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An In-Depth Analysis of Radio-Frequency Identification (RFID) Technology

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ABSTRACT

Radio-frequency identification (RFID) is a technology that uses communication via radio waves to exchange data between a reader and an electronic tag attached to an object, for the purpose of identification and tracking. The paper introduces the RFID technology and discusses topics such as the history of RFID, the different components involved in RFID, the physics involved in RFID. RFID has gained more popularity because of its applications. The applications of RFID which includes human implants and parking control system are discussed in detail and also the overview of how RFID fits into the next generation is discussed. The paper also discusses the various pros and cons of RFID. The final section describes the concluding remarks about RFID. RFID technology can be the next tool for success and management of various businesses. With more research, the flaws and limitations of this technology can be removed. This will make RFID technology very useful for diverse sectors like retail, transport and jewellery businesses.

INTRODUCTION

Radio Frequency Identification (RFID) is a proven technology that has been used in commercial applications since at least the 1970s, but has only recently been introduced to the consumer goods supply chain. Until recently, the expense of RFID, as well as lack of international standards, has limited its use to applications such as security badges and toll passes. As the cost of RFID systems decrease and standards are developed, companies are increasingly looking to use RFID technology to increase supply chain efficiencies and reduce supply chain costs. An RFID is highly reliable way to electronically control, detect & track variety of items using FM transmission methods. It is a method of automatic object identification using radio waves. A typical RFID system consists of RFID tags, interrogators or readers, and computers.

Radio Frequency Identification (RFID) is an emerging technology consisting of three key pieces: RFID tags (miniaturized chips); RFID readers; and a data collection, distribution, and management system that has the ability to identify or scan information with increased speed and accuracy. Compared to the bar code system, RFID promises long-term gains in supply chain management, transportation, defence and health care, to mention a few. RFID is increasingly used in commercial supply chain applications through pallet level tagging.

RFID, because it is a cross-cutting and enabling technology, adds to the important role ICT plays to promote innovation, economic growth, and global commerce. Looking toward the future, as the information infrastructures associated with RFID are increasingly accessed across IP networks, the OECD is well positioned to discuss with stakeholders how best to create a positive environment for growth, and promote best practices for the implementation and use of RFID.

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RFID, like the Internet, requires smart privacy and security policies that address questions that arise as a result of the growth and interconnectedness of information and communications networks. Disclosure, transparency and choice are important considerations for consumers as RFID migrates to item level tagging over the next few years. Policies that are informed by industry best practices and consumer concerns will foster the potential of ICT and facilitate acceptance of emerging technologies such as RFID

Radio-frequency identification (RFID) is a technology that uses communication via radio waves to exchange data between a reader and an electronic tag attached to an object, for the purpose of identification and tracking. Some tags can be read from several meters away and beyond the line of sight of the reader. The application of bulk reading enables an almost parallel reading of tags.

Radio-frequency identification involves interrogators (also known as readers), and tags (also known as labels).

Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions. The other is an antenna for receiving and transmitting the signal.

Fixed RFID and Mobile RFID: Depending on mobility, RFIDs are classified into two different types: fixed RFID and mobile RFID. If the reader reads tags in a stationary position, it is called fixed RFID. On the other hand, if either the reader or the tag is mobile when the reader reads tags, it is called mobile RFID. Last, the RFID is classified into mobile RFID for the case that both the reader and the tag are mobile.

There are three types of RFID tags: passive RFID tags, which have no power source and require an external electromagnetic field to initiate a signal transmission, active RFID tags, which contain a battery and can transmit signals once an external source ('Interrogator') has been successfully identified, and battery assisted passive (BAP) RFID tags, which require an external source to wake up but have significant higher forward link capability providing greater range.

There are a variety of groups defining standards and regulating the use of RFID, including the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), ASTM International, the DASH7 Alliance and EPCglobal. .

RFID has many applications; for example, it is used in enterprise supply chain management to improve the efficiency of inventory tracking and management.

II. COMPONENTS OF RFID

This system basically consists of following components.

1. A transponder (RF tag)
2. A transceiver (reader) with decoder
3. An antenna.

Fig. 1 shows a model of basic RFID system.

A.RFID Tag

RFID systems. The software manages the interaction between the RFID reader and the RFID tags RFID tags shown in Fig. 2 are usually known as transponders and act as a transmitter as well as a receiver in the RFID system. The three basic components of the RFID tag are an antenna, a microchip (memory) and the encapsulating material. There are two types of RFID tags, as given below.

Read-Only Tag: In the read only tag, the microchip or memory is written only once, during manufacturing process. The information, along with the serial number on the read only tag, can never be changed.

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Read-Write Tag: In the read-write tag, only the serial number is written during manufacturing process. The remaining blocks can be re-written by the user.

B. RFID Reader

RFID reader is the device used to transmit to and receive information from the RFID tag. It is also referred to as an 'interrogator'. It includes sensors that read the RFID tags in the vicinity.

