

WSN/RFID Architecture For Children's Monitoring

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Abstract

The RFID Technology (Radio Frequency Identification) has been designed to identify objects, animals and even people automatically using the radio frequencies. It is currently considered as the main methodology for distance detection of goods and any other resources, through the airwaves. The areas of possible use of this innovative technology are several: Medical, transportation, security, industrial automation, to name few. We talk about identification because this mechanism allows you to assign a unique identity to any element in which an RFID tag is applied while the term automated refers to the fact that this is done without the help of man. RFID technology is therefore a method to store and retrieve data from remote using smart labels known as RFID tag. Adhesive and often small, an RFID tag consists of an antenna that allows reception and transmission of information within the network to which it reports. In this paper we show an approach based on RFID technology for tracking children in shopping centers in order to quickly find the location of missing children within the area monitored. An application of this kind allows the monitoring of crowded places with highest precision in which risk factors exponentially increase.

I. INTRODUCTION

One of the main benefits of using RFID is to provide access to real-time information improving the efficiency and safety, significantly reducing management costs[1][2]. The application of RFID tags on valuable goods allows, for example, discouraging theft, forgery and to quickly recognize objects placed on smart shelves. The application fields, as mentioned, are many and they are growing every day more and more to affect many aspects of our daily lives: buildings, postal services, tracking of agricultural / food and baggage at airports, automated payments or used in paper documents to automate the management of archives and offices[2][3].

For example, The European Central Bank is planning to put RFID tags on the banknotes to deter counterfeiting of the same[4]. In addition, RFID technology is highly scalable, that's why you can think of a future (very close) where this technology can be fully integrated to a Wireless Sensor Network[2][5] in order to allow consumers to have real-time information about objects origin, their characteristics and their position. The components of an RFID system are four[6]:

- The tag (or transponder) that is electronically programmed
- The reader (or Scanner)
- The Server (Host Computer)

The entire architecture is shown in Figure 1.

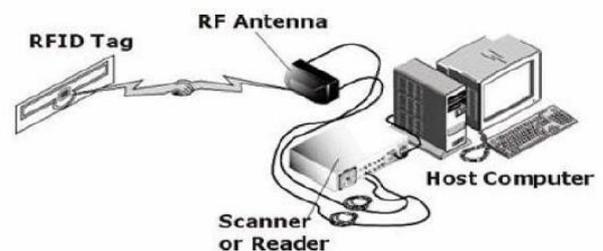


Figure 1: RFID System Scheme

The main task of an RFID system is to transfer data to the transponder and to recover data on time and in an appropriate way in order to satisfy particular application needs. The data contained within a tag may provide all the information required in relation to a piece in production in a factory automation environment, to goods in transit, to the identity of a vehicle, an animal or person. These data can be inserted through an appropriate electronic programming tool of the tag itself. In addition to tag you need a device which can read the tags and other systems to transfer these data to an information management equipment (host computer). The aim of this paper is to present an architecture RFID-based in order to monitor children in shopping centers. This mechanism for person tracking,

in fact, leads to increased safety in environments characterized by a large amount of visitors where the risk of loss (as well as kidnapping) of children is higher.

II. RFID APPLICATIONS

Over the years we have witnessed an exponential growth in the use of RFID technology and, as mentioned, application fields are potentially unlimited. Ducati, a leading Italian manufacturer of motorcycles in the world, started a project based on RFID to control the assembly of the engines in their motorcycles. At each engine is associated with a tag on which is stored the information for the installation, calibration and control. The RFIDs are also used in the retail sector to collect customer data through which, for example, it is possible to develop a shopping list to suggest a course of shopping. In health care[7], the spread of wireless technologies has had a slow development because of the danger of interference with diagnostic equipment and monitoring. Modern technologies of modulation, however, made it possible to overcome these obstacles opening the doors of the hospitals at these technologies. Some health applications are: electronic medical records, telemedicine, and medication therapy management, the patient localization in the building, the traceability of blood bags, applications to support the work of nurses and the control of the proper sterilization of instruments in the operating room[8]. In supply chain management, RFID tags are used to track products throughout the supply chain from supplier delivery, to warehouse stock and point of sale[9]. One area in which RFID technology is a valuable aid in tracking people, assets, products, and physical processes is certainly that of the production, for example, fashion area[10]. Another area of application of RFID systems fairly consolidated consists in the identification and monitoring of farm animals. In this context, the RFID device has replaced the ear tags with which cattle and sheep were identified. The RFID tag, in fact, may contain a relatively high amount of information useful for cross-checks[11]. A considerable use of RFID technology involves the application of subcutaneous chips in pets to store information such as owner, vaccinations, diseases, etc.. Another field of use is transport[12]. There are two categories of applications in this field:

