RFID - based Staff Control System (SCS) in Kazakhstan

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Abstract. RFID - based Staff Control System (SCS) will allow complete hands-free access control, monitoring the whereabouts of employee and record the attendance of the employee as well. Moreover, with a help of this system, it is possible to have a nice report at the end of the month and based on the total number of worked hours, the salary will be allocated to each personnel. The access tag can be read up to 10 centimeters from the RFID reader. The proposed system is based on UHF RFID readers, supported with antennas at gate and transaction sections, and employee identification cards containing RFID-transponders which are able to electronically store information that can be read / written even without the physical contact with the help of radio medium. This system is an innovative system, which describes the benefits of applying RFID- technology in the Education System process of Republic of Kazakhstan. This paper presents the experiments conducted to set up RFID based SCS.

1. Introduction

RFID-based equipment monitoring and tracking system is a complex, integrated system that offers an effective solution of managing items especially for large scale environment [1]. It combines the RFID technology and security devices to ensure the items are always been monitored and secured remotely. The system enable the organization to track and monitor selected individual to access locations inside the university, permit movement, record the data of arrival/departure and also enable the viewing of record via this system. This paper proposes the different components of RFID technology and focuses on its main core competencies, scalability and security. It will then provide detailed description of RFID – based SCS in Kazakhstan. RFID is wireless automatic identification technology that is gaining attention and is considered by some to emerge as one of the pervasive computing technologies in history. As the technology grows very precipitately, RFID has received considerable attention worldwide and widely used in controlling and tracking objects ranging from human identification to product identification. Previous research has successfully showed that RFID has been increasingly expanded in various fields such as retail supply chain, animal identification, metro pass cards and e-passports, asset tracking, postal and courier services, construction industry, education, medical etc. Developments in RFID technology continue to relinquish capacities of the memory, wider reading ranges, and faster processing. It is not possible that the technology will ultimately replace barcode but however, RFID will continue to grow in its established niches where barcode or other optical and wireless technologies are not effective, such as in the chemical container industry and livestock industry. RFID enables tracking and controlling of items over distances that range from about a centimeter to hundreds of meters. RFID can track any items starting from inventories, mobile handy equipment, and moreover, it can track people in real time as the tagged item travels around the organization. Tracking of mobile equipment can include wheelchairs, infusion pumps, and blood

supplies. RFID systems have been widely used in many different application areas, such as: product tracking via manufacturing and assembly, inventory control, access to parking lot and its control, tracking of container, ID badges and access control, equipment tracking in hospitals, etc. [2]. Compared to other automatic identification technologies, and especially, compared to optical barcode systems, RFID-technology has important advantages, and among of them, the most important one is the following: tag data can be read automatically beyond the line of sight, through certain materials, and from a range of several meters [3].

2. Comparison of RFID technology with barcode technology

Both RFID and barcode are automatic identification technologies that enable automated processes and improve overall operational control and management. Barcode technology relies on – line of sight between the barcode and the reader, meaning that the barcode must be visible to the reader. On the other hand, RFID does not rely on – line of sight, meaning that the RF Tag can be invisible to the reader. This is because RFID is a radio frequency based identification system, which transmits information from a RF Tag on demand to a reader using radio waves that can penetrate packaging materials.

RFID technology is more complex than the bar code, and it is because of the following facts:

- RFID technology is embedded and read with no requirement for line of sight;
- Tags can be reprogrammed easily, and it is capable of working in suitable and harsh environments;
- Ready to carry 96 bits of information – compare this with 16 bits for bar code;
- Fraud controlling increases, and moreover, cloning become non-existence;
- Improves antitheft protection;
- Better efficiency and cost saving;
- Simultaneous multi-tag reading;
- High speed data capture;
- Possibility of having a unique ID and portable database;
- Profit enhancement;
- Better supply chain and management of inventory;
- Reducing counterfeiting;
- Tracking work-in progress;
- Reducing human errors and rework.

3. RFID System Components

Radio-frequency identification (RFID) is a technology that uses radio waves to transfer data from an electronic tag – called an RFID tag or label, which is attached to an object – through a reader for the purpose of identifying and tracking the object.

