# RFID BASED STUDENT DATABASE MANAGEMENT SYSTEM

A thesis submitted in partial fulfilment of the requirement for the degree of

**Bachelor of Technology**

**In**

**Electronics & Instrumentation Engineering**

*By*

**Deepak Kumar Tudu**

Roll No- 107EI015

**Ramchandra Soren**

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Department of Electronics and communication Engineering
National Institute of Technology, Rourkela

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Under the guidance of

**Prof. Santos Kumar Das**


Department of Electronics and communication Engineering
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# CERTIFICATE

This is to certify that the thesis entitled "RFID BASED STUDENT DATABASE MANAGEMENT SYSTEM " submitted by DEEPAK KUMAR TUDU, Final year student of Electronics & Instrumentation Engineering, Roll No: 107EI015 and RAMCHANDRA SOREN, Final year student of Electronics & Instrumentation Engineering, Roll No: 107EI030 in partial fulfilment of the requirements for the award of B.Tech degree at NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA is a bonafide work carried out by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other university/institute for the award of any degree or diploma.

Place: Rourkela

Date:

**Prof. Santos Kumar Das**

Assistant Professor

Department of Electronics & Communication Engg.

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Rourkela-769008

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# Contents

# ABSTRACT

Radio Frequency Identification (RFID) is a flexible, wireless, automatic identification technology that transmits information about an object or person, using radio waves. RFID is becoming one of the hottest and cost-effective technologies today. The main objective of our project is to design a student database management system using RFID. In this project we convert the manual student management into computerized system for our convenience or data reliability. This system provides all types of information regarding students and faculties, institute details, course available, batch information and other resources too. It provides all the information of a student starting from the first day to the end of his/her course, so that it can be used later for all reporting purpose, attendance tracking, curriculum details, and hence can be used for future reference.

This system will have the required databases for student and faculty directory that shows students' details, faculty's details, courses offered by the institute, current status of a batch, attendance percentage. This application is being developed using Microsoft Visual Studio 2008 using C# programming language and using MS Access for creating the database.

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# Chapter 1

# Introduction

## 1.1 What is RFID?

Radio Frequency Identification (RFID) is a flexible, wireless, automatic identification technology that transmits the identity (in the form of a unique serial number) of an object or person wirelessly, using radio waves [1, 2]. It comes under the category of automatic identification technologies.

Auto-ID technologies include optical character readers, bar codes and some biometric technologies, such as retinal scans [1, 2]. These technologies are mainly used to reduce time and labour needed for manually data entry and to enhance data accuracy. Some auto-ID technologies, like bar code systems, often require a person to manually scan a label or tag to capture the data [1, 2]. While bar code tags and bar code systems are much less expensive than RFID at present, RFID provides many benefits than barcode system, which is listed below.

## 1.2 Technical characteristics of RFID

- Data read and write – RFID reader can read the data to the database without contact, and process multiple tags once, and write the logistic processing state into the tag for the logistic processing in the next stage [3].
- Miniaturized and diverse form – RFID will not be limited by the size or form when it reads data, so it needs not to use the paper with fixed size or print quality to fit for the precision. In addition, E-tag of RFID can be applied in different products by small size, so we can more flexibly control the production of the products, especially the application on the production line [3].
- Anti-pollution – RFID possesses strong anti-pollution nature for water, oil or drugs. And in the dark or polluted environment, RFID also can read data [3].

- Repetitive use – Because RFID is electric data which can be written repetitively, so the tag can be used repetitively [3].
- Penetrability – If RFID is covered by the paper, wood, plastics or non-metal or non-transparent materials, it can communicate through these materials except for the irons or other metals [3].
- Big memory capacity of data – The data capacity will be extended with the development of the memory scale, and the quality of the material carried by the goods is larger, the requirement of the capacity for the volume label also increase, and RFID will not be restrained [3].
- System safety – The system stores the data from the central computer to the work piece which will largely enhance the safety of the system [3].
- Data safety – The checkout method or the cycle redundancy checkout method will be used to ensure the data veracity stored in the radio frequency tag [3].

The RFID concept is not new but has been around for decades; in fact, it was introduced to the world for the first time during World War II by the British Air Force to distinguish Allied aircraft from enemy aircraft using radar (table 1 provides a brief overview of the history of RFID technology) [4]. Since then, this technology has been used for various applications. RFID technology has been used by thousands of companies in many different ways for a decade or more to create value [2]. Here are some of the business applications where this technology is used

- Asset Tracking – It is one of the most common uses of RFID. RFID tags can be put on assets that are lost or stolen [5, 2].
- Supply Chain Management – It is used in closed loop supply chains or to automate parts of the supply chain within a company [5, 2].

