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A MOBILE DEVICE APPLICATION FOR RFID-BASED SECURITY SYSTEMS

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Abstract. *The aim of this paper is to present an application allowing PDA mobile devices to be easily integrated into RFID-based security systems. The main goal of the application was to make the PDA devices capable of reading and writing RFID tags attached to different products or persons. Another important issue we focused upon was the communication between the PDA devices and the central security system that is located at the PC level. The communication component allows fast bi-directional data transfer. It is estimated that the PDA devices will considerably improve the overall quality of an RFID-based security system, reducing the time and increasing the speed of reading and writing operations.*
Keywords: *RFID tag, PDA, RFID reader*

Introduction

The range of usage of RFID (Radio Frequency Identification) is immense, and spans many different industries and activity fields. As the technology matures and applications proliferate, RFID has the potential to enable global commerce and spur innovation and competitiveness, and, most importantly, provide significant improvements in safety and security [10][11]. This technology has already started to replace the existing barcodes.
One of the main advantages that RFID has over barcodes is that the former is using radio signals instead of laser signals. This innovation, together with the transition in low frequencies of the electromagnetic spectrum, gives users the possibility to read RFID tags through packing and packaging materials.
Moreover, while barcodes must be individually scanned, the RFID technology allows the simultaneous reading and processing of multiple tags [9]. In addition to compliance with international standards, other advantages of the RFID system also include faster, more accurate scanning and data capture and considerable lower labeling costs. Electronic tags are reusable and their fixed costs can be spread over a long period of time, whereas barcodes are used once.
The use of the RFID technology on a large scale implies the development of a mobile device that will allow both the reading and writing of RFID tags. Within the framework of the RFID-based security system presented in [1], we have also focused on the design and development of an application that enables PDA mobile devices to read and write RFID tags. The use of RFID technology together with PDA mobile devices offers considerable advantages:

- the reading/writing of RFID tags, irrespective of time and place;
- maximum security and user-friendliness.

Given its high level of generality, the system allows its users to define their own format for the date to be saved on the RFID tags. Although initially designed to provide controlled access to company premises, our system can be easily extended with different functions: alarming, people evidence, etc

Handheld reader architecture

Within the framework of the RFID-based security system we developed, the handheld reader consists of a PDA mobile device (HP IPAQ 4150) connected to a portable RFID reader (Feig IDISC.PRH100). Figure 1 presents the overall structure of the handheld reader. Such portable systems are fit for managers and system administrators.

Figure 1. **Handheld reader architecture.**

The handheld reader will be used for the following purposes:

- to read the data stored on the RFID tag belonging to a person or a product;
- to store the RFID tag data into a PDA database;
- to transfer database records from PC to PDA databases and vice versa;
- to add all the data associated with a new transponder to the PDA databases;
- to modify the database information for a new or an already-existing transponder;
- to write the data of a databases transponder into an RFID tag;
- to display the transponder data stored in the database;
- to open and view the PDA event list, download the events on the PC with the possibility to remove them from PDA;
- to guarantee the safety of data.

Specifications for implementation

The first issue that we have focused upon in the implementation of the handheld reader is the way that databases can be handled on the PDA devices. There are many ways to work with databases on PDA devices, but the most common solutions are: Microsoft SQL Server and Pocket Access databases. Taking into consideration the fact that the use of Microsoft SQL Server on PDA devices results in running the application at a low speed and that it requires inexperienced users to follow complex installation procedures and instructions, we have chosen the Pocket Access database format [2].
Pocket Access is the native database format for all devices with Windows CE installed. A Pocket Access database may contain multiple tables but does not offer support for data encryption. Unfortunately, Microsoft did not provide any support for working with Pocket Access databases. The only solution is to buy specialized software components that provide access functions for Pocket Access databases [7] [8].
One good solution is to use the AdoCE.NET [5] component provided by InTheHand company.
Another problem we had to solve is the one related to data transfer between PC and PDA. Usually, the data transfer between PC and PDA is done using Microsoft Active Sync. This utility can be used to synchronize one or more files between the PC and the PDA. In principle, the synchronization process is very simple: when a synchronized file is modified at the PC level, it will be automatically copied to the PDA. Similarly, when a synchronized file is modified at the PDA level, it will be automatically copied to the PC.
Although the communication between the PC and the PDA is very easy to achieve, there are some major disadvantages that make Active Sync unusable in our security system:

- the communication is very slow;
- it is a stand-alone application and the transfer cannot be scheduled through another application;
- there is no way to transfer just one part of a table. Only whole tables and databases can be transferred. This results in a huge transfer time even if a database is slightly modified.