- RFID systems on transport systems driven by people for the identification of the vehicle and of its rider;
- Transponder on people transported by public transport systems for the identification of passengers and of the vehicle.

The first system, properly connected to some antennas, could be an advanced security system for ensuring proper use of the vehicle and to indicate tamper evidence. The second system could be an excellent way to identify the

customer to verify permission for use of vehicles and increasing security within the system as a whole. Another application, for example, is the use of RFID tags on luggage at airports[13]; this allows you to attach to luggage both the owner and the flight destination. It is very important, for the purpose of this work, the assessment of the use of RFID in access control and security in an monitored area. The transponders can be placed on the windshields of cars and on badges of employees. Readers, instead, can be inserted in the walls of buildings and along the access roads. There are many reasons for the adoption of RFID in this sector[14]:

- Enhanced security to limit access to restricted areas
- Employee tracking
- Preventing theft
- Compliance with internal security measures.

III. THE PROPOSED APPLICATION

The concept of traceability is closely related to the objective of achieving greater security in the society in which we live. Today we are all subject to a kind of indirect traceability. Just think how a person's movements can be recorded in a fairly accurate way thanks to the spread of mobile phones, credit cards, automatic payment methods and GPS receivers. There are many situations where you might need to know where someone is in a given time, especially when we talk about children in extremely large and crowded places. To this aim, the architecture here proposed could lead enormous relief to all those families who want to spend free time in shopping centers in total relax. It consists of an architecture based on RFID technology combined with a wireless sensor network (WSN). The architecture provides to equip the child of an RFID bracelet TG900 Secure Wristband (Figure 2) created just for locating people in safety applications.



Figure 2: TG900 Secure Wristband

It is an integral part of the tag, it is adjustable and it transmits an alarm when the wrist strap is cut or tampered with. The control architecture includes the

installation, within the monitoring area, of a gate (OmronV720 RFID gate reader in Figure 3) for detecting transit of children and their movements within the game area.



Figure 3: V720 RFID gate reader

Each gate must be equipped with a reader connected to two multiplexed antennas, whose reading area provides cover across the area to be monitored (Figure 4). This allows you to detect, in an automatic and certified way, each child both in entering and in leaving.

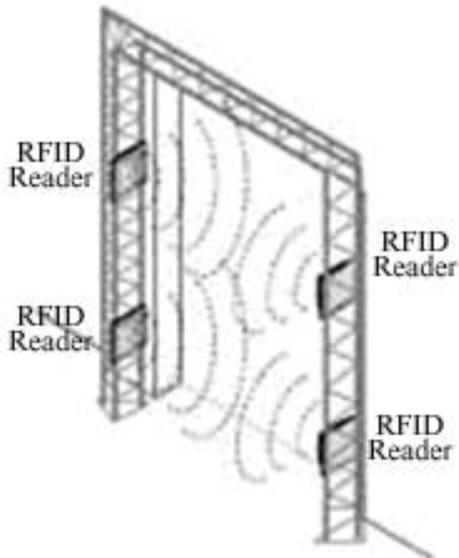


Figure 4 Gate with multiplexed antennas

The data of the children, if required, could be loaded on a central server to be combined with the univocal code of the tag. This allows you to implement a "system agent" that triggers an alarm after passing a certain time interval from detection of the tag in output (obviously if parents don't pick their children up). In addition, the use of a central server, allows you to use internet to implement a messaging service to inform the parents about the removal of the child from the monitored structure.