Table 1.1: RFID's History

| Date | Event |
|---|---|
| 1930 – 1940 | American navy research laboratories developed a system known as IFF (Identify Friend or Foe). |
| 1940 – 1950 | The first application of RFID consisted of identifying Allied or enemy planes during WWII through the use of the IFF system. |
| 1950 – 1960 | IFF technology was used to develop the modern air traffic control system. First RFID applications in the military sector, in research laboratories and in major commercial enterprises. |
| 1960-1970 | Sensormatic and Checkpoint Systems introduced new applications for RFID, such as electronic article surveillance (EAS) equipment. |
| 1970 – 1980 | Technological advancements led to the creation of the passive tag, and the first initiatives for animal tracking and factory automation took place. |
| 1980 – 1990 | Many American and European companies started to manufacture RFID tags. First RFID application for automatic toll payment. |
| 1990 – 2000 | Standards for RFID equipment interoperability were developed. |
| 2003 | The Auto-ID Centre from MIT became EPCglobal, an organization whose objective is to promote the use and adoption of EPC technology. |
| 2005 | Wal-Mart launched an EPC pilot. |

(Source: AIM Publication (2001), Manish (2005), EPCglobalinc.org)

- Retailing – It is used by retailers to improve supply chain efficiency and making sure product is on the shelf when customers want to buy it [5, 2].
- Payment Systems – One of the most popular uses of RFID today is to pay for road tolls without stopping. It can also be used in a convenient way to pay for bus, subway and train ticket [5, 2].
- Security and Access Control – It can be used as an electronic key to control who has access to office buildings or areas within office building [5, 2].

RFID technology is cheap and many new applications are being developed to solve common and unique business problems.

## 1.3 Architecture & Operation of a RFID System

A RFID system is composed of three basic components: a tag, a reader, and a host computer [6].

**1.3.1 RFID tags** contain tiny semiconductor chips and miniaturized antennas inside some form of packaging [6]. They can be uniquely identified by the reader/host pair and, when applied or fastened to an object or a person, that object or person can be tracked and identified wirelessly and on the move [6]. RFID tags come in many forms. For example, some look like paper labels and are applied to boxes and packaging; others are incorporated into the walls of injection moulded plastic containers; and still others are built into wristbands and worn by people [7, 8].

**Types of RFID tags**

i. **Active RFID tags** include on-board power source (miniature batteries) that are used to power the tag, and can transmit signals autonomously.

ii. **Passive RFID tags** don't include an on-board power source and have power beamed to them by the reader.

iii. **Battery Assisted Passive (BAP) or Semi-passive RFID tags** require an external source to wake up but have significant higher forward link capability providing greater range.

**Smart Tags**

i. **Read only tags:** Information is programmed onto chip during manufacturing, no overwriting, and information constant, least expensive.

ii. **Write Once Read Many (WORM) tags:** Information added only once along with unique identifier but can be read many times.

iii. **Read-Write tags:** Open to data manipulation by user's system without restrictions. It contains a unique identifier but carry an updateable memory for that to be added. It is expensive also.

The following are the commonly used frequencies:

i. **Microwave** works on 2.45 GHz, it has good reader rate even faster than UHF tags. Although at this frequency the reading rate results are not the same on wet surfaces and near metals, the frequency produce better results in applications such as vehicle tracking (in and out with barriers), with approximately 1 meter of tags read range [9].

ii. **Ultra High Frequency** works within a range of 860-930 MHz, it can identify large numbers of tags at one time with quick multiple read rate at a given time. So, it has a considerable good reading speed. It has the same limitation as Microwave when is applied on wet surface and near metal. However, it is faster than high frequency data transfer with a reading range of 3 meters [9].

iii. **High Frequency** works on 13.56MHz and has less than one meter reading range but is inexpensive and useful for access control, items identifications on sales points etc. as it can implanted inside thin things such as paper [9, 10].

iv. **Low Frequency** works on 125 kHz, it has approximately half a meter reading range and mostly used for short reading range applications such as shops, manufacturing factories, inventory control through in and out counts, access control through showing a card to the reader. These low frequency tags are mostly not affected when applied on wet and near metal surfaces [9, 11].

**1.3.2 RFID Readers** are composed of an antenna and an electronic module. The antenna is used for communicating with RFID tags wirelessly. The electronic module is most often networked to the host computer through cables and relay message between the host computer and all the tags within the antenna's range. The electronic module also perform a number of security functions such as encryption/decryption and user authentication, and another critical function called anti-collision, which enables a reader to communicate with multiple tags simultaneously [6].

The reader is also called the coupler. The coupler can send information in two directions: it can read information from a tag and send it to the PC (read mode), or it can read information from the PC and to an RFID tag (write mode) [12].

