Campus Access Management System via RFID

Komal K. Maheshkar, Dhiraj G. Agrawal

Abstract— For colleges where security is vital and access to certain areas of campus must be controlled & monitored, there should be some access control system that allows college administration to manage and monitor all access points & locks centrally and remotely, allowing for auditable security & quick responses to any security breaches. Campus Access Management System (CAMS) via Radio-Frequency Identification (RFID) allows only authorized persons i.e. student, teacher or an employee to enter a particular area of the college campus. The authorized persons are provided with unique RFID Tag & its PIN code, using which they can access that area. The system is designed using Peripheral Interface Controller (PIC) Microcontroller MICROCHIP-16F877 and comprises of RFID module (Tag+Reader), Keypad for entering access code an (Liquid Crystal Display) LCD module for displaying "name" of the authorized person & a relay for opening the door for him. For an unauthorized person door remains closed and buzzer alarms with indication as "invalid card" on LCD Display [1]. The data from RFID reader is transmitted to a Centralized Remote Computer or Server located in the administrative office of the college through a RS-232 interface. The centralized server determines the authorization & access control rights. The entire program code is written in Microsoft Visual Basic 6.0 Software.

Keywords— Inductive couplings, PIC controller, RFID reader, RFID Tag.

I. INTRODUCTION TO RFID

In every RFID system, the transponder tags contain unique identifying information in digital binary format. Here this information is nothing but the personal data of college students, lecturers or employees.

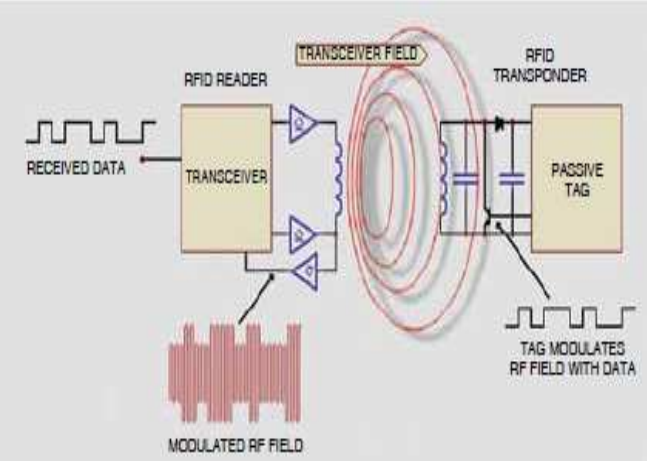

Fig. 1: Typical RFID System

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The RFID Transceiver communicates with a passive tag. Commonly, at the heart of each tag is a microchip. When the tag enters the generated RF field, it is able to draw enough power from the field to access its internal memory and transmit its stored information. When the transponder tag draws power in this way, the resultant interaction of the RF fields causes the voltage at the transceiver antenna to drop in value. This effect is utilized by the tag to communicate its information to the reader. The tag is able to control the amount of power drawn from the field and by doing so it can modulate the voltage sensed at the transceiver according to the bit pattern it wishes to transmit [1]. RFID works on the principals of *Inductive coupling*. *Inductive coupling* is the transfer of energy from one circuit to another through a shared magnetic field which is produced due to mutual inductance between two circuits. The reader antenna and the tag antenna each consist of a coil. An electric current passing through the coil of reader's antenna generates a magnetic field that induces an electric current in the coil present in the tag which is exposed to that field [2].

There are three basic elements of RFID system. List of elements are as follows:

1. *Tags:* An object that is attached to any product and uses a unique sequence of character to define it. It comprises of chip and the antenna.
2. *Antenna***:** It is responsible for the transmission of information between reader and the tag using radio waves.
3. *RF Transceiver:* It is the source of RF energy used to activate and power the passive RFID tags [1].

