RFID APPLICATION IN THE PUBLIC SECTOR

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Abstract: Mark Weiser, about two decades ago, described his vision of ubiquitous computing, now also known as Pervasive Computing. Utilizing ubiquitous computing technology, a RFID tag can be embedded and hidden into any object for observation and identification. This paper addresses several RFID applications in the public sector as examples to demonstrate the promising potential of RFID.

INTRODUCTION

Pervasive Computing articulates that computing technologies will become invisible and networked into our daily lives. It was first envisioned by Mark Weiser in 1988. He wrote that "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Weiser, 1991). Since the last decade, the tremendous progress in hardware technology has strengthened his vision. Pervasive Computing thus provides users with the ability to access and take action on information anywhere at any time. It is an evolving process from the traditional computing to mobile computing, then to embedded computing and now to invisible computing. Among all the Pervasive Computing technologies, RFID, Radio Frequency Identification, is perhaps the most well known and widely implemented example.

RFID

A typical RFID system consists of four main components: tags, an encoder, readers and a host computer. The RFID tag is basically a tiny electronic circuit made up of a microchip and a flexible antenna which can be detected by a reader. The encoder is used to write information to the tag. A tag can be active or passive. Active RFID tags broadcast under their own power, and they are capable of receiving and transmitting signals in the distance of 100 yards. They are well suited to applications where tags can be permanently mounted and maintained such as on trucks, railroad cars or shipping containers. Passive tags, in contrast, require no batteries and draw their power from the reader (or listener). Electromagnetic waves transmitted from the reader induce a current in the tag's antenna. The tag uses that energy to talk back to the reader (known as backscatter reflection). When these tags are not in the presence of a reader signal directed at them, passive tags do not generate any radio signal by themselves. Another type of tag is the so-called semi-passive tag. In many ways it looks like a passive tag: small, lightweight, and limited memory. But it comes with a battery backup to extend the answer range.

A tag can be designed for read-only or with read/write capabilities. As it passes through various scanner locations, the tag can be modified accordingly in its life cycle to allow for a recorded history of, for example, its location and time elements. It is an ingenious method for identifying objects and/or individuals via radio waves, which transmit digital data from an electronic computer chip. The relayed data are captured by readers. Here the signals are being converted into digital form that which can be linked to computers. The data collected over time can be stored for future use. RFID tags can also be embedded and hidden. They can be read through many materials including plastic, wood, leather, and cardboard. They are applicable in harsh environmental conditions such as outdoors, wet and high temperatures. Tags can be re-programmed as needed.

Since RFID has been widely implemented in the identification business, many people may mistakenly consider it as just a replacement of traditional bar code technology. In a way, RFID technology is similar to bar codes, yet it provides a more precise tracking capability using Electronic Product Code (or EPC). RFID doesn't require the line of sight. RFID tags can be read as long as they are within the range of a reader. Furthermore, EPC goes beyond identifying product by its category. It assigns a unique number to every single item, making it the only match. Governments all over the world are now incorporating this technology to develop their identity documents such as Identity Cards, Passports and smart cards for their people. Auto industry, likewise, starts to embed the RFID tags into car keys and hopes to reduce the number of car theft. The capabilities of RFID presented above provide new opportunities as well as challenges to various applications. RFID technology has been applied in a wide range of industries including consumer goods, manufacturing, automotive, healthcare, electronics, transportation, telecommunications, shipping, warehousing and

distribution, security, construction, entertainment, hospitals, and retail. This paper will address on a few famous programs using RFID in the public sector.

NEXUS Program

The Department of Homeland Security implements the technology of RFID to secure and facilitate the crossing of our borders. Millions of people cross our nation's borders everyday, and the lines to enter and exit the country can be very long. On land travel, the wait can cause traffic congestion, complicate trucking routes and delivery of goods to companies in both countries. To alleviate this situation, the Department of Homeland Security has implemented a program called NEXUS, which uses RFID technology to help speed up border crossing and still keep security tight.