**1.3.3 Host Computer** or PC provides an interface between the RFID hardware and application based system, which is the "brain" of any RFID system. They are used to network multiple RFID interrogators together and to centrally process information. The controller in any network is most often a PC or a workstation running database or application software, or a network of these machines [13].

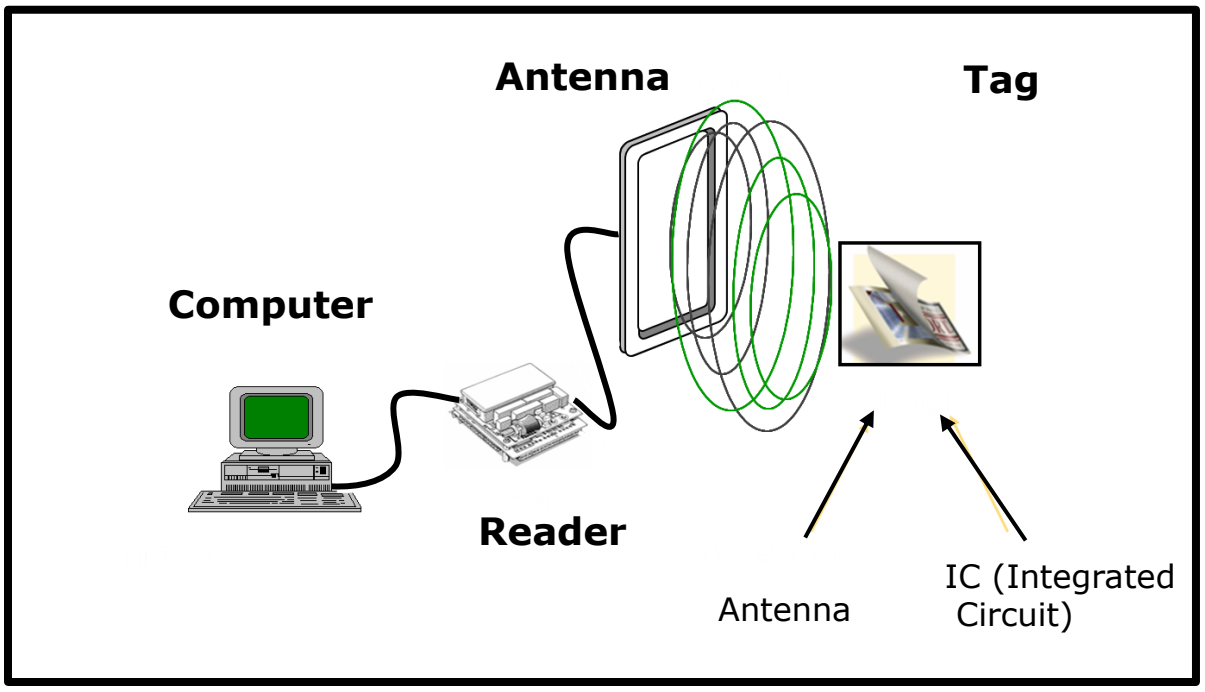


Fig 1.1 Components of RFID system

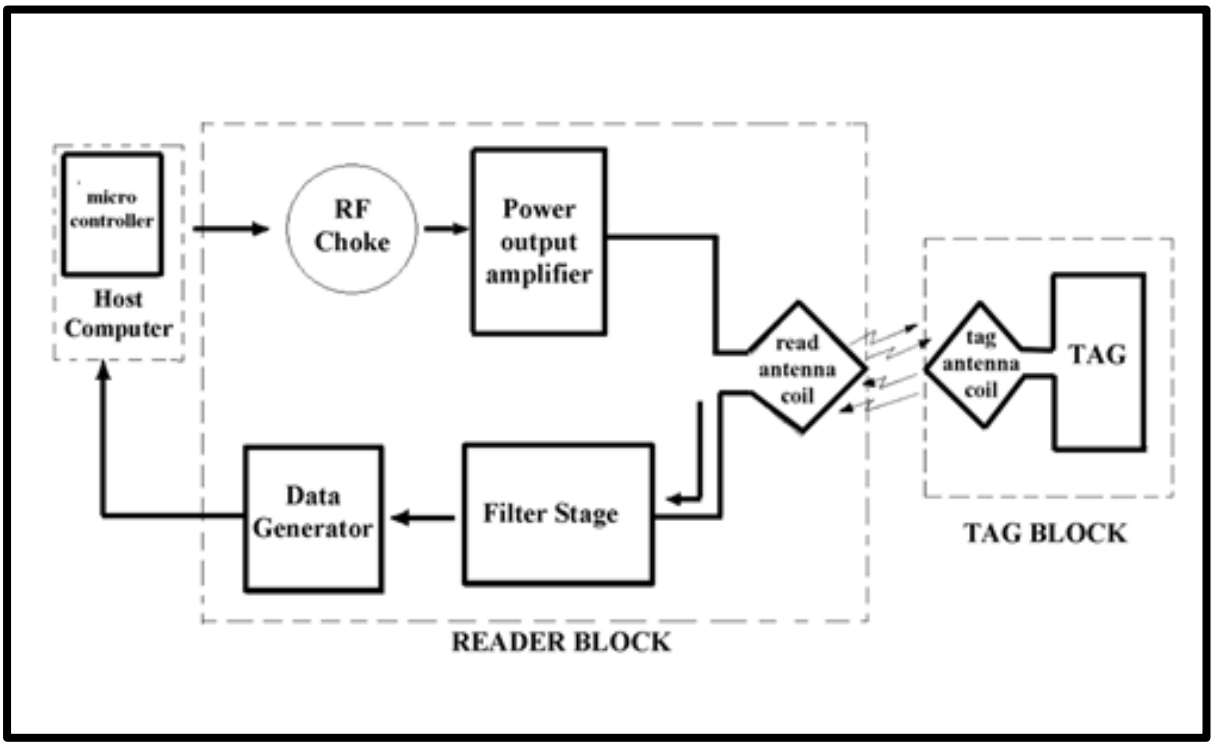


Fig 1.2 Basic architecture of a RFID system

# Chapter 2

# Student Database Management

## 2.1 Design

The student database management system using RFID is an automated version of manual student Management System. It provides all details about students and faculties that include institute details, their personnel details, and academic details subject details etc...

The manual system involved a lot of time, manpower etc. Our system has got almost all works computerized so that accuracy is maintained and maintaining backup is very easy. It can do within a few minutes.

This project uses a RFID reader which includes a contactless RFID tag. The reader can be connected to a PC through RS232 to USB converter. We propose a connection techniques and its implementation. The connection technique is very simple, where a reader will be connected to PC via RS232 cable. In our implementation, we considered the communication protocol between the reader and PC. We provided a front-end GUI using C# language with the supporting of MS Access database as the back-end.

## 2.2 RFID Reader Specification and Features

**Specification:**

- Reading range: Up to 10 centimetres
- Frequency : 125 KHz
- Interface : RS-232, Baud rate selectable (9600)
- None parity, 8 Data bits, 1 Stop bit
- Dimension : W134.2 x H38.4 x D65.4 mm
- Operating Temperature: 0 to 55 Deg. C
- Storage Temperature: -25 to 65 Deg. C
- Humidity : 5 ~ 95% RH

**Features:**

- Power supply 12VDC/AC.
- Read RFID transponder contactless.
- Verify the code number of RFID transponder.
- RS-232 Interface.

## 2.3 Connection Setup

Plugging with DB 9 points to PC serial port, plugging USB to PC Port and Crystal plug to reader or it can also be done by connecting DB9P male to DB9P female, plugging the USB to serial port and Crystal plug to reader.