There are three types of tags:

1. *Active Tags:* It own transmitters and power source, usually in the form of a small battery. These remain in a low-power 'idle' state until they detect the presence of the RF field being sent by the reader. Active tags can be detected at a greater range than a passive tag.
2. *Passive Tags:* Passive tags have no internal power source. These draw their power from the electromagnetic field generated by the RFID reader and then the microchip can send back information on the same wave. The reading range is limited when using passive tags [1].
3. *Semi-passive Tags:* This type of tags have no internal power source. These draw their power from the electromagnetic field generated by the RFID reader and then the microchip can send back information on the same wave

There are three ways of encoding the data into the tags:

1. *Read only tags:* in this tag contains data, which is pre-written onto them by the tag manufacturer or distributor.
2. *Write-once tags:* enable a user to write data to the tag one time in production or distribution processes.
3. *Full read-write tags:* allow new data to be written to the tag as needed and later other data can be rewritten over the original data [1].

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II. System Design

Fig.2 shows a Block Diagram of Campus Access Management system via RFID using PIC Microcontroller MICROCHIP-16F877.Other than the normal Microcontrollers PIC family supports more features, so we have chosen PIC 16F877 as the main controller.

The Main features of PIC are discussed below.

- High performance RISC CPU.
- Only 35 single word instructions.
- All single cycle instructions except for program Branches which are two cycle.
- Operating speed: DC - 20 MHz clock input.
  DC - 200 ns instruction cycle.
- Up to 8K x 14 words of FLASH Program Memory.
- Up to 368 x 8 bytes of Data Memory (RAM).
- Interrupt capability (up to 14 sources).
- Direct, indirect and relative addressing modes.
- Power-on Reset (POR).
- Power-up Timer (PWRT).
- Oscillator Start-up Timer (OST).
- Processor Read/Write access to program memory.
- Wide operating voltage range: 2.0V to 5.5V.
- Low-power consumption:
  - < 0.6 mA typical @ 3V, 4 MHz
  - < 1µA typical standby current.

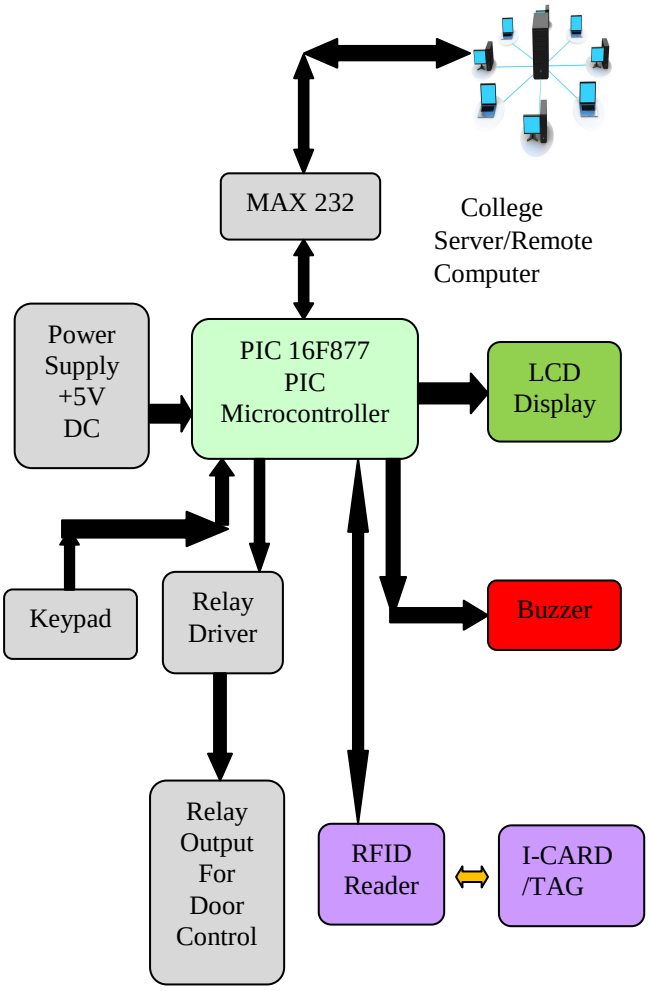

Fig. 2: Block Diagram of Campus Access Management System via RFID using PIC 16F877 PIC Microcontroller.

