BENEFITS AND APPLICATIONS OF RFID BASED INVENTORY SYSTEMS

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ABSTRACT

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna. RFID combined with GPS is an even more mind-blowing combination that has thousands of applications. Automatic Vehicle identification, Inventory Management, Document/ Jewellery tracking, Patient Monitoring, Biometrics, PCB tracking, Asset tracking, Animal tracking, Contactless payments etc are the lots of applications of RFID. RFID provides a unique identification for any product and GPS provides location-awareness. The use of RFID reduces the amount of time required to perform circulation operations. other Benefits of using RFID based inventory systems are High-Speed inventorying ,long tag life ,Provides total asset visibility, Gives full inventory history ,Allows reduced inventory-stocking levels, Provides full process control for products in the facility, Reduces lead-time, Shortens cross docking time.

Keywords: *RFID, PCB, GPS, UHF, EM.*

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INTRODUCTION

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, Electro-magnetic or electrostatic coupling in the RF portion of the electromagnetic spectrum is used to transmit signals. An RFID system consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted. Microchip and the antenna together are called an RFID transponder or an RFID tag. The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.

APPLICATION OF RFID:

Low-frequency RFID:

Tags are commonly used for animal identification, beer keg tracking, and automobile key-and-lock, anti-theft systems. Pets are often embedded with small chips so that they may be returned to their owners if lost. In the United States, two RFID frequencies are used: 125 kHz (the original standard) and 134.5 kHz, the international standard.

High-frequency RFID:

Tags are used in library book or bookstore tracking, pallet tracking, building access control, airline baggage tracking, and apparel item tracking. High-frequency tags are widely used in identification badges, replacing earlier magnetic stripe cards. These badges need only be held within a certain distance of the reader to authenticate the holder.

UHF RFID:

Tags are commonly used commercially in pallet and container tracking, and truck and trailer tracking in shipping yards.

Microwave RFID:

Tags are used in long range access control for vehicles, an example being General Motors' On Star system. Sensors such as seismic sensors may be read using RFID transceivers, greatly simplifying remote data collection. Implantable RFID "chips", originally designed for animal tagging are being used and contemplated for humans as well. Applied Digital Solutions proposes their chip's "unique under-the-skin format" as a solution to identity fraud, secure building access, computer access, storage of medical

records, anti-kidnapping initiatives and a variety of law-enforcement applications. Combined with sensors to monitor body functions, the Digital Angel device could provide monitoring for patients.

Potential uses:

RFID tags are often envisioned as a replacement for UPC or EAN bar-codes, having a number of important advantages over the older bar-code technology. RFID codes are long enough that every RFID tag may have a unique code, while UPC codes are limited to a single code for all instances of a particular product.

The uniqueness of RFID tags means that a product may be individually tracked as it moves from location to location, finally ending up in the consumer's hands. This may help companies to combat theft and other forms of product loss. It has also been proposed to use RFID for point-of-sale store checkout to replace the cashier with an automatic system, with the option of erasing all RFID tags at checkout and paying by credit card or inserting money into a payment machine.

ADVANTAGES OF RFID SYSTEMS

Rapid charging/discharging

The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the

Anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.

The other time savings realized by circulation staff are modest unless the RFID tags replace both the EM security strips or RF tags of older theft detection systems and the barcodes of the automated library system i.e., the system is a comprehensive RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking, but handles both simultaneously with a single piece of equipment. 3M has developed readers that can do both concurrently except for videotapes and audiotapes. These have to be desensitized and sensitized in a separate operation. In either case, there can be as much as a 50 percent increase in throughput.

The time savings are less for charging than for discharging because the time required for charging usually is extended by social interaction with patrons.

High reliability

The readers are highly reliable. Several vendors of RFID library systems claim an almost 100 percent detection rate using RFID tags. Anecdotal evidence suggests that is the case whenever a reader is within

12 to 14 inches of the tags, but there appears to be no statistical data to support the claims. There are fewer false alarms than with older technologies once an RFID system is properly tuned. The libraries contacted that have experience with both EM and RFID security systems; report a 50 to 75 percent reduction.

Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Were a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. However, the author has not been able to identify a library that has implemented this security feature. Other RFID systems encode the circulation status on the RFID tag. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge. If the material that has not been properly charged is taken past the exit sensors, an immediate alarm is triggered. Another option is to use both the "theft" bit and the online interface to an automated library system, the first to signal an immediate alarm and the second to identify what has been taken.

High-speed inventorying

A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.

Automated materials handling

Another application of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for reshelving. Given the high cost of the equipment, this application has not been widely used. There were approximately 40 systems in use in North America as of the first quarter of 2004.

Long tag life

Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

DISADNANTAGES OF RFID SYSTEMS

High cost

The major disadvantage of RFID technology is its cost. While the readers and sensors used to read the information are comparable in cost to the components of a typical EM or RF theft detection system, typically $2,500 to $3,500 or more each; a server costing as much as $15,000 may be required and the tags cost $.60 to $.85 each. It may be some time before the cost of tags comes down to $.50 or less, the figure which polling of librarians has determined is the key to their serious consideration of the technology. Gem plus, a European manufacturer of RFID tags, has predicted that it will bring a $.50 tag to market within two years, but there is considerable skepticism in the industry.

Vulnerability to compromise

It is possible to compromise an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal. Clearly, bringing household foil into a library using RFID would represent premeditated theft, just as bringing a magnet into a library using EM technology

It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.

Removal of exposed tags

3M, which recommends EM for security and RFID for tracking, argues that EM strips are concealed in the spines (30 percent of customers) or the gutters (70 percent of customers) of books and are, therefore, difficult to find and remove; while RFID tags are typically affixed to the inside back cover and are exposed for removal. The author found no evidence of removal in the libraries he visited, nor did any of the library administrators contacted by telephone report a problem. That does not mean that there won't be problems when patrons become more familiar with the role of the tags.

If a library wishes, it can insert the RFID tags in the spines of all except thin books; however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

Exit sensor problems

While the short-range readers used for circulation charge and discharge and inventorying appear to read the tags 100 percent of the time, the performance of the exit sensors is more problematic. They must read tags at up to twice the distance of the other readers. The author knows of no library that has done a before and after inventory to determine the loss rate when RFID is used for security. Lacking data, one can only conjecture that the performance of exist sensors is better when the antennae on the tags are larger.

Perceived Invasion of Patron Privacy

There is a perception among some that RFID is a threat to patron privacy. That perception is based on two misconceptions: (1) that the tags contain patron information and (2) that they can be read after someone has taken the materials to home or office.

The vast majority of the tags installed in library materials contain only the item ID, usually the same number that previously has been stored on a barcode. The link between borrower and the borrowed material is maintained in the circulation module of the automated library system, and is broken when the material is returned. When additional information is stored on the tag, it consists of information about the item, including holding location, call number, and rarely author/title. The RFID tags can only be read from a distance of two feet or less because the tags reflect a signal that comes from a reader or sensor. It is, therefore, not possible for someone to read tags from the street or an office building hallway.

Perceptions, even when mistaken, may have real consequences. It is, therefore, important to educate library staff and patrons about the RFID technology used in libraries before implementing a program. The best way to do that is to emphasize that RFID technology is not one technology, but several. E-Z pass is RFID that is meant to be read from a distance. It would be impractical to affix tags of that size and cost to library materials. The same is true of the tags used on pallets in warehouses.

Several states are considering legislation that would pose restrictions on the use of RFID by retailers and libraries. It is, therefore, important to monitor legislative activity and to be prepared to inform legislators about the differences between retail and library applications. Library administrators should be sure to keep their boards informed

LIMITATIONS OF RFID

The following technological limitations have been proposed as reasons why consumers should not be concerned about RFID deployment at this time. We address each perceived

limitation in turn, and explain why in themselves, these limitations cannot be relied upon as adequate consumer protection from the risks outlined above.