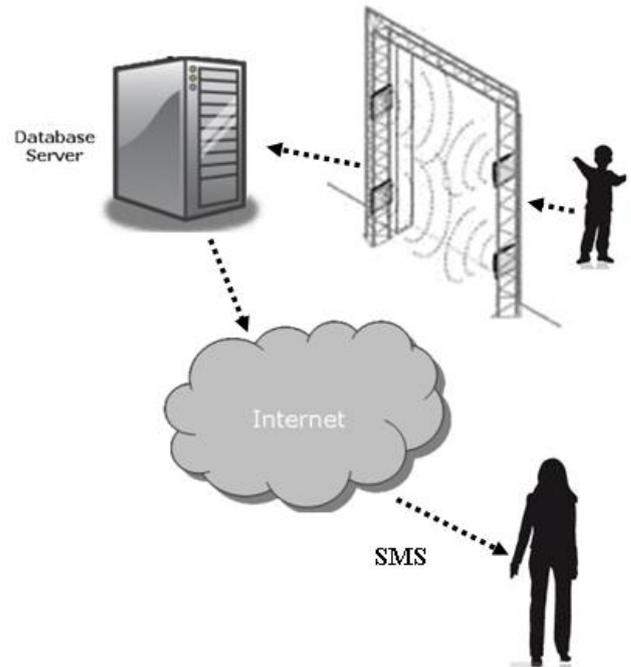


Figure 5: Application Scheme

The use of a "system agent" is very important because it has the task of identifying dangerous situations and automatically sending warning messages to the information center. The system aims to:

- Provide a better service to the visitors of the shopping centers
- Prevent kidnapping of children

Below we show the architecture scheme.

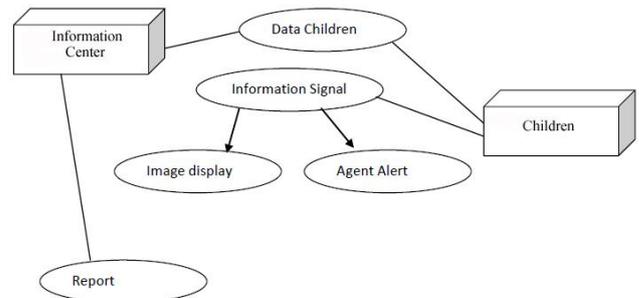


Figure 6: Entire Architecture

Data Children function deals with the recognition of each child through the signal coming from the tag. *Information Signal* function consists of reading the signal from the tag for later transmission to the computer for processing. *Image display* function consists in the refund of the signal, by the reader, to the database that converts it into a symbol-image. In this way you can always know the position of each child. *Alert Agent* function is meant to send a warning signal to the Information Center if the child had to leave the area to take action promptly. *Report Management*, finally, consists of sending periodic reports from the

system agent to the Information Center to inform it of current conditions.

The general system is divided into three parts: the preliminary work, start of operation, the analysis phase:

- Preliminary work: The Information Center must first access the data in the database. Through the monitor it is possible to display the position of the children in the structure. Parents who use the service will have to help, with the assistance of competent people, the child in wearing the RFID bracelet, in order to avoid loss of tags.
- Start of operation: the control passes to the multi-agent system which performs several tasks:
 - It outputs a symbol-image of the child.
 - It sends reports about the current situation.
 - It sends alarm message when the child abandons the area.
- Analysis phase: Reports are generated and sent to the Information Center.

RFID technology is used to receive information about children. Data are sent to the multi-agent to perform security checks. In the system there are three agents, each of which performs a specific task:

- Gate Agent: this agent based on the signal can get the position of the child. If the child leaves the monitored area, it will send a message to the alert agent.
- Alert Agent: the alert agent communicates data obtained to the Information Centre, who will know the current status in real time.
- Interface agent: it acts as an intermediary between the system as a whole and the Information Centre, provides all the information obtained from the other agent, supports the educator to address unforeseen situations and returns the data regarding the children's parents.

IV. CONCLUSIONS

This paper showed a children monitoring application by using RFID devices. This technology represents a rapidly evolving context and its use allows you to take advantage of many benefits such as traceability, identification and acceleration of IT processes thanks to the increase of data reliability and the reduction of human error. In a very difficult historical moment, the use of this technology, for security goals, is essential.

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