NEXUS was developed jointly by the U.S. and Canada to expedite border crossing for low-risk travelers. The Powers Border Crossing Program first piloted RFID in Port Huron, Michigan and is now being rolled out to other border cities in different countries. The NEXUS system works as follows: travelers who frequently cross the border can apply and sign up for the NEXUS program at the enrollment centers set up adjacent to major border crossings. They are then fingerprinted, photographed, and go through a background check. Once the screening process is complete, each applicant will be notified about the outcome of the application. If approved, the applicant is then called in for a personal interview. Successful applicant will receive a NEXUS identification card about the size of a credit card. Embedded in the card is a tiny computer RFID chip with antennae. Cardholders can access specially designated crossing lanes. Once in the lane, he or she holds the card up to an RFID reader positioned well in front of the inspection booth. After scanning, the personal information as well as the picture, is displayed on a computer screen inside the booth where the inspector verifies that the photo on the screen matches the occupant in the vehicle, and if all check out, the inspector authorizes the car to proceed. If there are multiple card holders in the vehicle, each person has to present their own ID before being allowed to cross the border. The reader and screen can display several photos for visual identification all at once. If there happens to be a person in the vehicle who is not a NEXUS-cleared participant, then he or she must go through the regular check lane. The transaction takes significantly less time than clearance through regular procedures. The system seems simple, but powerful security capabilities have been built into it. The original background check screens out program participants with no criminal history, no immigration, customs or agriculture violations, and those who are admissible to Canada or the United States through regular crossing.

In the months since it was installed, the NEXUS program has dramatically cut crossing time for enrollees, and it has helped ease the workload of border agents already stretched by newly tightened security requirements, giving them more time to spend on higher-risk activities. The result is a system that is of benefit to both border inspectors and NEXUS participants. The NEXUS system takes a lot of pressure off from border inspectors who have to check each and every vehicle that is trying to cross the border. With the NEXUS system, employees can be more effective in detecting high-risk targets. NEXUS currently is operational in the Pacific Northwest, Detroit, Mich., and Buffalo, New York and other locations. In Canada, it was expanded to Vancouver, Toronto and other border-crossing locations. Canada and the United States coordinate all three NEXUS programs – air, land and marine – to further improve their service to the traveling public, while maintaining safety and security.

ChemSecure Program

NASA has to closely monitor everyday activities from space shuttles to the supply chain of hazardous materials. In order to securely handle the hazardous materials, a real-time management system including usage, shipment, tracking and storage is crucial in its implementation. NASA Dryden Flight Research Center came up with a successful pilot, named ChemSecure, which focuses on improving the management of hazardous materials to enhance security and safety, and reducing supply chain costs. The ChemSecure program integrates radio-frequency identification tags (RFID) and sensor-based technology made possible by the collaborating efforts of NASA Dryden, Department of Defense's existing web-based Hazardous Materials Management System (HMMS) database, and leading private sector high tech companies including Oracle Corporation, Intermec Corporation, EnvironMax, Inc. and Patlite (USA) Corporation.

ChemSecure puts RFID tags on hazardous material containers and makes use of the Oracle Sensor-Based Services to monitor any movement or other changes of the hazardous materials. With this real-time information, NASA Dryden can make informed decisions about the handling of the hazardous materials such as usage, storage, shipment, and tracking of their location. In case of any changes, automatic alerts and warning will be given out in forms of text messaging, voice and e-mails to identified responders and proper authorities in security, safety, health and environment. The autonomy aspect of ChemSecure makes it adaptable to support the varying conditions of hazardous material management. Ultimately, ChemSecure will not only have the intelligence to improve the management of hazardous materials with its capability to capture, analyze and respond to the information being collected, but also provide insight into the ongoing business processes within an organization.

The ChemSecure has shown its potential in the pilot test. The information world can improve operations in the physical world by bettering the business processes and reducing costs and errors. NASA Dryden is planning a second phase of ChemSecure project that will maintain the full inventory management, track all climate-controlled chemicals in secured storage and supervise all

unguarded access points. The implementation of ChemSecure is not just for the protection of federal facilities, it also protects the surrounding communities through which the hazardous materials travel.

National Animal Identification System

Many may still remember the 2003 outbreak of mad cow disease. It had cost U.S. agriculture industry significantly when American consumers kept themselves from beef consumption. The ripple effects subsequently affected the restaurant, grocery, and consumer product businesses as well. Billions of dollars were lost. Dozens of countries around the world banned the import of beef from the U.S. The recurrence of another serious cattle-borne disease epidemic could come and literally spread from coast to coast again, and that may lead to a greater disaster than the one before. Thus, the means of identification and isolation for animals are desperately needed. In fact, well before the 2003 mad cow case, the agriculture industry and the government had already recognized the need for uniquely identifying and tracking animals. Since the 1940s, U.S. Department of Agriculture has had a cattle identification program in place to confirm each cow's vaccination for brucellosis. Now, with the progress of technology, the system is expected "to be able to identify all animals and premises that have had contact with a foreign or domestic animal disease of concern within 48 hours after discovery". (Can RFID Protect the Beef Supply? 2004)

