Radio Frequency Identification

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Abstract:

Wireless sensor networks have the potential to provide unprecedented remote monitoring capabilities that can benefit applications such as industrial control, environmental monitoring, and defense. Radio Frequency Identification (RFID) is one of the most exciting technologies that revolutionize the working practices by increasing efficiencies, and improving profitability. It is often presented as a replacement for today's barcodes, but the technology possibilities, such as individual serial item for each item, and the possibilities to read these numbers at a distance of several meters. They are simpler to deploy than wired solutions and these networks will enable improved understanding of processes and environments through continual monitoring of a larger set of parameters.

I. History and Technical Background:

In the year 1939, An IFF transponder invented in the United Kingdom, was routinely used by the allies in *World War II* to identify aircraft as friend or foe. In the year 1946 Léon Theremin invented an *espionage tool* for the *Soviet Union* which retransmitted incident radio waves with audio information. In the year 1969, the original business plan presented to investors sowed uses in transportation (automotive vehicle identification, automatic toll system, electronic license plate, electronic manifest, vehicle routing, vehicle performance monitoring), banking (electronic check book, electronic credit card), security (personnel identification, automatic gates, surveillance) and medical (identification, patient history).

In the year 1971, The initial device was passive, powered by the interrogating signal, and was demonstrated at the New York Port Authority and other potential users and consisted of a transponder with 16 bit memory for use as a toll device. In the year 1973, Mario Cardullo's was the first true ancestor of modern RFID; a passive radio transponder with memory. A very early demonstration of reflected power (modulated backscatter) RFID tags, both passive and semi-passive, was performed by Steven Depp, Alfred Koelle, and Robert Freyman at the Los Alamos National Laboratory. In the year 1983, the first patent to be associated with the abbreviation RFID was granted to Charles Walton in 1983.

II. Introduction to RFID:

Radio-frequency identification (RFID) is the use of an object (typically referred to as an RFID tag) applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. Most RFID tags contain at least two parts: Integrated Circuit and Antenna. Some tags can be read from several meters away and beyond the line of sight of the reader. There are generally three types of RFID tags: Active RFID tags and Passive RFID tags. Today, RFID is used in enterprise supply chain management to improve the efficiency of inventory tracking and management.

Active RFID:

An RFID tag is an active tag when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry and antenna. Some active tags contain replaceable batteries for years of use; others are sealed units. (Note that It is also possible to connect the tag to an external power source.) Features if active RFID are: - Longest communication range of any tag. The capability

to perform independent monitoring and control. The capability of initiating communications. The capability of performing diagnostics. The highest data bandwidth.

Active rfid tags may even be equipped with autonomous networking; the tags autonomously determine the best communication path. Major advantages are: - It can be read at distances of one hundred feet or more, greatly improving the utility of the device. It may have other sensors that can use electricity for power. Problems and disadvantage are: - The tag cannot function without battery power, which limits the lifetime of the tag. The tag is typically more expensive, often costing $20 or more each. The tag is physically larger, which may limit applications. The long-term maintenance costs for an active RFID tag can be greater than those of a passive tag if the batteries are replaced. Battery outages in an active tag can result in expensive misreads.

Passive RFID:

A passive tag is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive rfid tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. Major advantages are: - The tag functions without a battery; these tags have a useful life of twenty years or more. The tag is typically much less expensive to manufacture. The tag is much smaller (some tags are the size of a grain of rice). These tags have almost unlimited applications in consumer goods and other areas.

Problems and disadvantages are: - The tag can be read only at very short distances, typically a few feet at most. This greatly limits the device for certain applications. It may not be possible to include sensors that can use electricity for power. The tag remains readable for a very long time, even after the product to which the tag is attached has been sold and is no longer being tracked.

Zombie RFID:

One of the main concerns with RFID tags is that their contents can be read by anyone with an appropriately equipped scanner - even after you take it out of the store. One technology that has been suggested is a zombie RFID tag, a tag that can be temporarily deactivated when it leaves the store.

