IMPLEMENTING A DOCUMENT MANAGEMENT SYSTEM USING RFID TECHNOLOGY

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Abstract.With strong support in the industry from important players like Wal-Mart and Metro, RFID is a promising technology that can be used in many different ways to create value. This paper describes the use of RFID technology for implementing a document management system.

1.Introduction

For every company, one of the basic concerns is to increase productivity trough better organization and cost savings. Document management systems play an important role, because they free up human resources that can be assigned to more important tasks that are closer to the organization's primary activity.

A good document management system helps to keep track of important physical files with ease and offers an efficient way to locate them. Security is also an important issue that document management systems have to deal with. Some document management systems try to offer this functionality, however they often prove to be inadequate for new challenges that organizations face. There are rising security concerns that must be addressed and a growing document base pushes the scalability of these systems to the limit. Delays resulted from searching for files related to a client can lead to poor customer service, dissatisfaction on behalf of the client and the perception of general inefficiency of the company. Daily inventory and identification of documents trough manual work, proves time consuming and is subject to human error. Losing important documents like contracts or assurance files, or the inability to locate them on time can lead to problems and increased costs.

Using the RFID technology as the technology of choice for implementing a document management system can provide a solution to the limitations mentioned before.

2.Overview of RFID Technology

The term RFID (Radio Frequency Identification) is used to describe a system that transmits the identity of an object or a person as a unique serial number, using radio waves. The technology is part of a bigger group of automatic identification technologies that include bar code readers and optical readers. Unlike bar codes used for item identification, RFID provides several advantages such as longer read ranges and requires no line of sight.

A RFID system consists of readers, antennas and tags. The reader is the component that knows how to communicate with tags and implements a protocol to send data to the computer. A reader can have one ore more antennas attached. Antennas emit a signal that activates tags and are able to read and modify information stored on tags. A tag can hold from 64 bits to 2K of information, but increased capacity means also higher costs, so that it is generally preferable to only store a unique identifier on the tag (64 or 96 bits) and retrieve additional information from an external data source, such as a database.

The first commercially implemented RFID system dates back to mid-1980s when at the request of the Agricultural Department of USA, a group of scientists developed an animal tracking system. The farmers had a problem: the cows where being given medicine and it was very important that each animal receives the dosage exactly once. However, keeping track of cows was difficult and error prone, so that a new idea was used: a transponder encapsulated in glass was injected under the animal's skin and by using a reader it was possible to uniquely identify each animal.

Many companies have huge investments in RFID today. The biggest success stories are in the retail industry, where Metro and Wal-Mart are using RFID tags to track items in the supply chain. Wal-Mart has instructed its top 100 suppliers to use RFID tags on all their shipments by 2005.

3.Using RFID technology for document management

For a company, a RFID based document management system brings several advantages compared to a traditional one:

- Document location. A document could be at a given moment on the shelf, on the desk, in someone's office, or even in another building. Using RFID technology we can locate documents and prevent misplacement and lost of important files.

- Continuous monitoring of documents. For a company that has important documents like insurance files or contracts, a policy of access control must be in place. Using RFID, we can guarantee that this policy is respected and eventually start an alarm when an unauthorized person removes a document from the shelf.
- Flux analysis. By keeping track of the different locations where documents have been, statistics can be generated to better analyze and optimize the activity of the company by placing documents near the people that needs them, or acquire more copies of materials that are heavily used by employees.

The main features of the system we have implemented are illustrated in figure 1.

