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A Critical Study on RFID

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***Abstract* —** Radio-Frequency Identification Device (RFID) uses radio waves to read and capture information stored on a tag, attached to an object. A tag can be read from several feet away and does not need to be within the direct line-of-sight of the reader to be tracked. A RFID system is made up of two parts: a tag or label and a reader. RFID tags are embedded with a transmitter and a receiver. It can automatically identify a person, a package or an item. Barcodes are really simple and can be easily replicated or counterfeited where as RFID is effective, cheap and secure. So RFID technology has many applications in military zone, inventory management, supply chain, product tracking, transportation, and logistics.

Keywords: RFID, RFID tag, RFID Reader, Active Tag, Passive Tag.

I. INTRODUCTION

RFID (Radio Frequency Identification) can be defined as follows: Automatic identification technology which uses radio-frequency electromagnetic fields to identify objects carrying tags when they come close to a reader. RFID cannot be reduced to one technology. RFID uses several radio frequencies and many types of tag exist with different communication methods and power supply sources. In the year 1940 RFID was first used during World War II to identify aeroplanes (IFF: Identify Friendly Foe). The objective was to use the aeroplane's radar signal to read an Identification number in order to identify whether they were allies or enemies. During the 1960-70s, RFID systems were still considered a secret technology used by the army to control access into sensitive areas. In 1980 Technological developments lead to the creation of passive tags. In 1990 Standardization for the interoperability of RFID equipment began.

In 1999. The Massachusetts Institute of Technology (MIT) created the Auto-ID centre - a research centre specialized in automatic identification, it became the global EPC, an organism in charge of promoting the EPC (Electronic Product Code) standard in 2004. From 2005 RFID technologies are widely used in almost all industrial sectors such as aerospace, automotive, logistics, transport, health, life, etc.

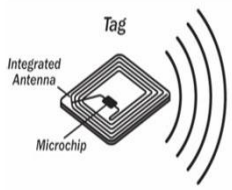

Figure 1.Tag

II. HOW DOES RFID WORKS?

The RFID component on the tags has two parts: a microchip that stores and processes information, and an antenna to receive and transmit a signal. To read the information encoded on a tag, a two-way radio transmitter-receiver called an interrogator or reader emits a signal to the tag using an antenna. RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention.RFID methods utilize radio waves to accomplish this. At a simple level, RFID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags contain an integrated circuit and an antenna, which is used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then transferred through a communications interface to a host computer system, where the data can be stored in a database and analyzed at a later time.

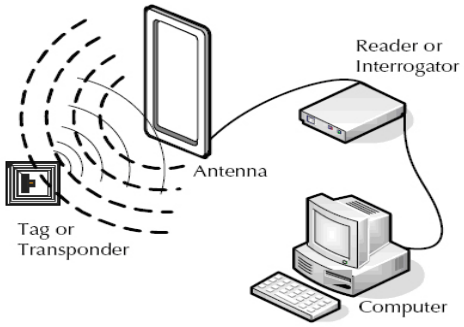

Figure 2.How does RFID works

III. RFID TAGS

As stated above, an RFID tag consists of an integrated circuit and an antenna. The tag is also composed of a protective material that holds the pieces together and shields them from various environmental conditions. The protective material depends on the application. For example, employee ID badges containing RFID tags are typically made from durable plastic, and the tag is embedded between the layers of plastic. There are two other common classifications of tags, depending on how the tag communicates with the reader: passive or active.

Active RFID: Active RFID tags have their own transmitter and power source (usually a battery) onboard the tag. These are mostly UHF solutions, and read ranges can extend up to 100 m in some instances. Active tags are usually larger and more expensive than their passive counterparts and are used to track large assets (like cargo containers, vehicles, and machines). Active RFID tags are also often equipped with sensors that measure and transmit temperature, humidity, light, and shock/vibration data for the objects they are attached to.

There are two types of active tags. Transponders only "wake up" and transmit data when they receive a radio signal from a reader. For example, a transponder attached to a vehicle in a toll payment or checkpoint control location would only be active when passing through a particular gate. This helps conserve battery life. Beacons, on the other hand, emit a signal at a pre-set interval. This type of active tag is used in real-time location systems (RTLS) for tracking anything from wheelchairs at a hospital to large cargo containers at a shipping dock.

Figure 3.Inside of an active RFID tag – note the on-board battery

Passive RFID: In passive RFID solutions, the reader and reader antenna send a signal to the tag, and that signal is used to power on the tag and reflects energy back to the reader. There are passive LF, HF, and UHF systems. Read ranges are shorter than with active tags and are limited by the power of the radio signal reflected back to the reader (commonly referred to as tag backscatter).Passive tags are usually smaller, less expensive, and more flexible than active tags. This means they can be attached or even embedded on a wider variety of objects. Passive UHF tags are commonly used for item-level tracking of consumer goods and pharmaceuticals, for example.

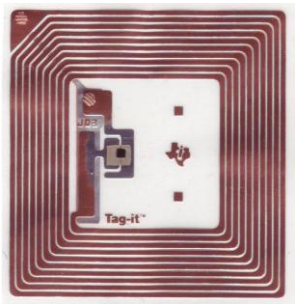

Figure 4.Passive tag

Battery-Assisted Passive (BAP) RFID: A third, hybrid type of RFID tag has also emerged. BAP systems, or semi-passive RFID systems, incorporate a power source into a passive tag configuration. The power source helps ensure that all of the captured energy from the reader can be used to reflect the signal, which improves read distance and data transfer rates. Unlike active RFID transponders, BAP tags do not have their own transmitters.

