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Research Study on RFID and its Future Applications

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Abstract: ***There has been a revolution in tracking and tracing of products and goods in the supply chain using passive radio frequency identification (RFID) systems. Recommendations to the suppliers have been released to various major retailers and government agencies after realizing the potential of RFID systems. This paper outlines some research done to identify a set of parameters which can help us in comparing the performance of Ultra High Frequency (UHF) passive RFID tags to be set as benchmarks. This paper is published on the notes of the above paragraph to provide a survey on radio frequency identification (RFID) technology. Primarily the RFID tags were developed to eventually replace barcodes in supply chains due to their advantages of being able to be read wirelessly and without line of sight, they contain more information than barcodes, and are obviously more robust. The RFID technology did not stop at item-level tagging. This paper tries to unfold the various studies and research done on the RFID beyond their just feature of being used as a tag. It tells us about the latest technology research that focuses on locating and tracking labeled objects that move using RFID. Passive radio frequency identification (RFID) systems are revolutionizing the way products and goods are tracked and traced in the supply chain. Radio frequency identification (RFID) and barcode technology are similar in some ways as they both are an automatic identification technology. Nowadays RFID is mostly involved in numerous tasks including managing supply chains, tracking livestock, preventing counterfeiting, controlling building access, and supporting automated checkout. This paper highlights the RFID technology, its working, its architecture and its applications. With the help of RFID the world is moving towards automation with reduced labor levels, enhanced visibility, and improved inventory management. This paper also underlines the different types of RFID tags. RFID is applicable in many fields like retail industry, agriculture, vehicle management, underwater applications, healthcare, smart homes and for security and safety purposes to name a few.. It enables distant identification unlike earlier bar-code technology it does not require a line of sight. This paper also addresses current RFID technology in terms of systems, components, and propagation, and provides a look forward towards its future applications.***

Keywords: Radio Frequency Identification (RFID), RFID Components, RFID Applications, Types of RFID, Future of RFID

I. INTRODUCTION

RFID tags, or simply "tags", are small transponders. Transponders are devices which receive a radio signal and automatically transmit a serial number or similar identifier wirelessly.

RFIDs generally consist of :

1) Microchip
2) Antenna
3) Case
4) Battery (for active tags only)

The size and form of the chip depends mostly on:
a) The Antenna size which eventually depends on the frequency the tag is using
b) On area of use of the tag

RFIDs are heavily used to track items in manufacturing industries to label items for supermarkets. Tags are generally considered as an alternative to barcodes but it has much wider scope as per its applicability. Through this paper we will understand the scope of new applications that can be achieved using RFID technology likely to locate lost items, tracking moving objects, and others. RFID has been either mandatory or recommended to the suppliers of some of the large retailers and government agencies that have realized the promise that RFID offers to businesses. There have been a number of incidents where the stringent timelines for these mandates have resulted in a number of misleading claims from RFID vendors and confusion among RFID end-users. These incidents have led to an immediate need for performance benchmarks of RFID products to give consistent information and to increase the efficiency.

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An RFID's size can vary from as large as the size of a book in the container logistics to as small as less than a millimeter for implants. Additional rewritable memory can be attached to RFIDs where the tag can store updates between reading cycles or new data like serial numbers. Figure 1 is the display of an RFID tag. The antenna is clearly visible. As mentioned earlier the antenna has the largest impact of the size of the tag. There is a microchip visible in the center of the tag; also as this is a passive tag representation so it does not have an internal power source.