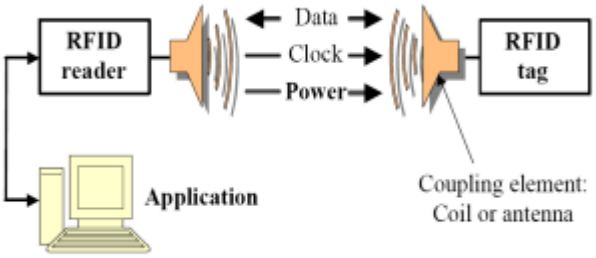

Figure 1. The workflow of RFID technology.

A conventional RFID system is made up of four components mainly,

1. RFID Reader;
2. RFID Antenna;
3. RFID transponder (or tag) electronically programmed with unique data;

4. Host computer with appropriate application software.

RFID systems 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. The system requires the usage of RF active readers able to communicate with the main station using 3 different communication mediums: serial cable, LAN cable, and WLAN antenna.

Our system relied on a MIFARE RFID-tag, specifically, the MIFARE MF1ICS50 typed RFID-tag. This type of tag was developed by the company NXP to be used in a contactless smart card according to ISO/IEC 14443 Type A. The MIFARE MF1ICS50 IC is used in such applications as public transportation ticketing, which major cities of the world have adopted as their e-ticketing solution. The MF1ICS50 chip consists of a 1 K-byte EEPROM, a RF-Interface and a Digital Control Unit. Energy and data are transferred via an antenna comprising a coil with a few turns directly connected to the MF1ICS50 [4].

As RFID-reader, EHUOYAN's YHU638 was used due to its cheapness and ease of use. This reader enables the contact-free reading and writing of operations and works on a 13.56 MHz frequency [5].

4. The description of the SCS

This system is able to check entrance/leaving times for any staff, control the location of any person who is registered in the system, and at the end of the month, this system prints reports about all staff based on some pre-assigned requests. The most important point of the use of this system is that it teaches staff be responsible and come to the work earlier, without being late or even absent. People know that this system is managed and controlled by the administration of the University, so they try to come to work at the time, because the system is able to get their time. The idea of this system is to supply every person with an ID-card, which is composed of unique ID. This system timestamps every swipe of this ID-card so that the system controls entrance and leave times of the person. This system is capable of the following:

- Accurate monthly report of staff attendance;
- No paperwork for HR department, less problem;
- Reports are saved in secured .PDF format, so that at the end of each month administration will have a nice documented attendance.

This system maintains a daily record of a person's arrival time to work and departure time from work to home. Besides this, the system features the name, position and the assigned number (so-called ID) of each personnel. The system also protects the employees by providing the exact number of hours they worked, making it much harder for employers to cheat out of their wages. Staff Control System is an application built on Java that checks every staff's arrival/departure time and provides print/save report-paper that much more simplifies the staff's attendance check-in. The application uses Postgre SQL as Database to store and exports reports, whose are stored in .PDF-format, so that, anything is handled on Windows - desktop, with no handwritten procedures. The application has additional plug-ins that directly refer to database. There are additional plug-ins that consist of RFID reader, Mifare Cards and tiny Java-based module that operates with this equipment. The application was built on NetBeans IDE, so nothing is derived from external source. The ID-cards of the employees are embedded with RFID-tag, which read by a reader. This RFID-reader is connected to a database through a computer. This method is more effective for preventing problems encountered when checking attendance manually.

To maintain perfect data flow and compact view of structure, it was decided to perform only one staff's table (also room) and temporary table of arrival, which can be cleaned up by end of the year. Those two tables perform and maintain all necessary information to prepare monthly attendance report.

Figure 2. Two different types of reader: left one-barcode reader, and the right one is RFID-reader.

SCS reader requires to be separated from desktop computer, with Java and PostgreSQL installed in this desktop. Furthermore, connection to server's database is required to be established; however, it is not strict condition, as SCS reader module stores all data in text file.

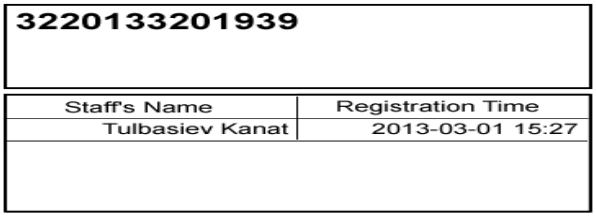

Figure 3. SCS reader module GUI.