1. Read-range distances are not sufficient to allow for consumer surveillance.

RFID tags have varying read ranges depending on their antenna size, transmission frequency, and whether they are passive or active. Some passive RFID tags have read ranges of less than one inch. Other RFID tags can be read at distances of 20 feet or more. Active RFID tags theoretically have very long ranges. Currently, most RFID tags envisioned for consumer products are passive with read ranges of under 5 feet.

Contrary to some assertions, tags with shorter read ranges are not necessarily less effective for tracking human beings or items associated with them. In fact, in some cases a shorter read range can be more powerful. For example, if there were an interest in tracking individuals through their shoes as they come within range of a floor reader, a two-inch read range would be preferable to a two-foot read range. Such a short range would help minimize interference with other tags in the vicinity, and help assure the capture of only the pertinent tag positioned directly on the reader.

2. Reader devices not prevalent enough to enable seamless human tracking.

The developers of RFID technology envision a world where RFID readers form a "pervasive global network" It does not take a ubiquitous reader network to track objects or the people associated with them. For example, automobiles traveling up and down Interstate 95 can be tracked without placing RFID readers every few feet. They need only be positioned at the entrance and exit ramps. Similarly, to track an individual's whereabouts in a given town, it is not necessary to position a reader device every ten feet in that town, as long as readers are present at strategic locations such as building entrances.

3. Limited information contained on tags.

Some RFID proponents defend the technology by pointing out that the tags associated with most consumer products will contain only a serial number. However, the number can actually be used as a reference number that corresponds to information contained on one or more Internet-connected databases. This means that the data associated with that number is theoretically unlimited, and can be augmented as new information is collected.

For example, when a consumer purchases a product with an EPC-compliant RFID tag, information about the consumer who purchased it could be added to the database automatically.

Additional information could be logged in the file as the consumer goes about her business: "Entered the Atlanta courthouse at 12:32 PM," "At Mobile Gas Station at 2:14 PM," etc.

Such data could be accessed by anyone with access to such a database, whether authorized or not.

4. Passive tags cannot be tracked by satellite.

The passive RFID tags envisioned for most consumer products do not have their own power, meaning they must be activated and queried by nearby reader devices. Thus, by themselves, passive tags do not have the ability to communicate via satellites.

However, the information contained on passive RFID tags could be picked up by ambient reader devices which in turn transmit their presence and location to satellites. Such technology has already been used to track the real-time location of products being shipped on moving vehicles through the North American supply chain.

In addition, active RFID tags with their own power source can be enabled with direct satellite transmitting capability. At the present time such tags are far too expensive to be used on most consumer products, but this use is not inconceivable as technology advances and prices fall.

5. High cost of tags makes them prohibitive for wide-scale deployment.

RFID developers point to the "high cost" of RFID tags as a way to assuage consumer fears about the power of such tags. However, as technology improves and prices fall, we predict that more and more consumer products will carry tags and that those tags will become smaller and more sophisticated. We predict that the trend will follow the trends of other technical products like computers and calculators

CONCLUSION

The development of this technology must be guided by a strong set of Principles of Fair Information Practice, ensuring that meaningful consumer control is built into the implementation of RFID. Finally, some uses of RFID technology are inappropriate in a free society, and should be flatly prohibited. Society should not wait for a crisis involving RFID before exerting oversight.

Radio Frequency Identification (RFID) could very well be the Next Big Thing. It's not because it's a fancy technology but because of process and productivity improvements it can enable.Radio Frequency Identification (RFID) has the potential of being a very disruptive technology just as the Internet is shaking up everything by making possible all kinds of shifts in how and where things can and be done! Very simply, instead of passive UPC symbols that you see on every product, it may be possible to print UNIQUE identifiers for each product in a box, giving it information about what it is as well as its serial number.

On top of this, it is an active technology instead of being a passive technology like bar codes.RFID tags send out signals constantly that can be picked up by sensors nearby. You need to scan a bar code to do anything with it.

RFID combined with GPS is an even more mind-blowing combination that has thousands of applications. RFID provides a unique identification for any product and GPS provides location-awareness. RFID/GPS tagged products know who they are and where they are! Place these tags in the shirt pockets of your children and they can never get lost! You can always look them up on a computer like you do an address now on MapQuest and you can see where they are in the world!

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