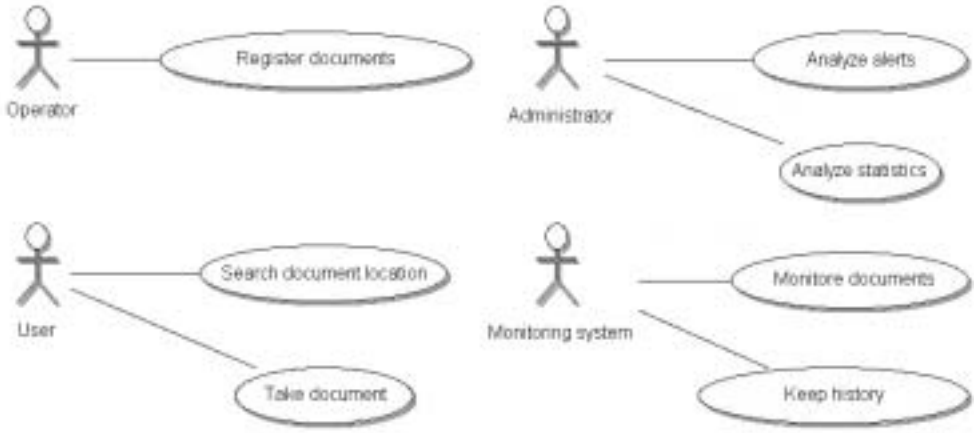

Figure 1: Functions of the document management system

As we can see, there are four actors in our system, each of them performing different functions. These functions are:

- Registering documents. The operator will register documents into the system by entering fields like author, description and the serial number of the tag that will be applied on the document.
- Searching the physical location of a document. If someone needs to find a document quickly, our system can provide valuable information like in which office or on what shelf the document resides at that moment.

- Taking the document. This is a feature related to access policy enforcing. In order to remove a document from its location, you have to be authorized or the system will detect the change and will alert the security staff.

- Analyzing alerts. Alerts generated by the system are stored in the database and can be later analyzed by the administrator.

- Analyzing statistics. By analyzing the history of the locations where a document has been, important knowledge can be extracted and used to optimize the company's activity.

- Monitoring documents. This is a function of the system itself. By monitoring the location of documents, all other functions can be achieved.

- Keeping a history. The system updates the history of documents, which is useful in order to generate statistics.

The physical structure of this document management system looks as in figure 2.

An adhesive RFID tag will be applied on each document that we want to monitor. Antennas have a reading range that defines a detection zone so that all tags in the detection zone can be read, thus documents can be identified. Trough the reader, information is passed to a computer where the business logic is implemented. By using a database, the computer stores and analyses data captured by the reader and interacts with the user trough a web interface.

The actual design of the system can include more than one reader. Antennas are added to the system to meet the specific needs of the company. More antennas mean finer grained locating of documents and improved ability to generate useful statistics. The size of the detection zone depends on the performances of the equipment used. However, unlike other applications where an extended range is beneficial, for our particular requirements increased ranges means less precise locating. An optimum between equipment cost and the precision of locating documents can only be achieved by analyzing the particular requirements of the company we are deploying for.

From an architectural perspective, the system consists of several software components that are detailed in figure 3.

The entry point in the system is the USB port, where the reader is connected. When the computer is powered on, a component named Service starts

