An Overview on RFID Technology Advantages

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ABSTRACT: ***RFID technology has been around for a while but hasn't gotten much traction due to a lack of standards and expensive prices. Costs have decreased as a result of new technology, and standards are being established. RFID is now primarily utilized for a variety of activities, including supply chain management, livestock monitoring, counterfeit prevention, building access control, and automated checkout. Security issues and a lack of standards are limiting RFID's usage. This article discusses RFID technology and its current uses. RFID (Radio Frequency Identification) is a technology that has been around for over 50 years. During World War II, RFID was initially employed in a Friend or Foe identifying system. Since then, RFID has piqued the interest of many scientists, universities, and businesses all around the globe. Radio Frequency Identification Technology (RFID) has gone from obscurity into main stream applications that assist expedite the handling of produced products and materials". Barcode is still the dominating player in supply chain sectors and departmental shops.***

KEYWORDS: ***Advantages, RFID, Technology***

1. INTRODUCTION

However RFID is replacing barcode technology and has the main benefit of being independent of line of sight issues and scanning the objects from a distance [1]. It provides the promise of reduced labor levels, greater visibility, and improved inventory management. Walmart has been one of the pioneers in the large scale deployment of RFID technology .RFID tags have a memory capacity of 16 - 64 Kbytes which is far larger than the barcodes (1 - 100 bytes) and can store extra data such as manufacturer name and product details. The first stage of RFID occurred during World War II, when the British employed it to identify whether planes belonged to "friend or foe". Some technological problems resulted in the shooting down of friendly aircraft and since then the usage of RFID was restricted to Defense and armed forces industries owing to the expense considerations [2].

New advances in science and technology have allowed use in commercial applications. Large institutions, such as the US Department of Defense, have subsequently implemented RFID which is now expanding to other organizations and industries. Walmart is the second largest consumer of RFID and spending considerable money to develop its applications. Security concerns still persisting regarding RFID technology is the worry that individuals may simply construct RFID readers with lower prices and can read data from an RFID chip without knowledge and maybe even change the data. For example, someone might use the RFID reader on an inexpensive product and upload the data to a chip that is on a costly product, thus obtaining the latter for a cheaper price. Another example is about obtaining data from unsecured RFID equipped mobiles. Different kinds of RFID tags exist, but are broadly classified as active or passive[3].

An active tag needs a power source and is either linked to a powered device or to a battery and is frequently restricted by the lifespan of its source. Being reliant on a powered source puts limitations on Active RFID tags. Cost, size, lifetime make them unsuitable for frequent usage[4]. On the other side, Passive RFID is of importance because of the fact they are independent of power supply and maintenance. Passive RFID also offer benefits of extended life and being tiny enough to fit into a suitable sticky label. Hence passive RFID tags are utilized for various applications and this article focuses more on passive RFID tags[5]. A passive RFID tag consists of primarily three parts: an antenna, a semiconductor chip connected to the antenna, and some encapsulation to protect the tag from the environment. As stated previously, passive RFID tags don't carry any powered device and become active only upon exposure to external energy. The RFID reader performs the wor for activating and connecting with the tag [6]. The passive RFID tag antenna absorbs energy from the reader and is responsible for transferring the data between tag and reader.

Roy Want says in, "Two fundamentally different RFID design methods exist for transferring power from the reader to the tag: magnetic induction and electromagnetic (EM wave capture) (EM wave capture). These two designs take use of the EM characteristics associated with and RF Antenna - the near field and the far field"[7]. Both technologies can transmit adequate power to a distant tag, usually the power levels will be in the region of 10μW and 1 mW which is extremely low when compared to regular Intel 4 processor power levels 50W. Near-field is the most popular method used for implementing passive RFIDs, and utilized for near range communications. It has the physical limits of range. The range of communication of near field technology

relies upon the formula c/2Πef where c is the speed of light and is the frequency. It has the restriction that frequency of operation rises as the distance decreases. One more limitation is the energy available for induction as a function of distance. These physical constraints have led to far field communication and far field communications depend upon backscattering[8].