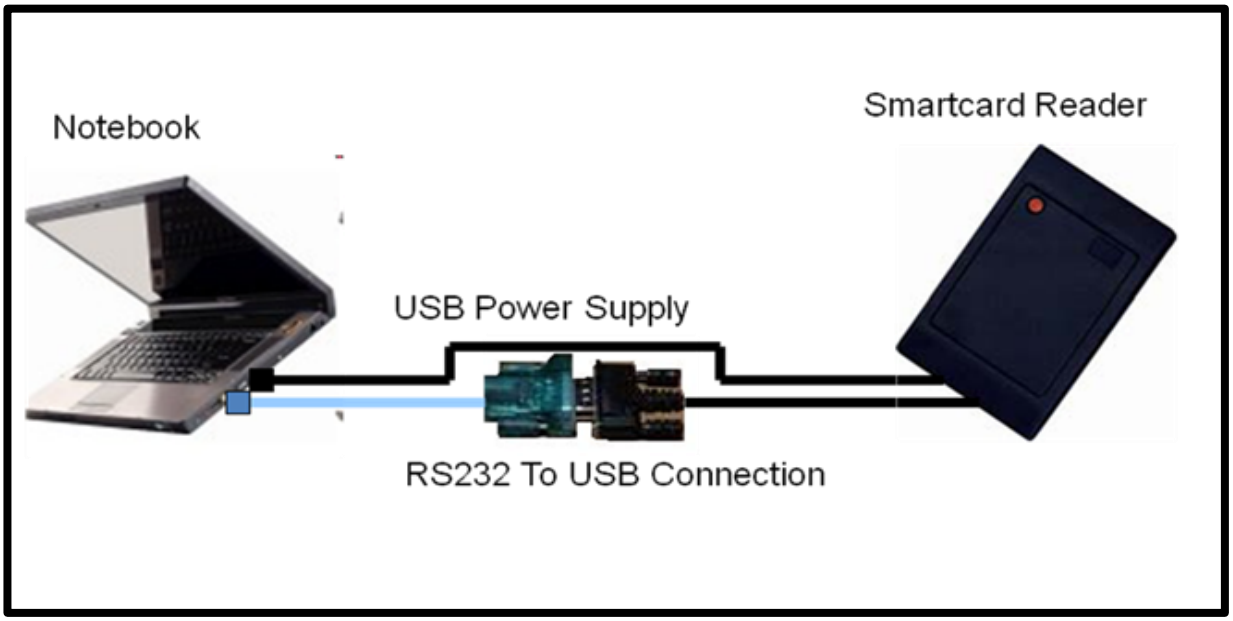


Fig 2.1 RFID Reader to Notebook connection through DB9 & USB connection

## 2.4 Software Implementation

We implemented the communication protocol using C# programming language with MS Access database. We provided a front-end GUI for user verification, enrolment, view/delete user list etc. and for back-end we used MS Access database, where we created a table in order to store user information. The following is the flowchart for our implementation.

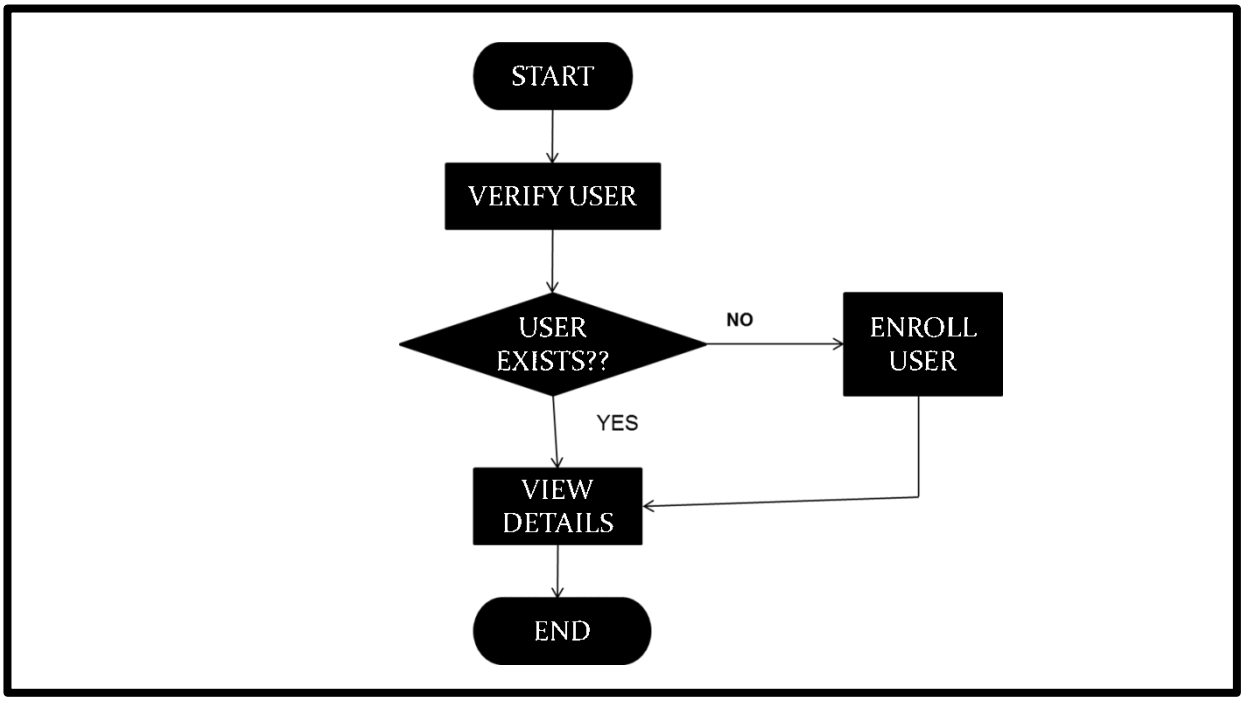


Fig 2.2 Flowchart

## 2.5 Authentication Technique

a) Reading the card ID number through USB port of PC.

b) Extracting the card ID number from the stream of data by discarding the start and stop bits.

c) Storing the extract number on MS Access database during user enrolment.

During Verification of user if the enrolled user tapped the card again, that will be authenticated and the message will be displayed on the system.

