

# Next Generation Identity Card: RFID-based Automatic Access Control System for Universities

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*Abstract:* - Automatic identification using RFID (Radio Frequency Identification) technology is a field of study attributed in identifying a person from non line of sight wireless link. The technique makes it possible to use the persons identity and control access to the services such as class rooms, labs, libraries, database access services, information services and remote access to the computers. This project represents a development of a Visual Basic and SQL Server based automatic access control system. The key idea behind it is to replace the existing Barcode System which is generally used in the identity card of the universities as well as to incorporate this technology where a decision is to be made regarding the persons right to access the services.

Identity card containing small size, low cost individualized RFID tag is able to transmit and receive information to an interrogator (RFID reader). Whenever the tagged object passes within the range of an interrogator antenna, information is exchanged. This information is used to access databases to make proper decision. There will never be any confusion as each RFID tag ever made has unique tag number and it is used as the discriminative feature or primary key to design and take control over the database.

*Key-Words:* - Radio Frequency Identification, Radio Signal Processing, Automatic Access Control

## 1 Introduction

Automatic Identification is the process of identification of objects with minimum human intervention. In recent years, automatic identification procedures (Auto-ID) have become very popular in many service industries, purchasing and distribution logistics, access control, manufacturing companies and material flow system. Automatic identification procedures exist to provide information about people, animals, goods and products in transit[1]. Radio Frequency Identification is an efficient technical solution to Auto-ID which uses radio frequency to identify and track individual item[2].

The most significant of all advantages of the wireless RFID AIDC systems (Automatic Identification and Data Capture) allow for non-contact reading, non-line-of-sight nature of the technology and are effective in environmentally challenging conditions like snow, fog, ice, paint, crusted grime etc., where barcodes or other optically read technologies would be useless. RFID technology can also be read in challenging circumstances at a remarkable speed, in most cases responding in less than 100 milliseconds[6].

## 2 RFID Operating Principles

RFID System enables remotely storing and retrieving information by means of electromagnetic radiation[5]. An RFID System consists of two main components: Transponder, Interrogator. Transponders are low functionality microchip connected to an antenna, acts as electronic data carrying device. It is naturally operated passively. On the other hand, Interrogator contains a transmitter/receiver module connected to an antenna. Interrogator (reader) detects transponders (tags) and performs read/write operations on transponder. Normally readers are connected with an additional interface to forward Tag-ID to another system, like a PC, Server or robot control system.

In the most common RFID system, the reader's antenna coil generates a strong, high frequency electromagnetic field and small parts of the emitted electromagnetic field generates voltage at the antenna coil of the tag by induction. This voltage is rectified and serves as the power supply for the data-carrying device (microchip/tag) to activate the embedded integrated circuit, and then transmits the information stored back to the reader through antenna.

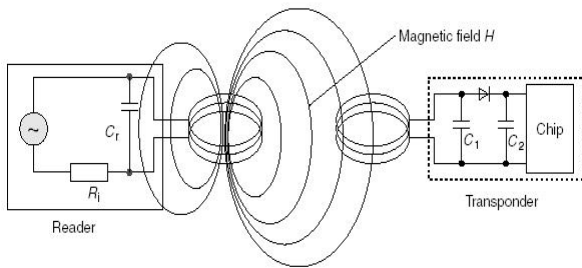


Figure 1 Operating Principles [1]

### 3 Identification System Modeling

The main objectives concentrate on Radio Frequency Identification by identifying the RFID tag which is within the range of the reader and to verify the tag from a set of data stored in the database in order to perform the respective operations seeking by the person. Processing of radio signal, proper design of database, discriminative matching, real time issues and optimization are the important concerns that have taken into account. For this purpose, individual modules are designed systematically in order to integrate them successfully to constitute the system.

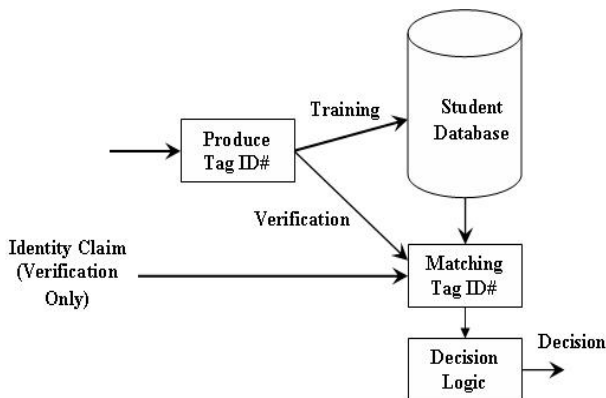


Figure 2 Identification System Modeling

#### 3.1 Front-end Processing

The first step of radio signal processing involves the reading of RFID tag to enable further processing. Front-end processing is performed both in training (storing data into storage) and verification phases.

#### 3.2 Signal Propagation

An RFID system generates massive amounts of data which needs to be guided properly and generally traffic is increased about 30% for RFID implementation. When the readers and tags are in operation (reading tags), there is a need to get the signals from the readers to the servers that will

handle the data[4]. If the readers have not built-in networking hardware, then a network must integrate the readers to the system. The network could be a regular WLAN connected to the data processing servers placed on the Internet[4]. This is a typical setup for a distributed system.

