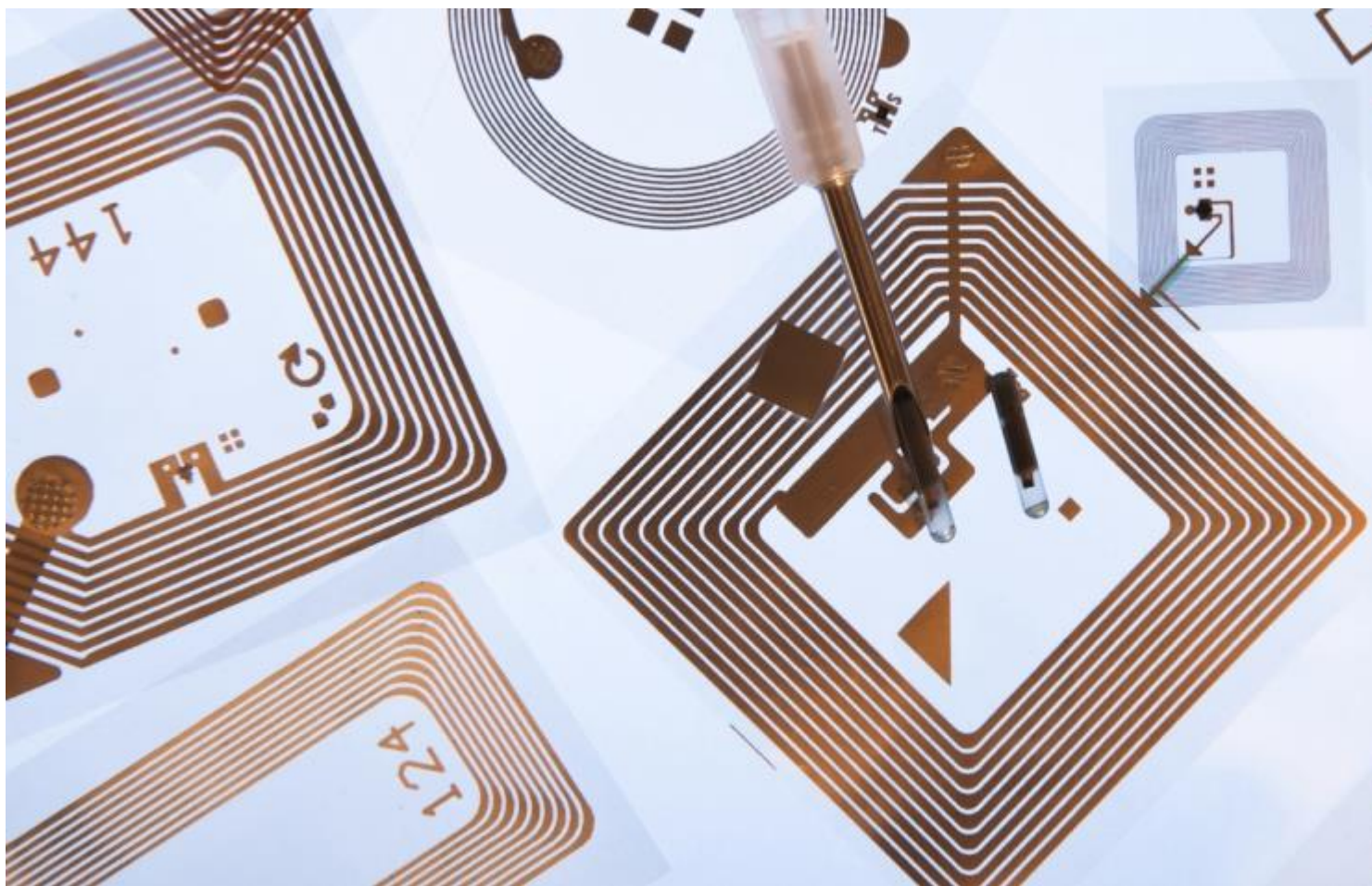# CREATING A SMART ENVIRONMENT IN KAZAKHSTAN

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RFID-based technologies can help automate processes for greater productivity.