Given its slow communication, we have decided not to use Microsoft Active Sync. We have focused on the idea of a faster data transfer that will involve only the modified data. The solution we propose is based on a client-server architecture. The client is running at the PDA level and the server at the PC level. The communication is done using a batch file which is written at the PDA level and read at regular lapses at the PC level. The batch file is readed only when the PDA is connected to the PC [3][6]. The server application will read and executes all the commands from the batch file and then it will erase the content of the file. The client and server applications were developed using Microsoft Visual Studio .NET 2003.
For the communication to work properly, we have developed our own library which can be used for the following purposes:

- to connect us to the PDA;
- to disconnect us from the PDA;
- to check-out the connection state;
- to copy files from the PDA to the PC;
- to copy files from the PC to the PDA;
- to remove files from the PDA;
- to verify if a file exists on the PDA;
- to create/remove directories on the PDA;
- to obtain all the information related to a file located on the PDA;
- to copy from the PC to the PDA and convert a Microsoft Access database to Pocket Access format;
- to copy from the PDA to the PC and convert to Microsoft Access format, a Pocket Access database;
- to copy from the PC to the PDA and vice versa only the modified tables of a Microsoft/Pocket Access database;
- to copy from the PC to the PDA and vice versa only the modified records of a Microsoft/Pocket Access database;
- to copy from the PC to the PDA and vice versa only the database records which meet a certain criteria established by the user.

Since the Pocket Access does not offer any support for SQL commands, we were forced to use the AdoCE.NET component [5].

Another important issue we have focused upon is represented by the realization of communication between the PDA devices and the RFID reader. We have developed our own communication library that can be used for the following purposes:

- to detect the RFID tags which are placed in the reading area of an RFID reader;
- to read multiple RFID tags at the same time;
- to write a new RFID tag or modify an already existing one;
- to encrypt the data written on RFID tags.

While testing the PDA-reader communication we have encountered following problems:

- RFID readers cannot work properly if:
  - they are too close one to another;
  - there are too many PCs in the reading area of the RFID reader;
  - the power source is different than the one recommended by the RFID reader producer.

- to avoid erroneous read/write operations, the RFID tags that are brought in the reading area of the RFID reader must be kept there for a longer period of time.

The graphical interface

The graphical interface was designed in such a manner as to fulfill all requirements of a PDA application: simple, user-friendly and intuitive, but without being overcharged.

Figures 2, 3, 4, 5, 6 and 7 present some screenshots taken from the application we have developed.

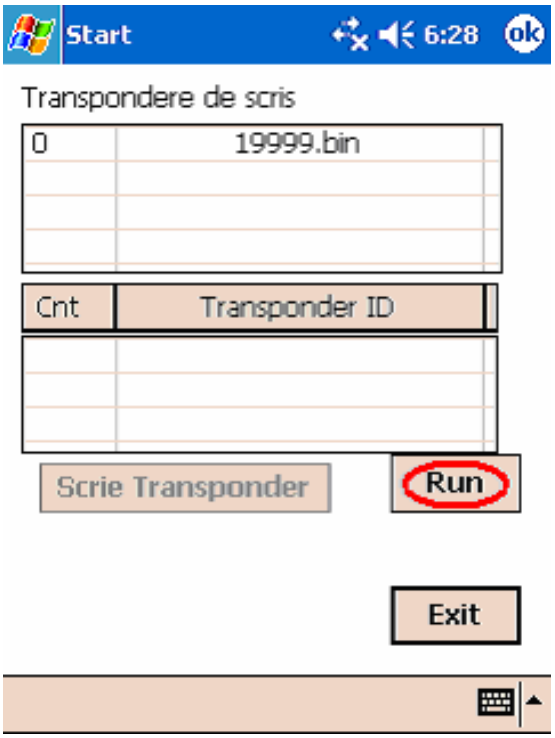

Figure 2. The window used for RFID tags detection.