National F.A.I.R. (National Farm Animal Identification and Records Program), a pilot program, is an animal identification model that unifies animal identification programs and links animal record systems to provide accurate, complete and cost-effective information that meets the various needs of the industry. The F.A.I.R. Information System provides the electronic capabilities that keep track of all the data that are recorded at various locations. The FAIR database keeps track of the following key information: premises (type of premises, GPS coordinates, etc.); animal ID (species, breed, sex, date of birth, etc.); animals at premises; animal movements; health and performance data. RFID-equipped ear tags or implanted devices are used in the National FAIR program to uniquely identify animals, and provide the most cost-effective way to track individual cows and herds as they move from location to location. The number of RFID tags read at packing plants and markets is also growing and in the near future, meat from tagged animals will be tracked through retail markets to provide source verification of meat products. The FAIR pilot program validates each animal with a RFID ear tag by checking animals for proper tag location and tag retention. Results from FAIR pilot herds demonstrate that RFID ear tag readability and retention are very high.

Today, it appears that the National Animal Identification System is well on its way to becoming an integral part of the American agriculture. Once the premises registration and animal identification elements are in place, animal health officials will be able to track an individual animal's movements over its lifetime, as it moves from place to place. The wide-scale implementation of such a system will not only benefit the whole agriculture industry, but also the meat supply chain and the general public. The nightmare of animal disease outbreaks, hopefully, will never come back.

RadSTraM

Highly radioactive sources are used in everyday life to treat cancer patients, as irradiators to preserve food, in industrial radiography to check for welding errors in pipelines and buildings, for thermoelectric generation of electricity in remote locations, and for a variety of other purposes. Radiological sources are essential to our society, yet there is no practical option to secure and control every item, everywhere. The ability to track radioactive material shipments in transit is desired by many government agencies. One of the main components of the Environmental Protection Agency's (EPA) Clean Materials Program is to prevent the loss of radioactive materials through the use of tracking technologies. If a source is inadvertently lost or purposely abandoned or stolen, it is critical that the source be recovered before any harm to the public or the environment occurs. Radio frequency identification (RFID) tagging on radioactive sources is a technology that can be operated in the active or passive mode, has multiple frequencies available for flexibility in use, is discreet and able to transmit detailed data. The Environmental Protection Agency and the Department of Energy has a Radiological Source Tracking and Monitoring System (RadSTraM). The purpose of this joint project is to evaluate the viability, effectiveness and scalability of RFID technology under a variety of transportation scenarios. RadSTraM is part of a larger program called Integrated Safety and Security Enforcement and Interdiction System. The EPA is researching different methods to track the sources such as satellites, RFID, Real Time Location Systems, and Integrated Technology Systems. The operational requirements of a tagging system will depend on the risk posed by the source to the public and the environment, the risk of the source being lost or stolen, and the need of the monitoring authority as to type of information and timeliness required. There are a number of available technologies that are used for tagging items; however, there is no information in the available literature about tagging technologies being tested in proximity to radioactive materials. RFID was chosen for reasons such as 'the cost of RFID tags has become affordable' or 'the technology has flexibility in frequencies used'. The goal of this project is to continue testing the integrated RFID tag for its feasibility in tracking radioactive sealed sources.

The integrated tag has been tested with various radioactive isotopes, supplied by the Oak Ridge National Laboratory. These packages have been passed by reading devices in various configurations to determine the optimal operating conditions for the tags.

Interior	Access cards
Labor	Records management
NASA	Hazardous materials management
Social Security Administration	Warehouse management, asset tracking, inventory control
State	E-passports
Transportation	Freight and mass transport
Treasury	Records management
U.S. Postal Service	Mail security and tracking
Veterans Affairs	Patient and supply-chain tracking

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se further inspection of the
ctive materials throughout
the tracking of interstate

Source: Wasserman, E. (2007), RFID Takes Root in Washington, *RFID Journal*

Figure 1: Samples of RFID Applications in U. S. Government

CONCLUSION

RFID technology is an up and coming technology that has been proven from the above cases to be effective in applications such as livestock tracking, border patrol, hazardous material tracking and radioactive material control and loss prevention. These applications in the public sector help to make this world a safer place. It is assuring to know that the government is keeping track of the radioactive materials at all times. The food supply is protected because the livestock and the history of their whereabouts are being monitored.

RFID is widely used in the public sector. The Border Crossing Program, ChemSecure Pilot Program, National Farm Animal Identification Records (FAIR) program and Radiological Source Tracking and Monitoring System (RadSTraM) are only some of the examples. More samples of RFID applications being tested or deployed in the U.S. government are listed in Fig.1. We can foresee the potential usage of RFID in the public sector in the near future. Along with the advance of its technology, RFID will be here to stay and make our society more secure and safe.

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