#### 3.3 Design of Database

A database is mandatory to provide an environment that is both convenient and efficient to use in retrieving and storing database information[3]. The result of front-end processing and related information of the tags are stored here.

#### 3.4 Decision Logic

The decision logic must be supplied either via programming or by another approach to make the final decision into graphical user interface about the claimed identity of the person and to execute the procedures for the respective operations.

## 4 Design of Software

The software is the brain of any kind of system. The most important task in creating a software product is extracting the requirements. For the simplicity of design task, the software is systematically divided into four modules considering the requirements: Access Control, Tag Management, Students Profile and Registration. Firstly, functions and purposes of each module are defined. Secondly, goals of the predefined module are achieved by two distinct process that are interrelated to each other: Algorithms, Flowchart.

#### 4.1 Access Control

Main function of this module is to scan valid input from the user (unique RFID tag number) and switch to execution according to the commands. Decision logic is applied if his/her access is granted into the system or not. Here RFID reader acts as authentication device and supply the tag number to the program. When the person wave the identity card (with tag) to the reader, it does a search operation in the database. If the person is registered to the university and there is no restriction to allow his/her access, then the system welcomes the person.

#### 4.2 Tag Management

Primary objectives of this module are to provide options for the system administrator. The system administrator will be able to perform insert, remove, update and search operation for the designed database by simply scanning or manually inputting a

tag number. Here RFID reader acts as the device to supply the tag number to the program.

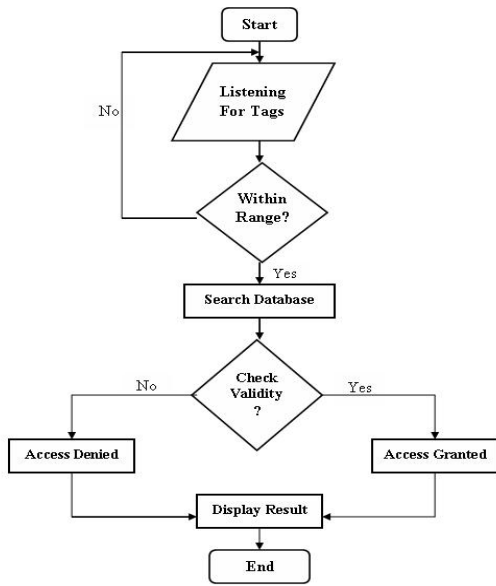


Figure 3 Flow Chart of Access Control

4.3 Students Profile

The tag number provides the key to view and update students profile. RFID reader acts as the device to pass the tag number to the program. When students wave the identity card (with tag) in front of the reader, it does a search operation in the database. If the student is registered to the university and there is no restriction to his/her name, then the system opens the opportunities to view and update his/her profile.

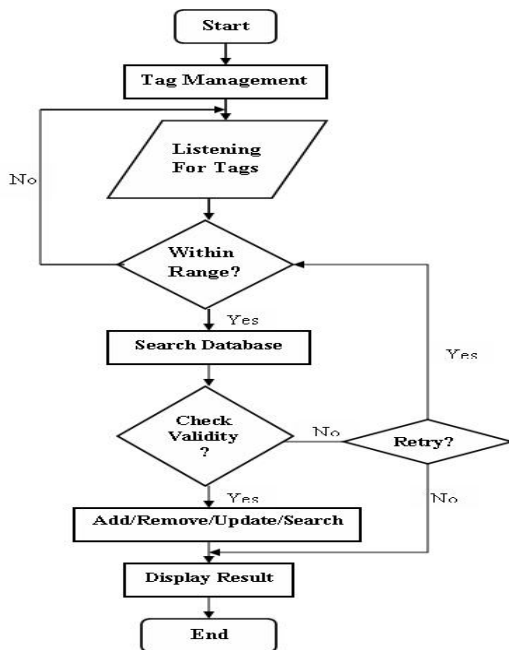


Figure 4 Flow Chart of Tag Management

4.4 Registration

The students as well as the system administrator will be able to register/remove courses from the students profile by placing his/her identity card in front of a reader. Students will be able to view the registered courses too. In this case, RFID reader supplies the tag number to the program.

5 Experimental Results

In this project, we attempted to identify persons by matching RFID tag number from a database. In the first phase, we inserted records into database by simply waving the identity card in front of an RFID reader. In the second phase, we matched the tag number in the similar way form the set of records of the database to determine the identity of the person. Our system is at its best 100% accurate in identifying the correct person when the distance between the RFID reader and tag is 4cm or less. Black Box testing method is used here as the definition of test case which takes input from the user and provides outputs into the user interface by the testing software. Following snapshots are taken during the Black Box testing.