Those cinematic scenarios in which people are located and then placed behind high security doors, and then determining how long they have been in that location, is now a reality courtesy of radio frequency identification technology (RFID).

While RFID technology usage is almost universal there are a few areas in Kazakhstan where it has been adopted. In Astana, the government introduced a City Development Strategic Program that utilises RFID applications. A similar program was adopted in Almaty, and one of the city's programme goals is to move to a "Smart-City" concept that will involve smart sensor technologies and systems as tools for transformation.

RFID APPLICATION IN THE UNIVERSITY

The U.S. Food and Drug Administration defines RFID technology as a wireless system consisting of tags and readers, where radio waves are used to send and receive signals between

the two sets of devices. The RFID tags are able to store data and information, with the mobile readers carried around or placed as permanent fixtures in entry and exit points, as well as in buildings and structures.

The RFID research projects I have done with students have resulted in several automated processes, such as taking staff and student attendance, enabling administrators to be more productive in generating records for student assessments and tracking staff movements for payroll purposes.

Automating attendance records
Like most global education institutions, class attendance is taken into account when grading students' work and performance in Kazakhstan. To do away with manual roll calls for student attendance on paper, which is time consuming and possibly inaccurate due to students wrongly confirming the presence of their classmates, my students and I created a system using RFID technology and implemented it in one of the local universities (Figure 1). The system architecture allows you to see that a student has to use an ID-card embedded with an RFID chip. The RFID reader reads this card, checks whether this data has been included in the database, while a Web-camera takes the student's picture simultaneously.

Why do we need this? The answer is trivial: there are scenarios when a student may cheat the system by presenting multiple cards so the reader would think many students were in class. Photo identification allows teachers to double check the class attendance of any student at a later time. In future, we would like to enable the system to automatically compare photos and decide if a student is "Present or Absent", without human interference. Compared with other RFID-based attendance checking systems, my system differs in architecture: there is no centralised database (DB), whereas many worldwide RFID-based systems prefer to establish centralised DBs, but this requires having a connection to the DB at all times, and requires a stable Internet connection. After due consideration, I decided to build a decentralised RFID system that is connected to a centralised DB but will only exchange data at the end of the day.
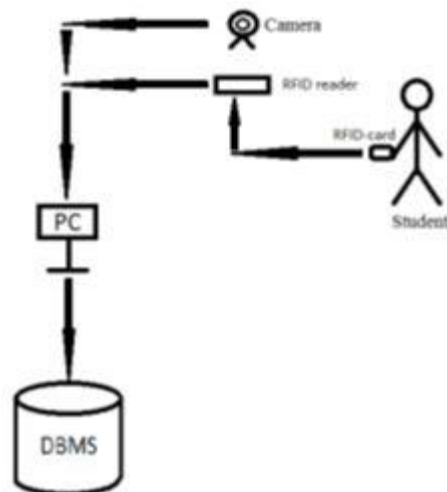

Figure 1. Architecture used in student attendance-control system.

Next, I developed an RFID-based Staff Control System (SCS) for hands-free access to control and monitor staff movements in the campus and their attendance at work. This system can document when staff exit or enter the campus and track their whereabouts. It will encourage staff to be accountable for their working hours, as well as work attendance.

The system is based on ultra-high frequency RFID readers, supported with antennas at gates and transaction sections, and the actual data exchange takes place at these points. The employee identification cards containing RFID-transponders are able to electronically store information that can be read without physical contact using a radio medium. The access tag can be read up to 10 centimetres from the RFID reader.