When the student, lecturer or employee places his I-Card (RFID tag) near to RFID reader, the tag enters the RF field generated by the RFID reader to transmit energy to the tag and retrieve data from the tag. Then the RFID reader communicates through RX and TX pins of the microcontroller for further processing. Thus on identifying the authorized person, output port pin of microcontroller goes high, output transistor drives into saturation, and relay energizes to open the door for the person. Simultaneously, the LCD shows *"name of the valid user"* message and at the same time small beep aural indication through buzzer. If the person is unauthorized, the LCD shows *"invalid card"* and the door doesn't open with continuous alarming the buzzer for 1 minute. Record has been saved on centralized server like date & time of access [1] [2].

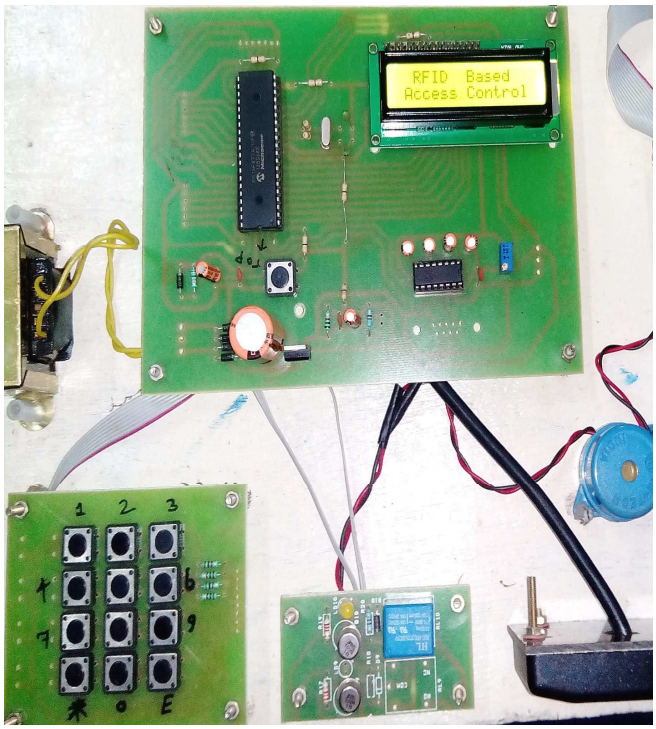

Fig. 3: Photograph of the System Hardware.

III. System Specifications

A. Hardware:

1. PIC Microcontroller PIC16F877
2. LCD Display
3. RFID Reader with Card (tag)
4. Keypad
5. Buzzer/Alarm
6. Max232 for PC/Server Interface
7. Relay
8. Step-down Transformer
9. 78XX Voltage Regulator
10. Registers, Capacitors, Diodes, Transistors, LEDs etc.
11. Printed Circuit Board
12. Computer/Server

B. Software:

1. Visual Basic 6.0
2. MS Access 2000
3. MPLAB
4. Hi-tech C Compiler

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IV. PROCESS FLOW OF THE SYSTEM