### 2.5.1 Reading card ID NUMBER

- The card number from the reader is obtained by programming the serial port according to the communication protocol.

- Communication protocols used:

Table 2.1 Communication Protocols

| Port Name | COM# |
|---|---|
| Baud Rate[1] | 9600 |
| Data Bits | 8 |
| Parity[2] | None |
| Stop Bit[3] | 1 |
| Flow Control | Hardware |

# Com Port number may vary depending upon the system and port used (COM3/4/5….)

[1]Baud rate – The baud rate is the number of times per second a serial communication signal changes states; a state being either a voltage level, or a frequency, or a frequency phase angle. If the signal changes once for each data bit, then one bps (bit-per-second) is equal to one baud. For example, a 300 baud modem changes its states 300 times a second [13, 14].

[2]Parity Bits – The parity bit, unlike the start and stop bits, is an optional parameter, used in serial communications to determine if the data character being transmitted is correctly received by the remote device [13,14].

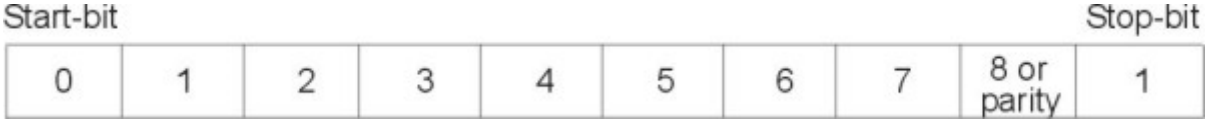


Fig 2.3 Parity

The parity bit can have one of the following five specifications :

- None - Specifies that the local system must not create a parity bit for data characters being transmitted. It also indicates that the local system does not check for a parity bit in data received from a remote host [14, 15].
- Even - Specifies that the total number of binary 1s, in a single character, adds up to an even number. If they do not, the parity bit must be a 1 to ensure that the total number of binary 1s is even. For example, if the letter a (binary 1100001) is transmitted under even parity, the sending system adds the number of binary 1s, which in this case is three, and makes the parity bit a 1 to maintain an even number of binary 1s. If the letter A (binary 1000001) is transmitted under the same circumstances, the parity bit would be a 0, thus keeping the total number of binary 1s an even number [14, 15].
- Odd - Operates under the same guidelines as even parity except that the total number of binary 1s must be an odd number [14, 15].
- Space - Specifies that the parity bit will always be a binary zero. Another term used for space parity is bit filling, which is derived from its use as filler for seven-bit data being transmitted to a device which can only accept eight bit data. Such devices see the space parity bit as an additional data bit for the transmitted character [14, 15].
- Mark - Operates under the same guidelines as space parity except that the parity bit is always a binary 1. The mark parity bit acts only as filler [14, 15].

[3]Stop Bit and start bit- The start and stop bits are used in asynchronous communication as a means of timing or synchronizing the data characters being transmitted. Without the use of these bits, the sending and receiving systems will not know where one character ends and another begins [14, 15].

### 2.5.2 Extraction of the exact card ID number

To obtain the exact card number the start and stop bits should be discarded using proper methods. We have used the following cardRead() method which returns the 8 digit card number.

```
private string cardRead()
      {
           string readcard2 = "";

               if (!myserialPort.IsOpen)
                   myserialPort.Open();

               string readcard1 = myserialPort.ReadExisting();

               int len = readcard1.Length;
               if (len >= 10)
               {

                   for (int i = len - 10; i < len - 2; i++)
                   {
                       readcard2 += readcard1[i];
                   }
               }

               return readcard2;
       }
```

### 2.5.3 Linking with the database

- The database design includes creating an MS Access database and tucking into Visual Studio 2008. The database having a table “Student” is created.

- The following table shows the data definition “Student”

Table 2.2 Student Database design

| Column Name | Information |
|---|---|
| Card Number | Tag number-number |
| Student Name | Name of the student-text |
| Roll Number | Roll no. of student-text |
| Department | Name of the dept.-text |
| Semester | Current semester of the student-number |
| Year of Joining | Text |
| Father’s/Guardian’s Name | Text |
| Present Address | Text |
| Permanent Address | Text |
| Blood Group | Text |
| Phone Number | Number |
| Email Id | text |

- Connection with the database is done by the Add Data Source Wizard in Visual Studio C#.

The database is then dragged onto the form to use it accordingly.

### 2.5.4 Storing in user database

- Verification of user is done by comparing the RFID card number with the Student ID of existing users. The algorithm used for verification and subsequent procedures:

If cardnumber != null

Select data from table having StudentID = cardno

Details textbox=details from student table;

If student exists with particular cardno

Show a message box displaying welcome message

Cardno.visible = false;

Details textbox.visible = true;

Else

Message = not registered;

Enroll button.visible = true;

If Enroll button.pressed = true

Redirect to registration page

Filling the form

Submit button.pressed = data entry to database with ID from Cardno textbox;

Else

Message=Tap card properly;

# Chapter 3

# Result & Discussion

## RESULT & DISCUSSION

This is the homepage of our student database management system.