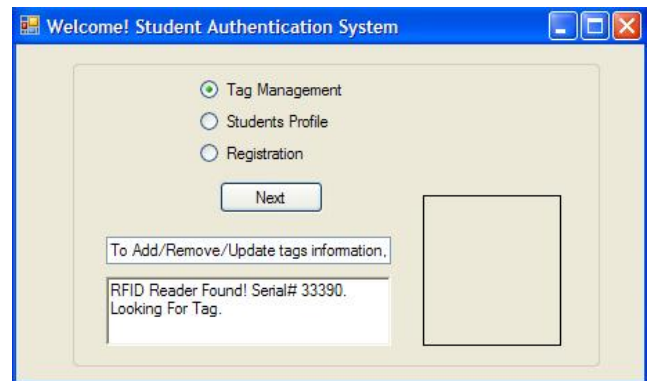


Figure 5 Running Access Control Software

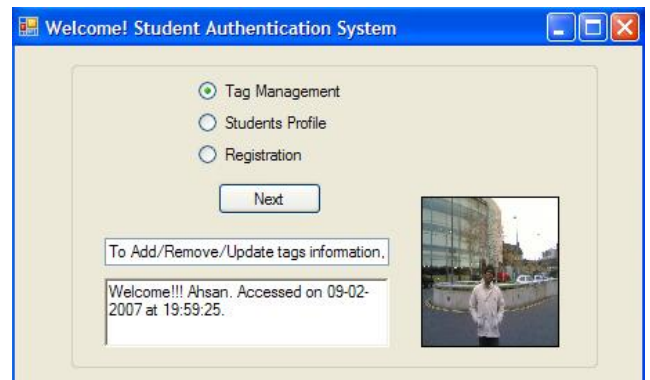


Figure 6 Access Granted

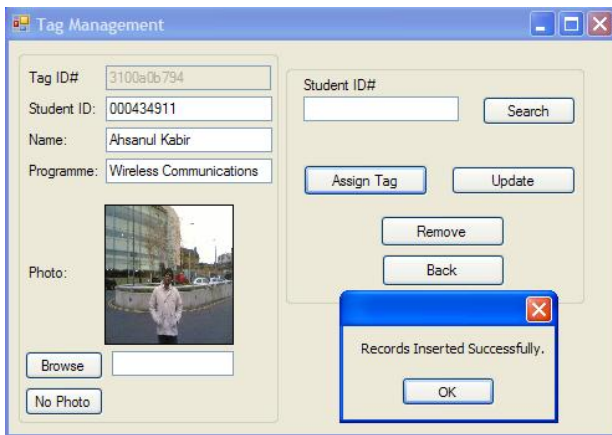


Figure 7 Tag Management

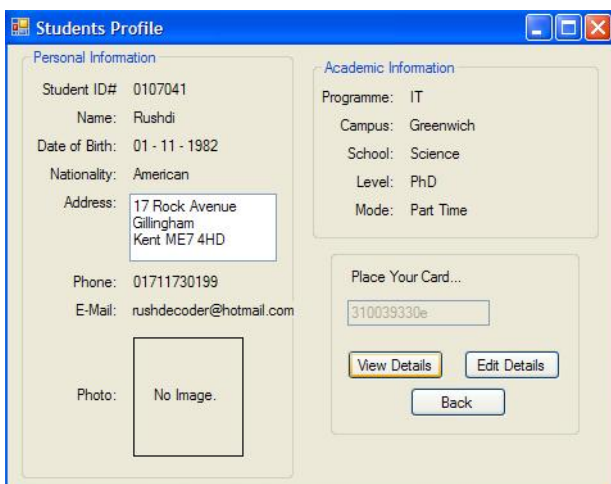


Figure 8 Students Profile

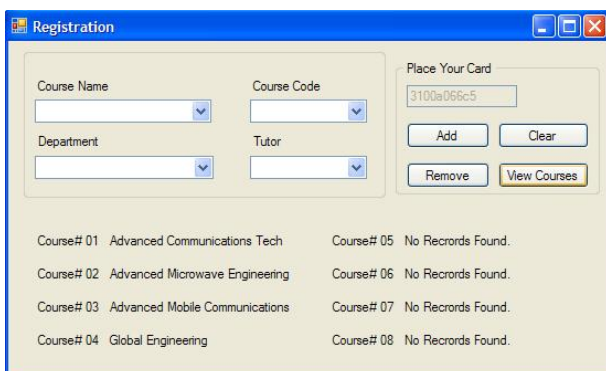


Figure 9 Registration

obstacles may seriously affect its functional capabilities as well as operations. Still RFID is considered expensive. The tags are economic and large orders further make it economic. But the readers are expensive. Moreover, read range is another factor that needs to be considered seriously. The developed software has a read range of approximately 4 cm. This could be proved short, especially when the reader is in continuous operation. From the human-interface point of view, it is important to consider how the users should be prompted, and how identification errors should be handled. Furthermore, various other analyses could be carried out on location approximation, remote access to the computers, combination of RFID and voice recognition, considering timing information to enable the reader to enter into stand-by mode etc.

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## 6 Conclusion

Ability to read identity card inside wallet/purse, makes RFID very interesting. It signifies that person can be verified without removing the identity card from the wallet/purse. This is smart and time saving. RFID functions by the propagation of radio waves, it implies that metals, other conductors and physical