At the end of the month, the system generates a report based on pre-assigned user settings and access, showing the total number of hours each employee has worked for payroll purposes. This enables the institution to have an accurate monthly report of staff attendance without any paperwork needed for the human resources department (Figure 2).
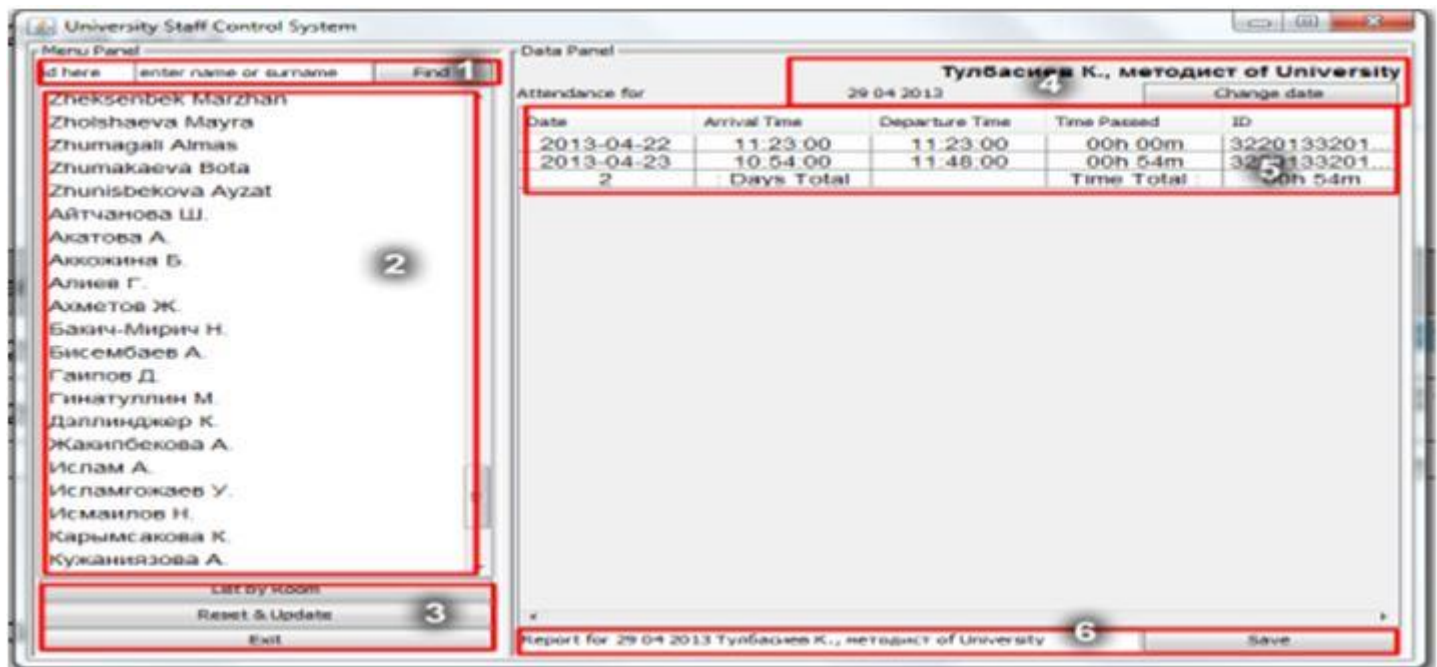

Figure 2: Staff Control System main page.

One-key access
Adapting RFID technology for mobile phones, my team and I developed a near field communication (NFC) system to replace the use of keys for locking and unlocking doors. The NFC-enabled Access Control and Management System were developed and introduced using Android 4.4 software for smartphones. Why do we need this?