Fig 3.1 Homepage

Here we apply serial port settings according to system's port and RFID configuration.

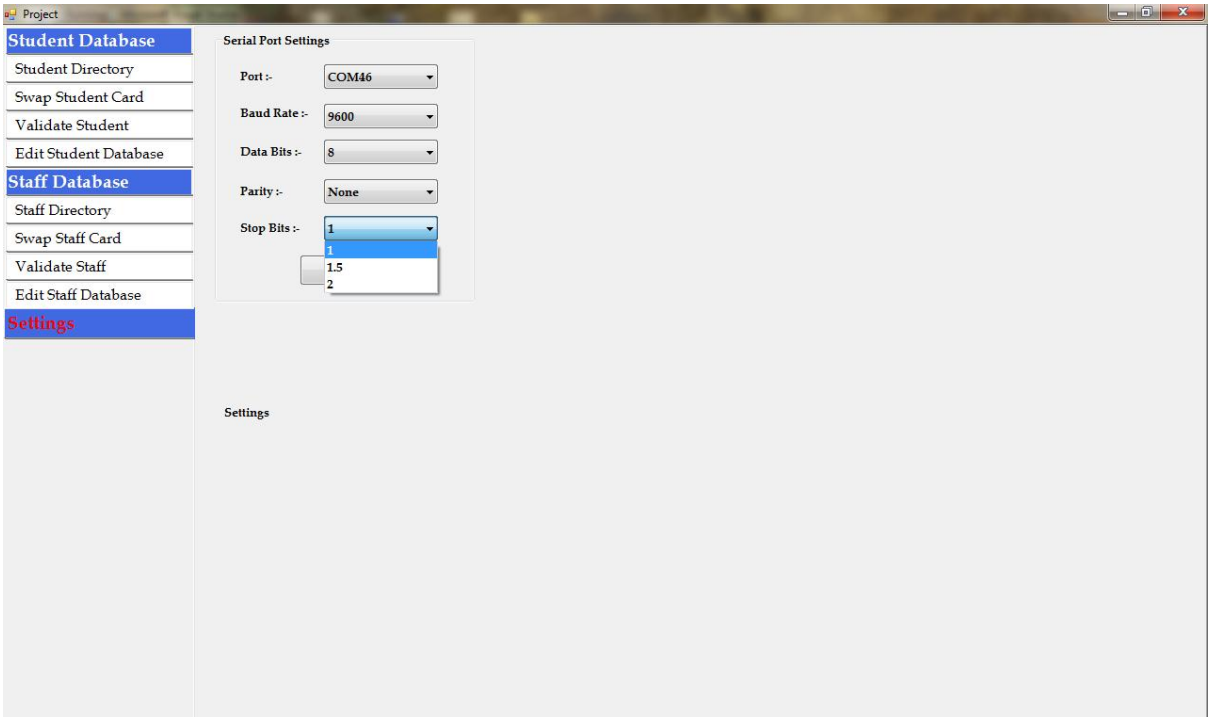


Fig 3.2 Port Setting

Here we can access the details of each and every student from all batches

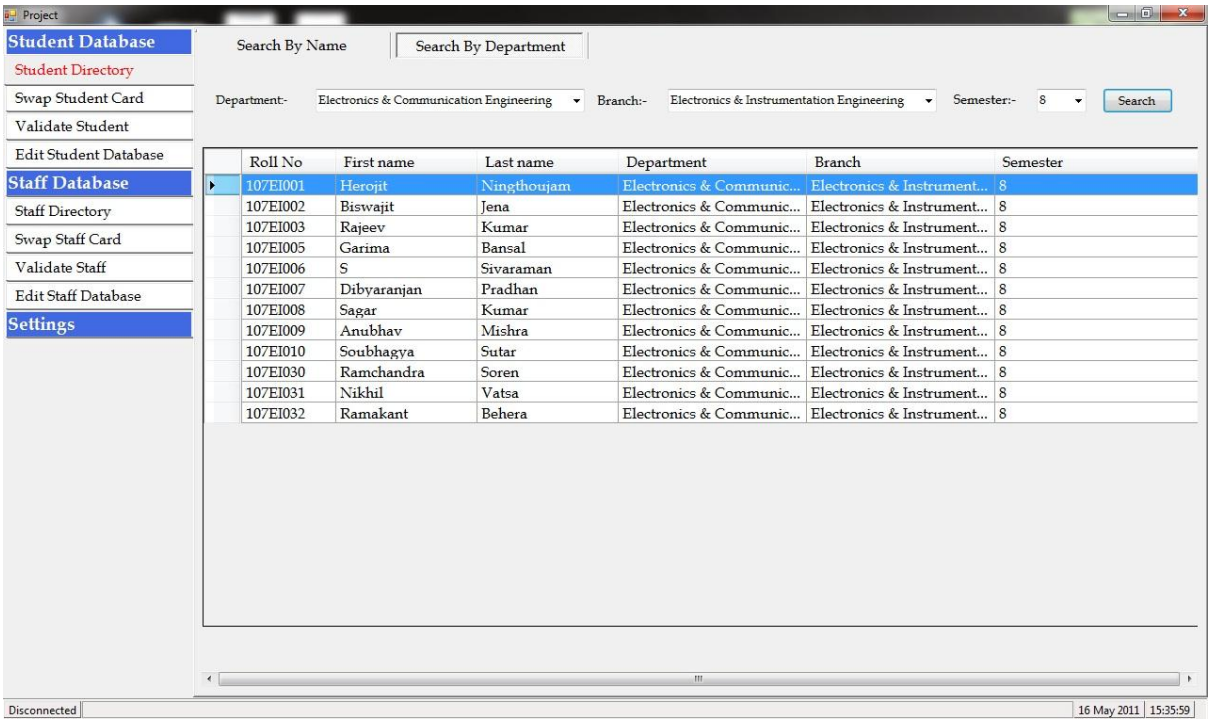