Figure 5. BAP Tag

IV. FREQUENCY OF TAGS

RFID tags can be grouped into three categories based on the range of frequencies they use to communicate data: low frequency (LF), high frequency (HF) and ultra-high frequency (UHF). Generally speaking, the lower the frequency of the RFID system, the shorter the read range and slower the data read rate.

Low Frequency (LF) RFID: These RFID systems operate in the 30 KHz to 300 KHz range, and have a read range of

up to 10 cm. While they have a shorter read range and slower data read rate than other technologies, they perform better in the presence of metal or liquids (which can interfere with other types of RFID tag transmissions). Common standards for LF RFID include ISO 14223 and ISO/IEC 18000-2. LF tags are used in access control, livestock tracking, and other applications where a short read range is acceptable.

Table 1 Classification of RFID tags

Class 0	UHFl read-only, pre-programmed passive tag
Class 1	UHF or HF; write once, read many (WORM)
Class 2	Passive read-write tags that can be written to at any point in the supply chain
Class 3	Read-write with onboard sensors capable of recording parameters like temperature, pressure, and motion; can be semi passive or active
Class 4	Read-write active tags with integrated transmitters; can communicate with other tags and readers
Class 5	Similar to Class 4 tags but with additional functionality; can provide power to other tags and communicate with devices other than readers

High Frequency (HF) RFID: HF systems operate in the 3 MHz to 30 MHz range and provide reading distances of 10 cm to 1 m. Common applications include electronic ticketing and payment and data transfer. Near Field

Communication (NFC) technology is based on HF RFID and has been used for payment cards and hotel key card applications. Other types of smart card and proximity card payment and security systems also use HF technology. Standards include ISO 15693, ECMA-340, ISO/IEC 18092 (for NFC), ISO/IEC 14443A and ISO/IEC 14443 (for MIFARE and other smart card solutions).

Ultra-High Frequency (UHF) RFID: These systems have a frequency range between 300 MHz and 3 GHz, offer read ranges up to 12 m, and have faster data transfer rates. They are more sensitive to interference from metals, liquids, and electromagnetic signals, but new design innovations have helped mitigate some of these problems.UHF tags are much cheaper to manufacture, and as such are commonly used in retail inventory tracking, pharmaceutical anti-Counterfeiting, other applications where large volumes of tags are required. The EPC global Gen2/ISO 18000-6C standard is a well-known global standard for item-level tracking applications.

V. HOW IS RFID DIFFERENT FROM BARCODE?

Barcode is the most common method of tagging used today. Almost all products that are being sold have their own barcode that makes it easier for the teller to get the right price of the product. A barcode scanner uses a light that is reflected on a series of black bars to read the data, these data is then converted to its numeric equivalent for further processing. A new tagging method called RFID (Radio Frequency Identification) uses radio waves to retrieve the data stored in a tiny circuitry. Radio waves can pass through solid objects, meaning no line of sight is necessary in getting the data. Barcode scanners are also bit difficult to use because you would need to individually position and scan each item to get the barcode. RFID can get 40 to 100 tags in a single second and since it doesn't require line of sight, it can get all the tags in an area in no time at all. The data in a barcode is printed on a sticker and needs to be visible so that the scanner can easily spot it and get the data. This creates two problems that make barcodes unsuitable for some applications. RFID doesn't suffer from any of this. Since it doesn't require line of sight, it can be tucked inside where it is safe from damage. Its electronic nature also means that the data can be encrypted in order to prevent malicious people from copying it.

VI. APPLICATIONS OF RFID

Proximity (short range) and Vicinity (long range) are two major application areas where RFID technology is used. Track and trace applications are long range or vicinity applications. This technology provides additional functionality and benefits for product authentication. Access control applications are Short range or proximity type of applications. Agile Sense Technologies is focused on delivering innovative, high value RFID solutions assisting company's track assets, people and documents. Agile Sense provides robust and complete RFID solutions built on top of its extensible middleware/framework for Government, Healthcare, Manufacturing and Aerospace industries

Asset Tracking: Static or in-motion assets tracking or locating, like a healthcare facility, wheelchairs or IV pumps in, laptops in a corporation and servers in a data centre, was not so easy task.

People Tracking: People tracking system are used just as asset tracking system. Hospitals and jails are most general tracking required places.

Document tracking: This is most common problem. Availability of large amount of data and documents brings

lots of problem in document management system. An RFID document-tracking system saves time and money by substantially reducing:

- Time spent searching for lost document
- The financial and legal impact associated with losing documents.

Government Library: Many government libraries use barcode and electromagnetic strips to track various assets. RFID technology uses for reading these barcodes unlike the self-barcode reader RFID powered barcode reader can read multiple items simultaneously. This reduces queues and increases the number of customers using self-check, which in turn will reduce the staff necessary at the circulation desks.

Healthcare: Patient safety is a big challenge of healthcare vertical. Reducing medication errors, meeting new standards, staff shortages, and reducing costs are the plus points of use of RFID solutions. RFID wristbands containing patient records and medication history address several of these concerns.

VII. CONCLUSION

Barcodes uses a sensor and light to read the data on the tag while RFID uses radio waves, which doesn't need line of sight, to get the data.

Barcode scanners can only process tags one at a time while RFID scanners can process dozens in a single second. Barcodes are really simple and can be easily replicated or counterfeited while RFID is more complex and secure

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