C. Antennas

The antenna emits radio signals to activate the tag and read and write data to it. Antennas are the conduits between the tag and the transceiver, which controls the system's data acquisition and communication. Antennas are available in a variety of shapes and sizes; they can be built into a door frame to receive tag data from persons or things passing through the door, or mounted on an interstate toll booth to monitor traffic passing by on a freeway. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. If constant interrogation is not required, the field can be activated by a sensor device. Data is transferred without a line of sight to the tag.

Note, however, that unfavorable conditions can cause transmission problems with certain technologies, such as metallic environments or liquids. Tags and readers/writers must have compatible frequencies. High-frequency (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) systems, offering long read ranges (greater than 90 feet) and high reading speeds.

Supporting Infrastructure

The supporting infrastructure, includes related software and hardware required for RFID systems. The software manages the interaction between the RFID reader and the RFID tags.

III. APPLICATIONS OF RFID TECHNOLOGY

- Payment by mobile phones
- Transportation payment
- Asset management and retail sales
- Product tracking
- Animal identification
- Hospital operating rooms
- Promotion tracking
- Libraries
- Passports
- Schools and universities
- Social retailing
- Race timing
- Human implants
- Parking control systems

POTENTIAL USES

- Complement to barcode
- Telemetry
- Identification of patients and hospital staff

IV. PARKING CONTROL SYSTEM

- Parking lot operators, whether public or private, face a number of challenges such as:
- The inability to accurately and intelligently identify, collect and record the data of the vehicles that enter and leave the parking lot then processing this data to better analyze traffic patterns and facilitate client billings.
- Need to increase the security (and user integrity) of the parking lot.
- Adding human resources, especially in peak traffic times that burdens operating costs and reduces profitability.
- Line-ups created for parking payments, especially during peak traffic times that reduces the service levels to customers.

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An intelligent parking control management system has launched that integrates RFID technology, automatic control technology and applications software. The RFID tag on the vehicle will be able to automate the in and out privileges of the subscriber and then transfer this data to the enterprise software for the above-mentioned benefits of traffic analysis that allow you to optimize the human resources needed for traffic flow in and out. For customer payment, the RFID tag can be read to debit a pre-pay system or charge the parking services against a credit card. All of this will facilitate customers entering and leaving and this improves service levels and increases capacity in the parking lot. These benefits will drive higher revenues.

V. ADVANTAGES OF RFID

RFID technology has a number of advantages.

1) RFID tags are very simple to install/inject inside the body of animals, thus helping to keep a track on them. This is useful in animal husbandry and on poultry farms. The installed RFID tags give information about the age, vaccinations and health of the animals.

2) RFID technology is better than bar codes as it cannot be easily replicated and therefore, it increases the security of the product.

3) Supply chain management forms the major part of retail business and RFID systems play a key role by managing updates of stocks, transportation and logistics of the product.

4) Barcode scanners have repeatedly failed in providing security to gems and jeweleries in shops. But nowadays, RFID tags are placed inside jewelry items and an alarm is installed at the exit doors.

5) The RFID tags can store data up to 2 KB whereas, the bar code has the ability to read just 10-12 digits.

VI. DISADVANTAGES OF RFID

The RFID technology, though very beneficial, is expensive to install. Small and medium scale enterprises find it costly to use it in their firms and offices.

1) It is difficult for an RFID reader to read the information in case of RFID tags installed in liquids and metal products. The problem is that the liquid and metal surfaces tend to reflect the radio waves, which makes the tags unreadable. The tags have to be placed in various alignments and angles for taking proper reading. This is a tedious task when the work involves big firms.

2) Interference has been observed if devices such as forklifts and walkie-talkies are in the vicinity of the distribution centers. The presence of mobile phone towers has been found to interfere with RFID radio waves. Wal-Mart, the retail sector giant, has installed billions of RFID tags in their products throughout the world and they have encountered such problems.

3) The USA and Europe, for instance, have different range of frequencies that allow RFID tags to function. This makes it mandatory for international shipping companies and other organizations to be aware of the working pattern of other nations also, which can be very time-consuming.

4) RFID technology has been referred to as invasive technology. Consumers are apprehensive about their privacy when they purchase products with RFID tags. Once the radio chips are installed in the product, the customer can be tracked and his personal information can be collected by the RFID reader. However, many stores have a facility that deactivates the RFID tags after the product has been purchased.

RFID technology can be the next tool for success and management of various businesses. With more research, the flaws and limitations of this technology can be removed. This will make RFID technology very useful for diverse sectors like retail, transport and jewelry businesses.

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VII. CONCLUSION

Is RFID not a striking technology? We are sure answer is yes. From the above discussion we can conclude that RFID is an emerging field in present expanding technology. In no time we will notice RFID revolutionizing our day today life. This entity is a cresset in the present knowledge rich world.

Since it is expected to be used even in retail products, the RFID tag cost has to be more economical for a common man to afford. This is the technical challenge that RFID technology is facing in the present trend.

VIII. REFERRENCES

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