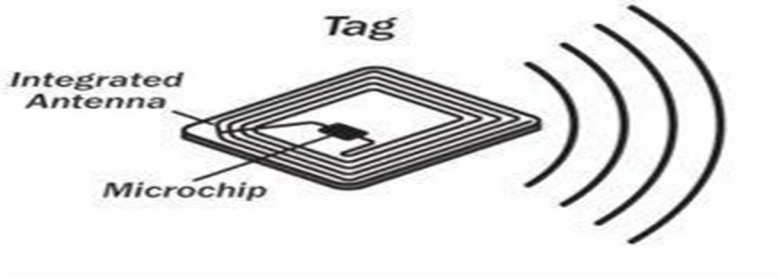

Fig. 1: Representation of an RFID Tag

A. History of RFID

The existence of the family of RFID technology has been there since the 1940s. Governments of different nations developed identification technology to track military equipment and personnel in the 1960s and 1970s using this technology. RFID had become the major technology to be used in the identification and temperature sensing of cattle by the late 1970s. However, only by late 1980s and 1990s when the semiconductor companies were able to achieve improved performance with size and cost reduction, the RFIDs became widely in use.

*B. What is RFID***?**

Radio Frequency Identification (RFID) refers to a wireless system composed of two main components:

1) Tags
2) Readers.

Device that has one or more antennas that emit radio waves and receive signals back from the RFID tag is referred to as a reader. Tags, on the other hand, are the ones which use radio waves to communicate their identity and other information to nearby readers. Tags can be passive or active.

Tags which are powered by batteries are the Active RFIDs while Passive RFID tags are powered by the reader and do not have a battery.

RFID tags also possess the capability to store a range of information from one serial number to several pages of data. There is a huge possibility of the Readers to be mobile. They can be carried by hand, or they can be mounted on a post or overhead. The Reader systems can also be built or designed as per the architecture of a cabinet, room, or building.

Two technologies supporting the advancement of IoT i.e. "Internet of Things" are Radio Frequency Identification and Wireless Sensor Networks. Using these technologies as a combination has successfully led to the development and invention of high-end softwares which can automatically identify people, objects, and animals, as well as monitoring environmental parameters, and area monitoring.

C. Working of RFID

1) RFID is an Automatic identification technology that identifies the product uniquely without being in line of sight.
2) RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). Automatic identification of objects, collecting the respective data and then storing the data directly into the systems with no or very less human connect can be reached through AIDC methods.
3) RFID methods utilize radio waves. At a basic level, RFID systems are made of three components: an RFID tag or smart label, an RFID reader, and an antenna.
4) RFID tags contain an integrated circuit and an antenna, which is used to transmit data to the RFID reader (also called an interrogator). Then the radio waves are converted into more usable form of data using the reader.

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5) A communications interface is used to transfer the information collected from the tags to a host computer system. This data is stored in a database to be analyzed at a later time.

Fig. 2: RFID System

The mechanism to track and trace individual items through the supply chain, i.e. from the manufacturer, through the distributor, to the retailer, and finally to the consumer has now become simple with the use of RFIDs. It has enabled companies to know exactly where every item in their supply chain is at any given point of time. RFID is considered as an investment for the future which can provide advantages like cost reduction by maintaining correct amount of stock levels, increase in revenue by reducing the out-of-stocks, counterfeit protection, shrinkage protection, and real-time tracking of supplies for the retailers. These benefits are pervasive throughout the supply chain.
There is always the risk of getting biased information, even though there are better third party solutions and softwares to provide the best input. Hence there occurs a need for unbiased, good, and reliable source of information for RFID products.
There is a need for benchmark measures that are repeatable, providing a scientific way to compare performance and can also be an indication of the real-world performance of the tags. These measures, when combined, can provide the expectations in performance that can give information towards implementing better RFID systems.

Tagging products with an unique identifier through RFID it has extended its applicability to:
a) Have spectacular development of wireless monitoring and control applications with passive integrated circuits
b) Processes held in harsh industrial environments.
c) In textile industries & industrial laundries, the RFID system with passive RFID tags involves specific architectures and building solutions. Various design change requirements have been established for passive RFID tags:

- They should be washable and wearable
- They should be robust enough to operate in harsh environments
- Must have a sufficiently long lifetime.
- They should be cost-efficient

D. Importance of RFID
1) It automatically captures the information and stores it on the computer.
2) RFID made it possible for computers to attain the capability of computing and understanding what is happening in the real world without human intervention.
3) RFID technology reduces human efforts and errors by automating data collection.
4) Links the digital and real worlds.