Privacy Protection: - The process would work like this: you bring your purchase up to the register, the RFID scanner reads the item, you pay for it and as you leave the store, you pass a special device that sends a signal to the RFID tag to "die." That is, it is no longer readable. The "zombie" element comes in when you bring an item back to the store. A special device especially made for that kind of tag "re-animates" the RFID tag, allowing the item to reenter the supply chain.

Miniaturization:

RFID tags can be highly miniaturized, which makes it easy to conceal or incorporate them in other items. For example, in 2009 researchers at Bristol University successfully glued RFID micro transponders to live ants in order to study their behavior. This trend towards increasingly miniaturized RFID is likely to continue as technology advances. However, the ability to read at distance is limited by the inverse-square law.

Library:

RFID has many library applications that can be highly beneficial, particularly for circulation staff. Since RFID tags can be read through an item, there is no need to open a book cover or DVD case to scan an item. This could reduce repetitive-motion injuries. Advantages are: - Where the books have a barcode on the outside, there is still the advantage that borrowers can scan an entire pile of books in one go, instead of one at a time. Since RFID tags can also be read while an item is in motion, using RFID readers to check-in returned items while on a conveyor belt reduces staff time. But, as with barcode, this can all be done by the borrowers themselves, meaning they might never again need the assistance of staff.

Different types of Collisions:

Collisions are of two types: -
(a)Anti-collision:- In the context of RFID, anti-collision refers to different ways to keep radio

waves from one device from interfering with radio waves from another device. RFID readers may make use of anti-collision algorithms to enable a single reader to read more than one tag in the reader's field.

(b)RFID tag collision: - Tag collision in RFID systems happens when multiple tags are energized by the RFID tag reader simultaneously, and reflect their respective signals back to the reader at the same time. This problem is often seen whenever a large volume of tags must be read together in the same RF field. The reader is unable to differentiate these signals; tag collision confuses the reader.

Different systems have been invented to isolate individual tags; the system used may vary by vendor. For example, when the reader recognizes that tag collision has taken place, it sends a special signal (a "gap pulse"). Upon receiving this signal, each tag consults a random number counter to determine the interval to wait before sending its data. Since each tag gets a unique number interval, the tags send their data at different times.

Manufacturing Process:

The Flip chip assembly technology helps in designing the RFID tags at a faster rate. A special conductive material is used to contain the RFID chips. Designing at the rate of 5-8 thousand units per hour. Each tag contains its own unique identification. The annual output has increased exponentially over the years. RFID tags continue to prove promising to the future of mankind. As these tags contain unique identification the output increased from 1.04 billion tags to over 150 billion tags as the size of the antennas are reduced.

Applications of RFID: Human Implantation

An early experiment with RFID implants was conducted by British professor of cybernetics Kevin Warwick, who implanted a chip in his arm in 1998.RFID is a low cost effective means for tracking products. The implications that RFID might be used to track or provide information about a person, by implanting the device under the skin, has led some to believe that this is the Mark of the Beast.

Some believe that devices such as this, will allow us to be tracked at all times, even in our homes and that even the possibility of such loss of privacy cannot be allowed at any cost. Some foresee a time when we can walk into a store, load up the buggy full of products and simply walk out of the door. That person will simply have his/her credit card billed, but consideration should be factored in whether to use RFID to identify or track people because of the risk of privacy issues and the risk of it being deemed “inhuman”. And in the future the stolen books could be traced even outside the library. Removing of the tags could be made difficult if they are so small that they fit invisibly inside a (random) page, possibly put there by the publisher.

Applications of RFID: Replacing Barcodes

RFID tags are often a replacement for UPC or EAN barcodes, having a number of important advantages over the older barcode technology. They may not ever completely replace barcodes, due in part to their higher cost and the advantage of multiple data sources on the same object. The new EPC, along with several other schemes, is widely available at reasonable cost.