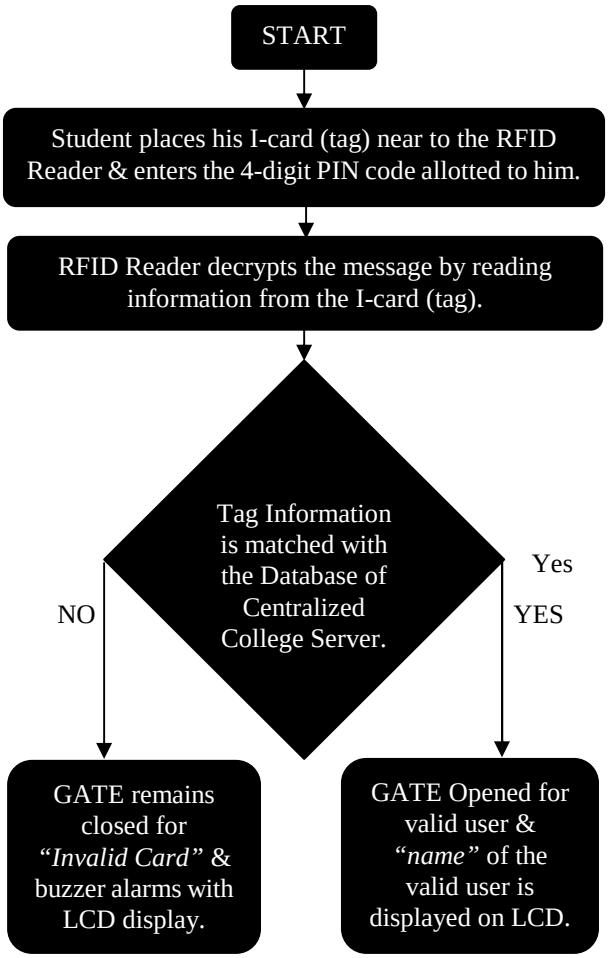

Fig. 4: Flowchart of working of the System.

First of all, college administration office staff has to store the database of students, lecturers or employee in the format shown below in fig.5 by clicking on "*Register*" tab designed by using Microsoft Visual Basic 6.0 Software on the Centralized Server of the college.

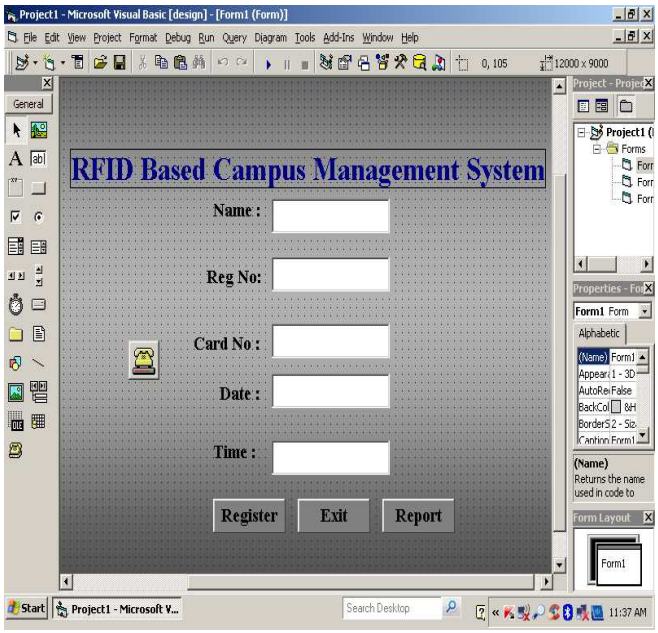

Fig. 5: Main Program GUI Window.

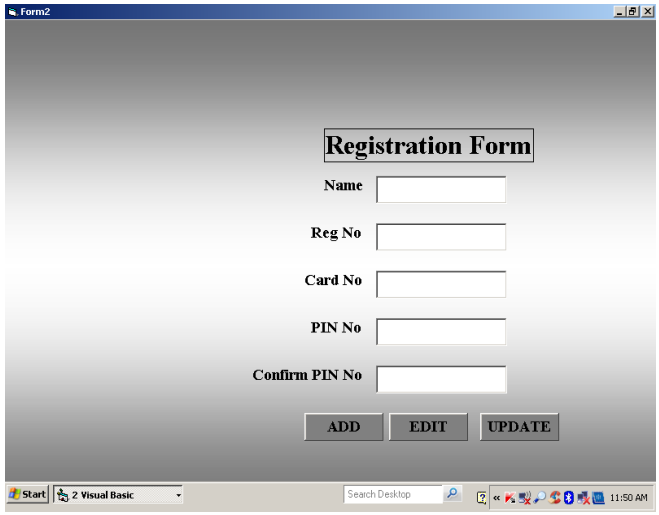

Fig. 6: Registration Form GUI Window.