1.1 Basic components of RFID ;

- Tag: There are three basic components, the antenna, the integrated circuit, and printed circuit board/substrate, in all RFID tags. The antenna primarily is responsible for sending and receiving radio waves and occasionally collecting the energy from radio waves if the tag is a passive tag (types of tag will be described soon) (types of tag will be explained shortly.) The primary function of integrated circuit (IC) is to convey the tag's unique identification. Moreover, the printed circuit board (PCB) serves to keep the tag together . In contemporary RFID technology, there are 4 kinds of tag, passive tag, semi-passive tag, active tag, and semi-active tag[9].
  - Passive tag: This kind of tags includes no power source on board; thus, they are very inexpensive and tiny. Passive tags absorb their energy when they encounter an electromagnetic field (also called Near Field) produced by RFID reader's antenna. The Near Field may be proximately computed using the following equation: $r = \lambda / (2*\pi)$, where λ is the wavelength. Due to the cause of no power provided on board, the read range of passive tags is extremely limited. Once an RFID reader has interrogated passive tags, and passive tags have absorbed enough energy, they utilize backscatter (an RF method) to transmit their data back to RFID reader[10].
  - Active tag: Unlike passive tags, this kind of tags comes with power provided on board such as battery. Since they have their own power source, they don't need to be powered by the Near Field of RFID readers' antennae. Therefore, passive tags have longer read range than passive tag. The disadvantages are that they are more expensive and larger in size. Active tags send out signals which are encoded with their identifiers at regularly scheduled pace typically between 1 to 15 seconds (known as beacon rate) (known as beacon rate) .
  - Semi-Passive/active Tag: Both kinds of tag include electricity provided on board. The main difference is how the battery is utilized. Batteries in semi-passive tags are solely needed to power the internal electronics. The semi-passive tags nevertheless need to be displayed within the Near Filed in order to absorb power for data transfer between RFID readers and themselves. The benefit of semi-passive tags is greater read ranges than passive tag because the energy they collect from Near Field is completely utilized to transmit data exclusively. Batteries in semi-active tags are utilized precisely the same as those in active tags; however, the energy will only be released to power the tags when the tags are being interrogated by RFID readers. The advantage of semi-active tags is that semi-active tags may live longer than active tags because the batteries will only be engaged when the tags are being interrogated by RFID readers.
- RFID Reader: An RFID reader may be in various forms such as price gun in shop, toll plaza in highway, and so on. An RFID reader is regarded as a middle man in between tags and backend systems. It interrogates (typically termed "read") the data contained in tag and transmits the data to backend system for application wirelessly or via wire. Therefore, an RFID reader should, of course, contains an antenna and an RS-232 serial port or an Ethernet connector. Generally, there are two kinds of RFID readers, read-only readers and read/write readers. A read-only reader only can read tag's data. A read/write reader may read tag's data and also write data to tag if the tag includes a read/write memory.
- Backend System: As I stated previously, the RFID reader acts as a between man between tags and backend systems. Once a backend system gets data sent by an RFID reader, the system runs application depending on the data it received. Several RFID applications will be presented in section.

1.2 Application Of RFID :

In the late 1960s and early 1970s, the first commercial applications of RFID technology were developed. The Electronic Article Surveillance system is the name of the system (EAS). Its main purpose is to prevent theft by using the most basic type of RFID, 1-bit tags. Furthermore, in June 2003 and October 2003, the US Department of Defense (DOD) and WallMart Corporation, respectively, imposed requirements for their suppliers to use RFID technology [4]. Those measures are widely regarded as the most significant push in recent years for the commercial use of RFID technology. RFID technology is being used in a variety of commercial applications, including health care, retail, the automobile sector, financial transactions, and so on. Below are some examples of effective RFID uses in various fields.

- Automotive Sector: Vehicle immobilizers are perhaps one of the most popular RFID applications in the automotive industry. A car immobilizer is a device that stops a vehicle from being driven if the RFID tag supplied is incorrect. Nearly 40% of new vehicles sold in North America are fitted with an RFID-enabled immobilizer. Aside from this anti-theft system, RFID technology is also used in the automobile sector for inventory management to keep track of stock levels .
- Payment Transactions: In the United States, several RFID-based payment systems are available in markets such as ExxonMobil's Speedpass and American Express's ExpressPay. RFID-based payment systems can also be found in transportation areas around the world, such as SmarTrip, which is used in the Washington, D.C. Metro system, EasyCard, which is used in the Taipei Metro in Taiwan, Nagasaki Smart Card system in Japan, and Oyster Card, which is used in London Transportation. The Octopus system in Hong Kong is perhaps the most amazing RFID-based payment system in the world. The Octopus system enables customers to pay for virtually anything with only a single smart card, not simply transit tickets.
- Retailing: RFID-based applications in retailing are primarily used for inventory management and product monitoring. Wal-Mart Corporation announced a requirement in June 2003 requiring all shipments shipped to three of its Texas distribution facilities to include a passive RFID tag by January 2005. Wal-CIO Mart's said a month after the deadline that more than 5 million tag readings had been taken. Also, although the read rate at the case level has surpassed 90% for cases on carts, the read rate at the case level for cases on pallets has been extremely low (averaging 66%). Wal-Mart has seen a 16 percent decrease in out-of-stock goods after using RFID technology. Furthermore, replenishment of out-of-stock goods is three times quicker than with a bar code system, and RFID-enabled shops are more successful at replenishing out-of-stock items. Overall, according to research company Sanford C. Bernstein & Co., Wal-Mart may save over $8 billion per year if RFID is completely implemented across all of its stores .