The storage of data associated with tracking items will require many terabytes. Filtering and categorizing RFID data is needed to create useful information. It is likely that goods will be tracked by the pallet using RFID tags and at package level with Universal Product Code (UPC) or EAN from unique barcodes. RFID tag data capacity is large enough that each individual tag will have a unique code, while current bar codes are limited to a single type code for a particular product. The uniqueness of RFID tags means that a product may be tracked as it moves from location to location, finally ending up in the consumer's hands.

Efficient paths to the future of RFID:

The scanning antennas can be permanently affixed to a surface; handheld antennas are also available. They can take whatever shape you need; for example, you could build them into a door frame to accept data from persons or objects passing through. When an RFID tag passes through the field of the scanning antenna, it detects the activation signal from the antenna. That "wakes up" the RFID chip, and it transmits the information on its microchip to be picked up by the scanning antenna.

When the cargo is passed through the RFID scanner the Radio frequency signals transmitted from the scanner detect the RFID tags located at various locations on the cargo. These tags retransmit the data back to the system where the details of the products are stored and are prepared for shipment. Earlier the manufacturer had to scan and detect a cargo one by one but at present due to the improvised RFID tags the products can be scanned at the same time. RFID tags scanned can be stored in the warehouse. Improvised RFID help to detect the products located in the warehouse.

Problems and Concerns of RFID:

Global standardization: - The frequencies used for RFID in the USA are currently incompatible with those of Europe or Japan. Furthermore, no emerging standard has yet become as universal as the barcode. *Security concerns:* - A primary RFID security concern is the illicit tracking of RFID tags. Tags which are world-readable pose a risk to both personal location privacy and corporate/military security.
Exploits: - *Ars Technica* reported in March 2006 an RFID buffer overflow bug that could infect airport terminal RFID Databases for baggage, and also Passport databases to obtain confidential information on the passport holder.

Passports: - In an effort to make passports more secure, several countries have implemented RFID in passports. However, the encryption on UK chips was broken in less than 48 hours. Where a criminal used to need to secretly open and then reseal the envelope, now it can be done without detection, adding some degree of insecurity to the passport system. *Shielding:* - A number of products are available on the market that will allow a concerned carrier of RFID-enabled cards or passports to shield their data. Others claim that simply wrapping an RFID card in aluminum foil, only makes transmission more difficult, yet is not completely effective at preventing it.

Passport Identification using RFID:

The first RFID passports (E-passport) were issued by Malaysia in 1998. In addition to information also contained on the visual data page of the passport, Malaysian e-passports record the travel history (time, date, and place) of entries and exits from the country. Standards for RFID passports are determined by the International Civil Aviation Organization (ICAO).

In the current proposed system the RFID tag gives out its signal when totally exposed to the RFID reader. But the major disadvantage of this tag is to emit the signal even when it is partially opened. The improvised RFID tags are Uni-directional. These tags only give a signal when it is completely opened and shuns the signal when it is partially opened. In the current proposed system due to the lack of privacy leaving the security of the nation at stake. When this passport comes in contact with an explosive device connected to an RFID reader it could trigger the bomb. In the improvised shielding system the RFID tags can be prevented from being detected. This change could prove the safety of the nation.

Future applications of RFID:

In the future when a customer approaches to a product the virtual billboard, the product would be identified by the RFID reader and the cost of the product would be displayed. The customer could simply take the product and leave the store. An RFID scanner placed at the entrance or exit would detect these tags and are immediately deactivated and the bill is send to him.

III. Conclusion:

Radio frequency identification (RFID) continues to play a major role in the field of technology apart from the social conflicts regarding the privacy issues of an individual being. The miniaturization of these tags further helping to

track and detect any product or an individual plays a vital role in the present generation. RFID is proved to be promising for the future of mankind.

IV. References:

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