From the Fig.6, it is clear that each tag (I-card) is programmed by filling Registration Form with details like Name, Registration No, Card(tag) serial No(last-5 digit from the back side of the tag) & the PIN No(last-4 digit from the back side of the tag) and Update this Database in college Centralized Server or Remote Computer.

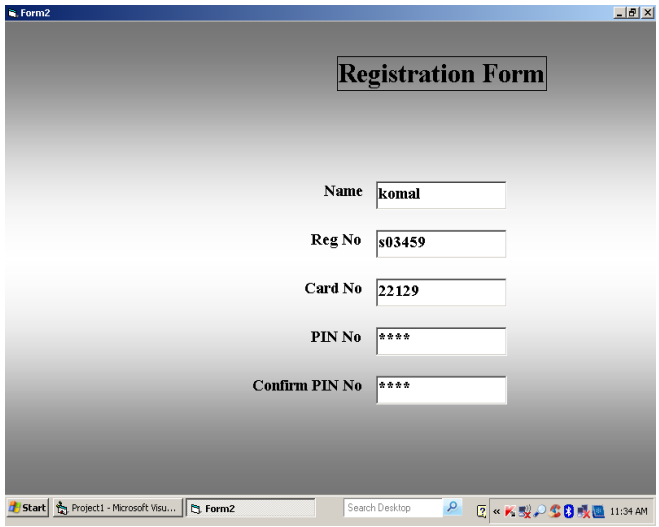

Fig. 7: My Personal data filled in the Registration Form.

Fig.7,shows my personal details filled, as in the college Registration Form while getting issued I-Card (RFID-tag) & its access PIN code.

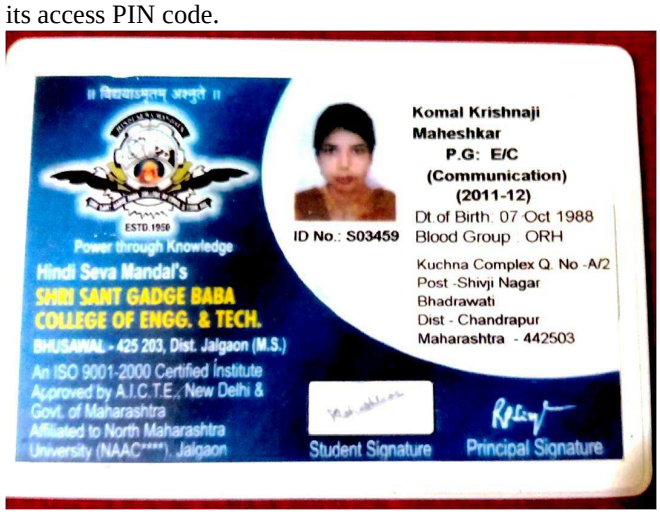

Fig. 8: My college I-Card (RFID Tag).

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Fig.8, shows view of my college I-card (Registration ID No: s03459) enabled with RFID Tag. Once it is done then the work remain is only to show I-card (RFID Tag) to the RFID Reader installed in the various locations in the college campus like auditorium, library, seminar hall, exam hall, canteen etc. & enter the personal PIN Code allotted to you on the keypad of the RFID Reader.

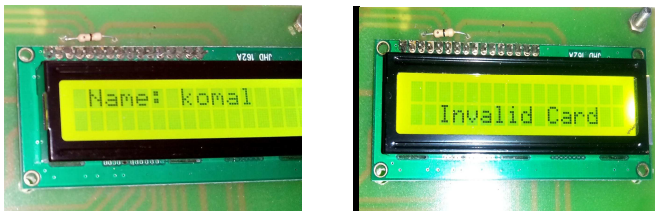
(a) **(b)**

Fig. 9: Process flow

From the above fig.9: (a) & (b) it is very much clear that, when the authorized person, student or employee place his I-Card near to RFID Reader installed at door and enters the PIN code the information from tag is verified with the Database stored at the college Centralized Server and after matching the door gets opened to the valid user by displaying *"name"* on the LCD display at the same time. For invalid user as soon as he/she places I-card near to the RFID Reader the continuous alarm on the buzzer last for 1-minute alerts security person for unauthorized access & *"invalid Card"* is displayed on the LCD display. The door remains closed for unauthorized access [1] [2].

