supportive in a healthcare facility to attain patient safety, employees' security and for many operational goals [9]. It is prepared to establish a customized system that satisfy the requirements of different departments such as NICU, Memory-care unit, maternity ward, Labor, and delivery etc. The RFID based products in the medical lab is useful to track tissue or fluid samples, to reduce the errors from data entry. Besides, the location of the millions of proprietary pharmaceutical compounds in the libraries gets tracked.

Library System: RFID library management mechanism enhances the effectiveness of

circulation operation. While barcodes need the specific line of sight, the identification of RFID tags can be done in different angles which enable the check-in and check-out significantly faster. In libraries, the library staff's time and their tasks are saved automatically by RFID. Using RFID library management, an organization can saves the book reader's precious time that he would have been spent, waiting for his turn in a queue for borrowing or returning a book. Taking care of books and making them accessible to the book readers are significant tasks.

Transportation: In the transportation industry, RFID has instituted many applications from

trucking to airports, from rail to shipping. As it is true for early technologies, once its mechanism in one application is intellectual engineers begin to spot further applications to expand, by this means influencing the investment of the initial application. Some of the advanced cities are using RFID for Intelligent Transportation Systems (ITS) [7]. Popular example for RFID application in transportation is RFID based toll gates. Electronic payment of toll collecting using E-ZPass is a wide spread application. E-ZPass tags are RFID transponders attached to the car license plate and sends account particulars to the utensils erected into lane-based or open toll collection lanes. The toll system will charge from a pre-entered credit card or sends a check. The most recent enrichment towards this technology is sending the bill details instantly to the user's mobile phone and is also used to track stolen cars and other vehicles by police departments with the use of GPRS and RFID [3] [9].

Retailing: In the Retailing industry RFID systems are used for direct marketing, customer driven marketing and for obtaining loyalty strategies. Various retailers are in the front line of RFID implementation. These retailers are currently focused on improving supply chain and making sure product is on the self when customer wants to buy it [1] [8].

Gaming: Higher security, acceleration of anti-counterfeiting functionality, and acceleration of the chip counting process are provided by RFID installed chip. Gambling tables along with the RFID reader's system offers ability to often track individual chips and allocate these chips with a player who received them [10].

Asset Tracking: Asset tracking is one of the most familiar uses of RFID. Companies can put RFID tags on assets that are lost or stolen frequently, that are underutilized or that are just rigid to situate at the instance when they required. Just about every type of RFID systems is used for asset management.

Manufacturing: RFID is used in manufacturing plants for more than a decade. It is used to track parts and work in procedure and to reduce defects,

increase throughput and manage the production of different versions of the same product [11].

7. Conclusion

RFID technology has a big potential to become omnipresent in the vicinity of future. The components like reader and tags are simple radio communications and raise concerns about the privacy effects of RFID deployment. A lot of probe on RFID tags is ongoing including on embedding these with other devices, especially mobile devices. RFID producers and consumers seem for proper standardization and regulation of RFID. As prices plunge additional and technical improvements continue to occur, RFID technology is anticipated to become economically and technically more viable and impact our everyday lives as more applications are developed. This paper gave a review on RFID technology; we also showed basic RFID system and some of its applications. Regardless, much research is being focused on organic components for other purposes, like flexible displays. Developments in this area will benefit RFID, potentially opening the door to many inexpensive and interesting future applications.

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