II. TYPES OF RFID

RFIDs are distinguished on the basis of power or energy in the following manner:

A. Passive
B. Semi-passive
C. Active

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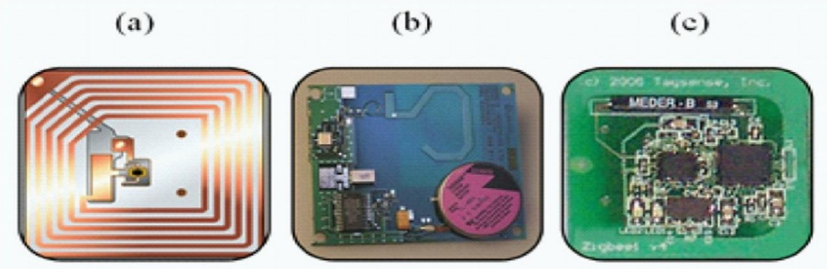

Fig. 3: Type of RFIDs

1) Passive tags do not have an internal power source, and they therefore rely on the power induced by the reader. To have a complete transaction, the reader has to keep up its field. These are the smallest and cheapest tags available in the market as they do not have any battery requirement Hence their lifespan is unlimited as they do not depend on any internal power source.
2) The second type of tags is semi-passive tags. These tags have an internal power source that keeps the microchip powered at all times. Advantages of semi-passive tags are as follows:
a) Because the chip is always powered it can respond faster to requests
b) Increasing the number of tags that can be queried per second which is important to some applications.
3) The third type of tags is active tags. Like semi-active tags they also contain an internal power source but they use the energy supplied for both, to power the microchip and to generate a signal on the antenna. Active tags that send signals without being queried are called beacons. The lifetime is up to 5 years.

III. ONGOING INNOVATIONS IN RFID

Few ongoing innovations in RFID are as follows:

A. Enhancements to Design of Antenna: A good designed antenna can be a better performer by reducing the heating of the tags, its durability, robustness etc.
B. Increased in on the fly memory storage of tags: Increased memory will add more intelligence into the tag
C. Integrating sensors & communication technologies to tags.
D. Data security using cloud based solutions

IV. APPLICATION OF RFID

A. Healthcare Applications
B. Baggage Applications
C. Toll Road Applications
D. Animal Identification
E. National Identification
F. Asset Tracking
G. People Tracking
H. Document tracking
I. Government Library
J. Healthcare
K. Manufacturing & Aerospace
L. Authentication

V. CONCLUSION

Using the latest technologies and seeing the enormous acceptance it has received, RFIDs will become more reliable and cost-effective for a larger number of applications. The modifications will bring down the cost of tags with more memory and will enable the “smart asset” applications. Enhancements on the communication and sensory fronts will help MNCs in better monitoring and managing of assets and shipments. We are near to see the Passive sensors for temperature, moistures, pressure, vibration etc to be combined with RFID to provide even more intelligence from the edge of the enterprise.

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This will also help in recognizing any mishap in the industrial zone as well as can be enhanced to intelligently call the emergency services and trigger the alarm. The RFID industry is about to enter an exciting period in which increased adoption will provide the means for technology providers to invest in new, exciting innovations. Along with the new developments described above, advancements in materials, organic polymers, nanotechnology, and other areas will change the way RFID is incorporated into products. Instead of a tag attached to a garment, an RFID transponder could be printed directly into cloth or packaging using biodegradable conductive inks.

The future of RFID is here, so both end users and RFID manufacturers should be prepared to leverage these new technologies and ready themselves for more widespread use of RFID. It is astonishing how a modest device like an RFID tag, essentially just a wireless license plate, can give rise to the complex mélange of security and privacy problems that we explore here. RFID privacy and security are stimulating research areas that involve rich interplay among many disciplines, like signal processing, hardware design, supply-chain logistics, privacy rights, and cryptography. The scale of the systems and data flows that RFID will introduce, as well as the new forms of user perception of security and privacy will continue to bring new problems and new interdisciplinary intersections to light.