V. RESULT

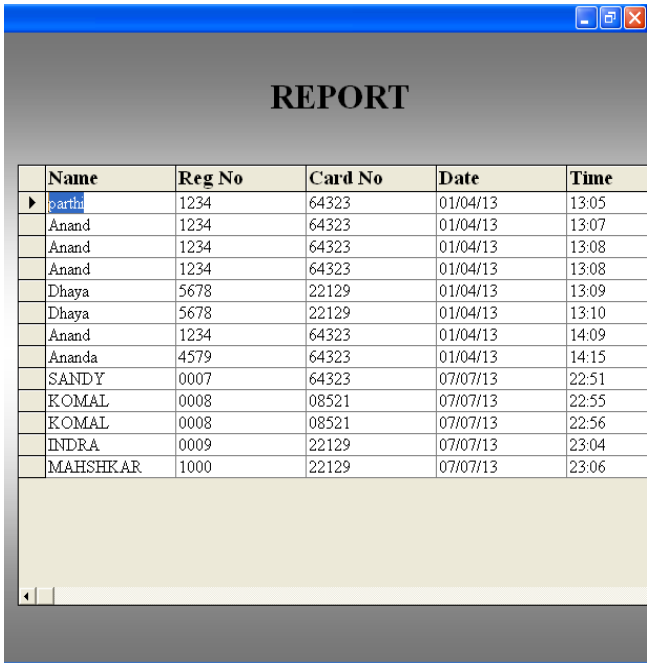
The primary aim of the project is to uniquely identify individual persons, employees or students based on their unique tag identifiers. RFID Based Gate Access Security System which is able to identify authorized persons and allow only them was successfully developed. The major contribution of this work is managing to write a functional code for Microcontroller to communicate with the RFID devices and store authorized person's data. This system should be able to minimize the technical human error during secured gate access. Besides, the system also helps user to use paperless environment and save the time. Following figure shows the different status of LCD Display [3].



(a) For *"Valid User"* **(b) For *"Invalid User"***

Fig. 10: LCD Display Status

Report of access into the college campus with Name, Registration No, Card No, Date & Time also been taken from the Centralized Server located at College Administrative building by clicking on *"Report"* tab of the main GUI Window (Fig.5).



REPORT

Name	Reg No	Card No	Date	Time
parthi	1234	64323	01/04/13	13:05
Anand	1234	64323	01/04/13	13:07
Anand	1234	64323	01/04/13	13:08
Anand	1234	64323	01/04/13	13:08
Dhaya	5678	22129	01/04/13	13:09
Dhaya	5678	22129	01/04/13	13:10
Anand	1234	64323	01/04/13	14:09
Ananda	4579	64323	01/04/13	14:15
SANDY	0007	64323	07/07/13	22:51
KOMAL	0008	08521	07/07/13	22:55
KOMAL	0008	08521	07/07/13	22:56
INDRA	0009	22129	07/07/13	23:04
MAHSHKAR	1000	22129	07/07/13	23:06

Fig. 11: Report obtained from Centralized Server.

VI. CONCLUSION AND FUTURE SCOPE

RFID is increasingly used with biometric technologies for security. The significant advantage of all types of RFID systems is the *non-contact, non-line-of-sight nature* of the technology. Tags can be read through a variety of substances such as snow, fog, ice, paint. Hence, this project can be very much useful and can be implemented in real time applications for recording the attendance. By integrating both RFID and Microcontroller generates a project with wider boundaries and effective solutions. The system can be improved by increasing the range of Reader in which the tag can be read. Further improvement can be done by using a method in which the tag encrypts its ID and then sends to the Reader, which will eliminate the capturing of the tag IDs and hence cloning the tags [2] [3].

VII. RFID APPLICATIONS

Fig.12 shows the RFID applications in the various fields [4].

Fig. 12: RFID Applications.

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