Readers can be one or many, but each of them requires specific desktop computer. Reader part has its own launcher (launcher.exe), the shortcut of which should be placed to Windows Startup Folder: X:\Users\\user\\AppData\Roaming\Microsoft\Windows\StartMenu\Programs\Startup.

It is highly recommended to shut down desktop machine, to prevent any damage and to perform more lifelong service time: Windows Task Scheduler – at 22:00, operation "shutdown –s";

Database setup: PostgreSQL to be installed with archived database structure, which comes with installation folder (postgres.backup). For any login, password and destination database value changes should be also modified in configuration file (conf.txt) in the given format as "login password destination".

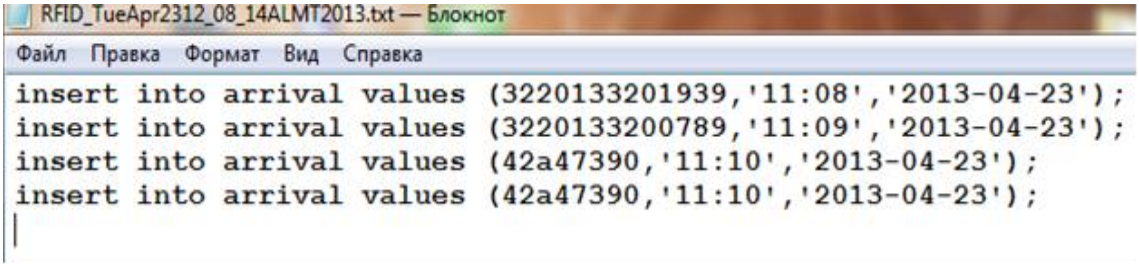

Figure 4. Registration log-text file.

The best way to secure data can be gained by preventing any access to the data, so this way, nothing can be changed, so in this application, even HR-Department is restricted from an access to this application. SCS application (Figure 5) provides simple user-friendly GUI, with static and efficient functions, which operate with database, without modifying it.

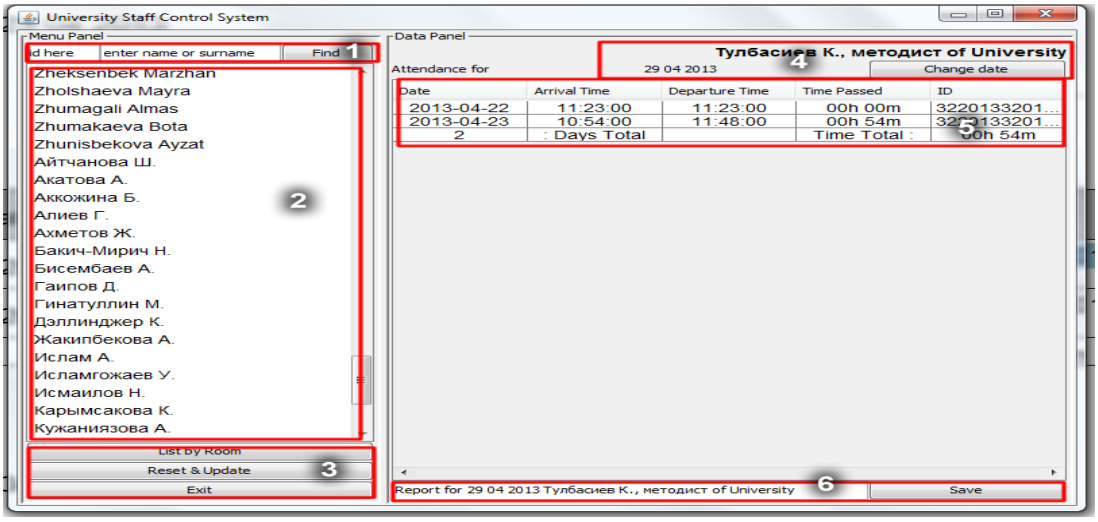

Figure 5. SCS main page.