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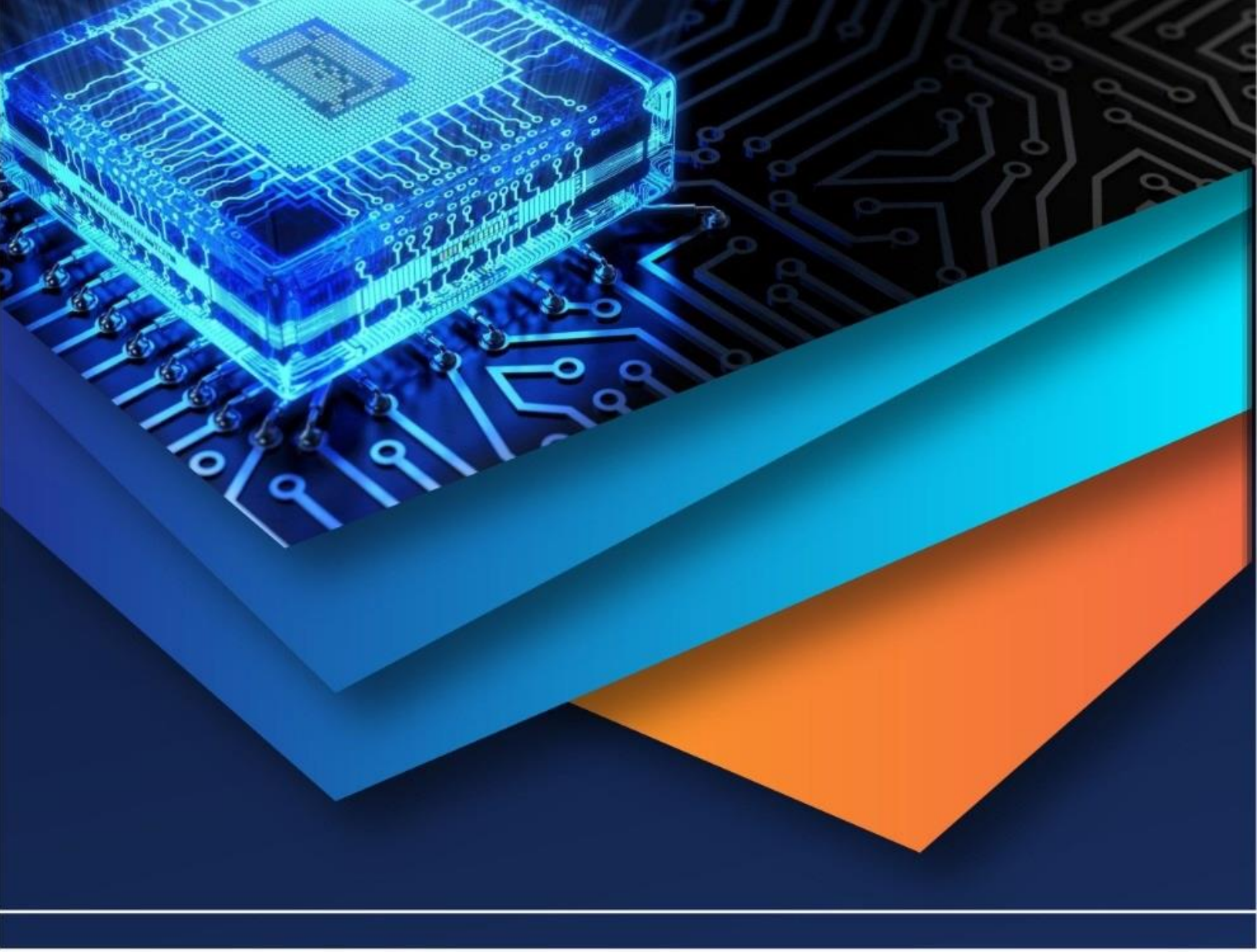

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