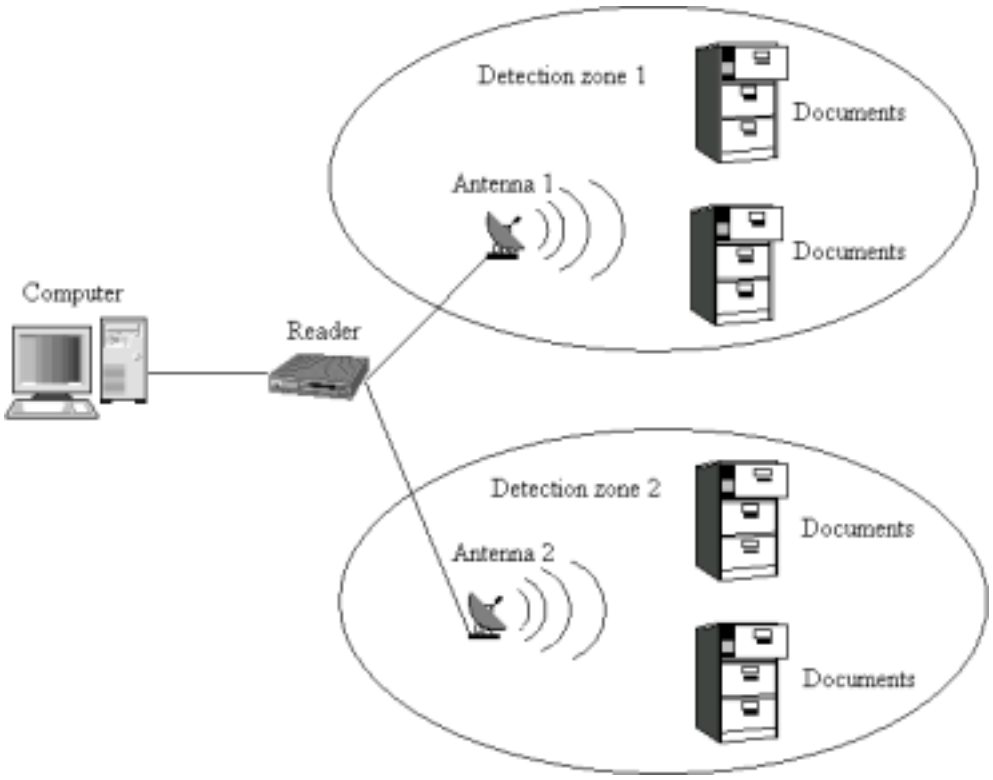

Figure 2: Physical structure of the system

up. This software component is provided by the equipment manufacturer and has the role to listen on the USB port to incoming messages from the RFID equipment. In order for our application to be notified of incoming data, a COM component - the MessageHandler - has to be registered with the Service. The MessageHandler has the option to register itself only for a chosen set of messages, useful to the application.

The COM component runs with system privileges, so it is unwise to implement business logic, data connection and user interaction at this level. Instead it is preferable to send data to a separate software module where all this functions can be easier implemented. In this particular implementation Java was chosen because of increased productivity and platform independence. The communication between the Java module and the COM component is realized trough a socket connection. This method is preferable to using JNI because it is easier to implement and provides us with the advantage of being able to de-

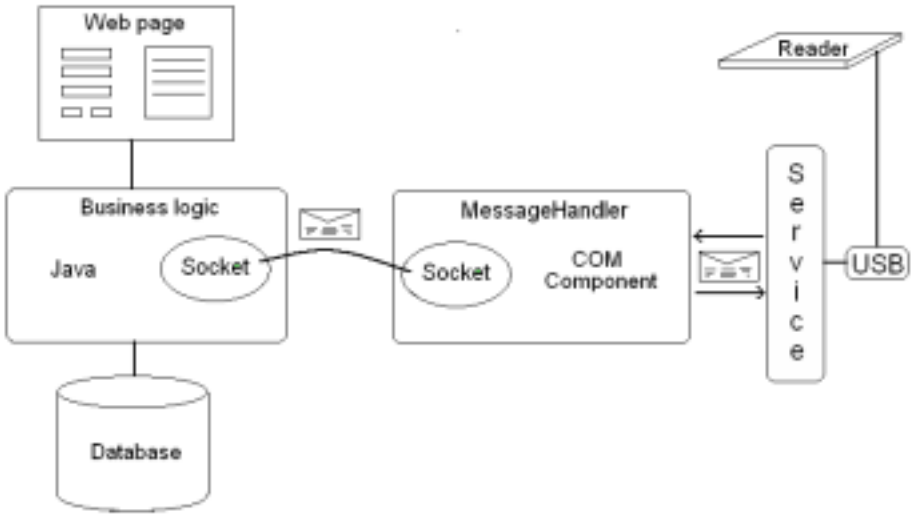

Figure 3: System architecture

couple the computer on witch the COM component resides from the computer that interacts with the user and the database.

4. Conclusion

Knowledge management is very important to any organization. In order for the experience accumulated in one project to be further used, a good document management system must be in place. Important legal files like contracts or insurances must be well protected and locating them in time is essential for the company's activity and for the clients to be promptly served. In this context, a document management system is a critical tool for any company. RFID technology provides features that can be used to bring important advantages to classic management systems: it requires no line of sight, it can provide information regarding the physical location of a document, tags can store additional information and access control can be implemented. The system presented offers these features and can be successfully implemented for any company that wants to optimize its activity by addressing the shortcomings of traditional document management systems.

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