SCS application panel explanation

1. Search by ID and Name criteria: ID line should be consistent and correct; otherwise, no result will be acquired; and Name criteria search is more relevant for inputting word. Search input may include from one to many characters. Found staff will be highlighted in query.

2. Staff List: The whole list of staff that appeared in data – table “person”. The personnel is ordered by person.first_name criteria. Double – click for future procedure.

3. Menu Buttons: List by Room/List by Name – changes query type from staff to rooms. Reset & Update – refreshes list appearance, cleans – up data panel. Exit – closes the application.

4. Date and Information panel: Shows the staff’s degree and faculty or just working type. Change date button refers to day – month specification. Chosen date appears in report.

5. Data panel: Shows arrival/departure log for specified staff and date. Total time and days are labeled at the bottom of the table.

6. Report label: This line input refers to name of the report, by default it is set to current date and staff’s criteria. Save buttons exports .pdf report.

5. Conclusion

In this research paper, the idea of implementing the system controlling the staff based on RFID-technology is discussed. The authors we have consulted in our research have shown how a system relying on RFID- technology may be developed. This system is flexible, which means that it may be extended by adding more modules. The cards that have been employed for this specific system are RFID-cards, and the algorithm used has shown stable and reliable results; moreover, this algorithm has secured important data that we have stored on these cards. Regarding the algorithm, there is research paper [6] that discusses the structure of the algorithm, which have been implemented for this system. These cards can be put to use at the university and may replace personnel ID cards. As demonstrated, personnel and students, alike, can use these cards for many purposes; additional functions can always be incorporated into the system and greater security provided to the cards. RFID-technology continues to develop, and the time has come for us to avail ourselves of its promise and convenience. In the

research [7], the authors have shown the system for checking the students' attendance in Kazakhstan. The idea is similar, however, there were some differences, and this implemented system have shown an importance of using and developing such systems for educational purposes in Kazakhstan. The main aim of this research has been to demonstrate potential uses of RFID-technology and build a system reliant on it. For the future work, this research should be extended by adding more modules and making some updates or changes. We are planning to extend this system by adding some new modules, specifically "Library module", "Doors Access Control module", "Payment module", "Parking lot module", and so on. There was research done in [8], which showed how to build and implement Library Management system based on RFID. Simultaneously, other cards should be checked and be replaced, because cards which were used for this research seemed to be secure less, and new cards should have enough memory size so that we can keep more data inside of them. Furthermore, the possibility of using some additional tools like GPS, GSM and so on is considered, and the project for implementing such a system is started. We plan to use GPS and GSM technologies in educational system, and the work that was done in [9] is an impulse for this project implementation.

6. References

[1] S. Sharma, S.L. Shimi, and S. Chatterji, "Radio Frequency Identification (RFID) based Employee Monitoring System (EMS)", International Journal of Current Engineering and Technology, Vol.4, No.5, October 2014.

[2] K. Domdouzis, B. Kumar, and C. Anumba, "Radio Frequency Identification (RFID) applications: A brief introduction", Advanced Engineering Informatics, Vol. 21, 2007, pp 350-355.

[3] S. A. Weis, S. E. Sarma, R. L. Rivest, and D. W. Engels, "Security and Privacy Aspects of Low-Cost Radio Frequency Identification Systems." Security in Pervasive Computing, 2003, pp 201-212.

[4] NXP official web-site. For additional information, visit http://www.nxp.com.

[5] Ehuoyan Technology Co, Ltd. Official website: http://www.ehuoyan.com.

[6] Saparkhojayev, Nurbek, and Olzhas Shaiken. "An Implementation of MD5 Hash Algorithm for RFID Tags." International Journal of Computer Applications 72 (2013).

[7] Nurbek Saparkhojayev and Selim Guvercin, "Attendance Control System based on RFID-technology", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 3, No 1, May 2012.

[8] M. Dhanalakshmi and U. Mamatha, "RFID based library management system", Proceedings of ASCNT, pp.227- 234, 2009.

[9] S.B. Patil and R.M. Walli, "Design and Development of fully automatic AT89C52 based low cost embedded system for rail tracking", International Journal of electronic communication and soft computing science and engineering", Vol. 1, Issue 1.