It avoids disturbances caused by students opening doors and looking into the classroom during class time. Essentially, the system prevents entry of unauthorised people so that teachers can concentrate on their classes instead of having to deal with interruptions. Figure 3 shows the architecture of this system. Any registered smartphone that has an NFC module can be placed next to the NFC reader, the NFC reader then reads the cell phone, and sends data to the server to check if this cell phone has passed the registration phase. If this cell phone exists in the server DB, then the reader sends a signal to the power source and locks or unlocks the door.
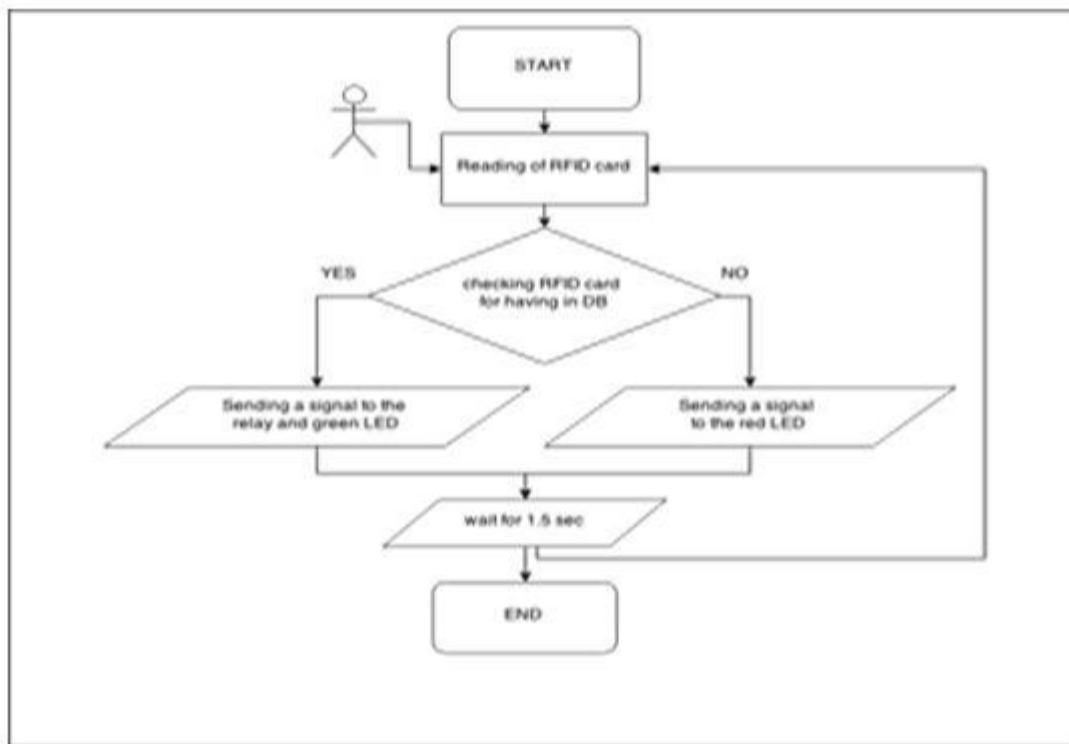
Figure 3: Architecture of NFC-based Door-Control system.

At Almaty University, my students and I developed a system that allowed hands-free computer access via an RFID card. The system, shown in Figure 4, was subsequently introduced university-wide.

The idea of this system is based on supplying every person with an ID-card, which comprises a unique ID. This system is based on the idea that every student will have access to a PC, to which administrators of this system give permission.

Users will open their PCs by using their unique RFID cards/tags. Unauthorised persons cannot start any PC. The most important feature of this system is that it protects the PC from possible theft of its hardware components. Moreover, the data installed on the hard drives is protected since no one can connect a USB thumb drive to retrieve data from it, and the only open components of the PC are the monitor, keyboard and mouse. This system is therefore capable of ensuring accurate control of computers located in the labs of the University; no data loss or data copying from the computers; no possibility of connecting any device to the computers; and no possibility of working on unassigned computers.

Figure 4. Workflow of RFID-based Computer Access System.

RFID FOR THE FUTURE

The possibilities for RFID technology are endless. In the university setting it has brought benefits in efficiency through improving and speeding up workflow, as well as enhanced security within the existing system.

To harness the potential of RFID, further research could be carried out regarding library services and the parking of vehicles as well as door access and control. Generally speaking, RFID technology can be used not only in the educational sector, but in different aspects of business. This technology can be used in developing "smart cities", and also in manufacturing and logistics, when the remote control of the flow of goods is needed. Many foreign companies with businesses in Kazakhstan have already started using this technology. In a few years, RFID and NFC technologies will be used in many different areas and there will likely be many new areas that will experience the advantages of adopting these two technologies.

The smart environment can also leverage tools such as the Global Positioning System and Global System for Mobile Communications, better known as GPS and GSM respectively. Using both GPS and RFID technology, for example, stores can pinpoint the exact location of any item in the shop for any customer. Also, the location of employees can be checked remotely so that managers can check the amount of time that an employee spends doing his/her duties at work. I hope to present and use such a system within the next two years.

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