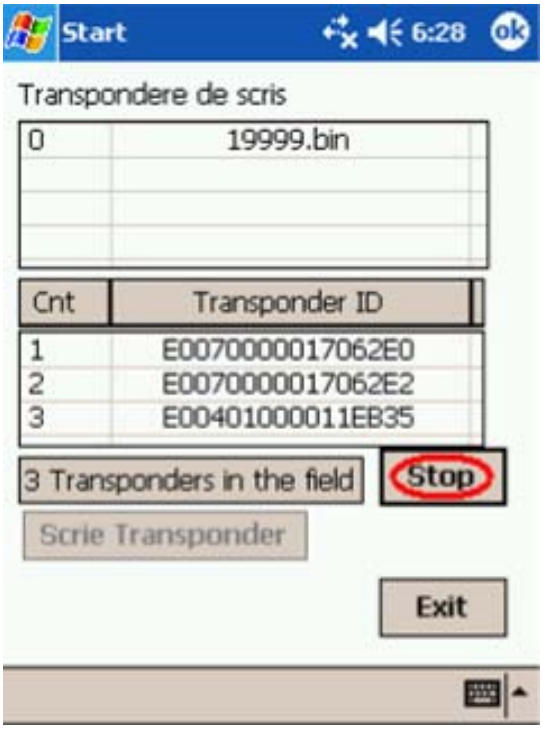

Figure 3. The window used for writing RFID tags.

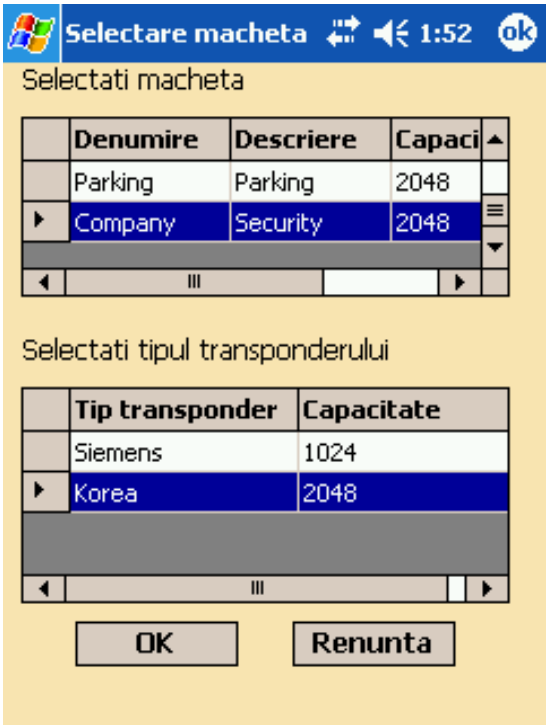

Figure 5. The window used for selecting the transponder's template.

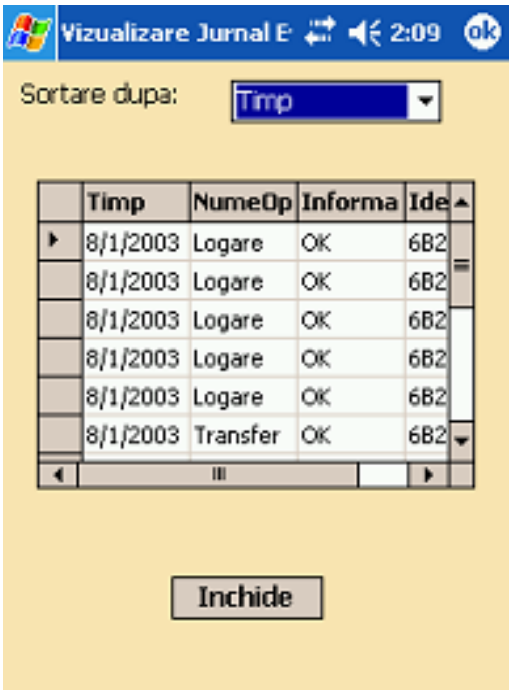

Figure 4. The event list.