1.3 RFID Security and Privacy Threats ;

- RFID Protection : Because there is no line of sight issue, anybody may access RFID data and collect data. This is the main and fundamental security risk with RFID. Furthermore, individuals are copying RFID tags and utilizing them in the same manner that credit cards were formerly used. The issue of preventing effective RFID tag cloning is still open and difficult to solve. RFID devices may be used by criminals to scan crowds for high-value currencies. Terrorists may also scan digital passports to track down individuals of a particular nationality. RFID malware is currently being researched . Exploits, worms, and viruses are the three types of RFID malware that may be found. RFID exploits are conventional hacking techniques such to buffer overflows, code insertion, and SQL injection vulnerabilities that may be discovered on the Internet. RFID worms and viruses are nothing more than RFID exploits that transfer the original exploit code to new RFID tags. The key distinction is that RFID worms need network connections, while RFID viruses do not.
- Technical Solutions: One of the issues with RFID tags is that consumers often forget to remove them from their clothing after purchase, allowing for customer monitoring. After selling the goods, a better option is to utilize the EPC stop command as a pro-privacy technology. Another option for preventing data leakage from RFID tags is to employ encryption as a privacy protection. As a consequence, there's a new issue with key management, as well as the degree of encryption standards and their cost. Tag passwords are an alternative method that allows a tag to only emit essential information if it gets the correct password. The problem arises from the reader's need to know the tag's identification. Another option is to employ a timer-based system that causes the tag to update the password on a regular basis according to a predetermined schedule. Another option is to employ Blocker tags, which generates an RF environment unfriendly to RFID readers by combining two tags with a Blocker tag. However, distinguishing the reader based on their energy levels is a simple and effective way to avoid data leaking from RFID tags. This was predicated on the premise that criminals would keep a greater distance from legitimate RFID readers and that their power levels will vary. Readers should see [9,10] for further information on RFID security procedures.

1.4 Advantages Of RFID Technology:

- It improves operational efficiency in a number of ways : One of the most appealing features of RFID is that it needs less supervision, allowing workers to concentrate on more productive activities. Furthermore, reading tags does not require a straight line of sight, allowing many tags to be read at the same time. You may also program the RFID reader to read tag data automatically when you need it

- It eliminates the possibility of human error : Human mistake is always a possibility while doing manual work. To read data using RFID, no human interaction is required. All of this may be done automatically by the reader. The advantages of RFID much outnumber the costs. RFID not only saves time and money, but it also improves accuracy by removing the mistakes that occur with human data entry and product restocking.
- It lowers the cost of capital : Maintaining tight control of your stock or assets, particularly costly company assets like test equipment, transport packaging, computer systems, field cars, and more, is the simplest method to keep prices down. If any of them go missing, you'll have to pay a lot of money to replace them. RFID allows you to keep track of these assets in a simple and cost-effective manner.
- It gives you access to real-time data : RFID's advantages go beyond freeing up workers' time. In harsh settings, RFID provides dependable track-and-trace. This system can simply monitor inventory and product location and give real-time data. Automatic real-time data gathering may help you keep track of huge asset inventories, individual items, or batches. High humidity, dramatic temperature changes, exposure to chemicals and sunlight, very high temperatures, and hard handling are just a few of the circumstances that RFID can endure.
- Provides Insights to Help You Make Better Decisions : Real-time data may be examined to provide additional information and help you make better choices. RFID keeps you updated at all times, which comes in useful when it's time to make profit-boosting planning and operational management choices.

2. DISCUSSION

It turned out that RFID technology has managed to gain big markets taking profit from the benefits of radio transmission. The markets are worth billions of dollars and comprise component commerce, algorithm and tool creation and engineering, as well as integration and deployment. Although this technology is extensively utilized, it is still in its infancy in terms of security. We're still waiting for cost-effective, lightweight security solutions that guarantee secrecy while reducing processing time. RFID also requires many engineers and application designers to create unique and perhaps amusing applications, such as an intelligent refrigerator that detects items and recommends what you should purchase the next time you go out. It's also a thriving study area that produces a number of intriguing articles each year. According to RFID industry experts, the system and tag value will be worth $26.9 billion by 2017 with 670 billion tags in use, up from “only” 2 billion tags and $4.96 billion in 2007 [5].

3. CONCLUSION

RFID is still in its early stages of development, with more innovative uses on the way. RFID tags are being utilized in clothes for billing and security reasons, among other uses that have previously been created. Animals have RFID tags implanted in them for tracking reasons. RFID tags implanted in uniforms may be used to determine how long it takes an employee to perform a job. Several organizations are opposing the use of RFID to monitor individuals, citing concerns about the effect on people's social lives and privacy. Clearly, the degree to which RFID will be utilized is still up for discussion. RFID tags are the subject of a lot of study, especially when it comes to integrating them with other devices, particularly mobile ones. RFID producers and users want the technology to be properly standardized and regulated. RFID technology is anticipated to become more economically and technically feasible as costs decrease and technological advancements continue. As new applications are created, RFID technology is expected to become more economically and technically viable and influence our everyday lives.

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