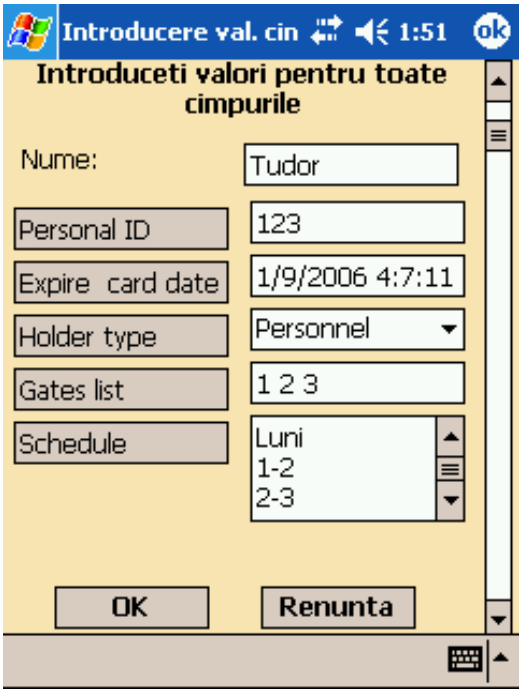

Figure 6. The window used for adding a new database transponder.

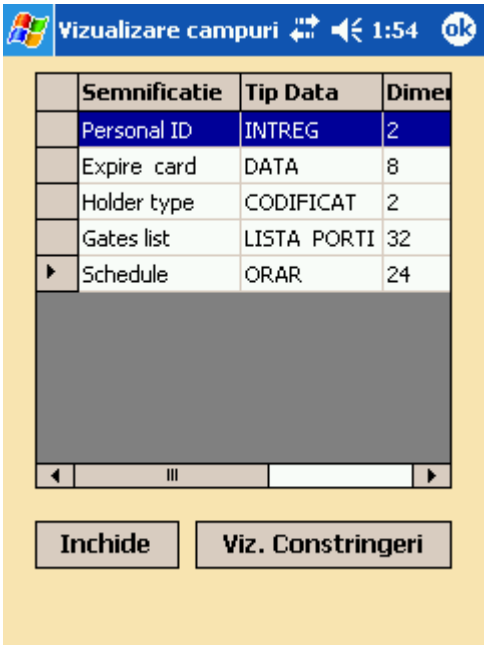

Figure 7. Transponder fields viewer.

Conclusions

Within the framework of the RFID-based security system we developed, the PDA application provides considerable advantages: reading/writing the RFID tags with the update of PC and PDA databases, data transferring in both directions (PC to PDA and vice versa), data visualization for all RFID tags that are stored in the database, adding/modifying RFID tags stored in the database, etc. The data security was another important issue we have dealt with. The implementation of ingenious solutions has resulted in a high-performance security system.

References

[1] Remus Prodan, Cristina Turcu (2005), *Sistem de securitate configurabil utilizând tehnologii RFID*, Procesare distribuită, Ed. Universităţii Suceava, ISBN 973-666-177-6

[2] http://www.pocketpcmag.com/

[3] http://www.pdatopsoft.com/

[4] http://www.opennetcf.org/

[5]http://www.inthehand.com/library/InTheHand.Data.Adoce.html

[6] http://www.pocketpcdn.com/libraries/

[7] Labban, Ramzi (2003), *Mobile Access Control with a Pocket PC*, Smartphone & Pocket PC Magazine, November 2003, http://www.pocketpcmag.com/_archives/Nov03/access_control.asp

[8] Morgan, Bryan (2002), *Mobile Database Review: Microsoft Databases for Windows CE*, Addison-Wesley Professional, http://www.awprofessional.com/articles/article.asp?p=26223&seqNum=3&rl=1

[9] Juels, Ari (2005) *RFID Security and Privacy: A Research Survey*, http://www.rsasecurity.com/rsalabs/staff/bios/ajuels/publications/pdfs/rfid_survey_28_09_05.pdf

[10]http://www.activewaveinc.com/applications_airport_security.html

[11]http://blogs.ittefaq.com/tech/archives/2005/08/hong_kong_airpo.html