Fig 3.3 Student Directory (Search by Department)

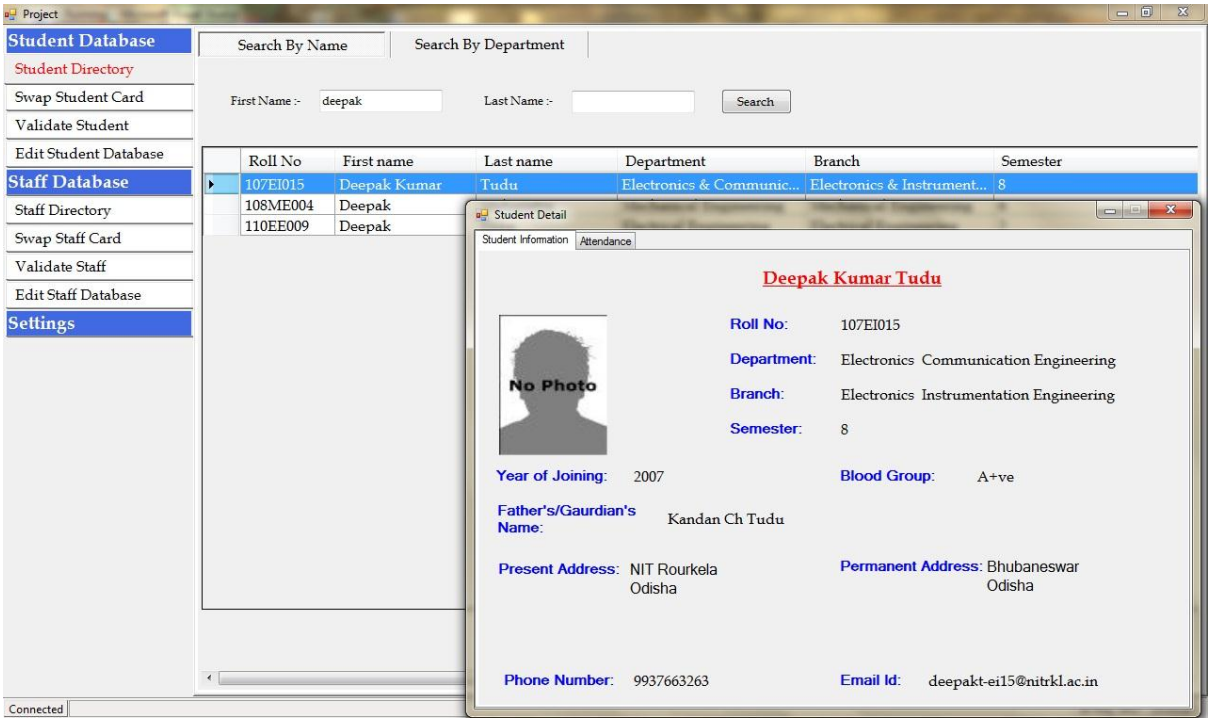


Fig 3.4 Student Directory (Search by Name)

Once the user taps the RFID tag, it shows all the required details about that particular student, if information is stored against that tag.

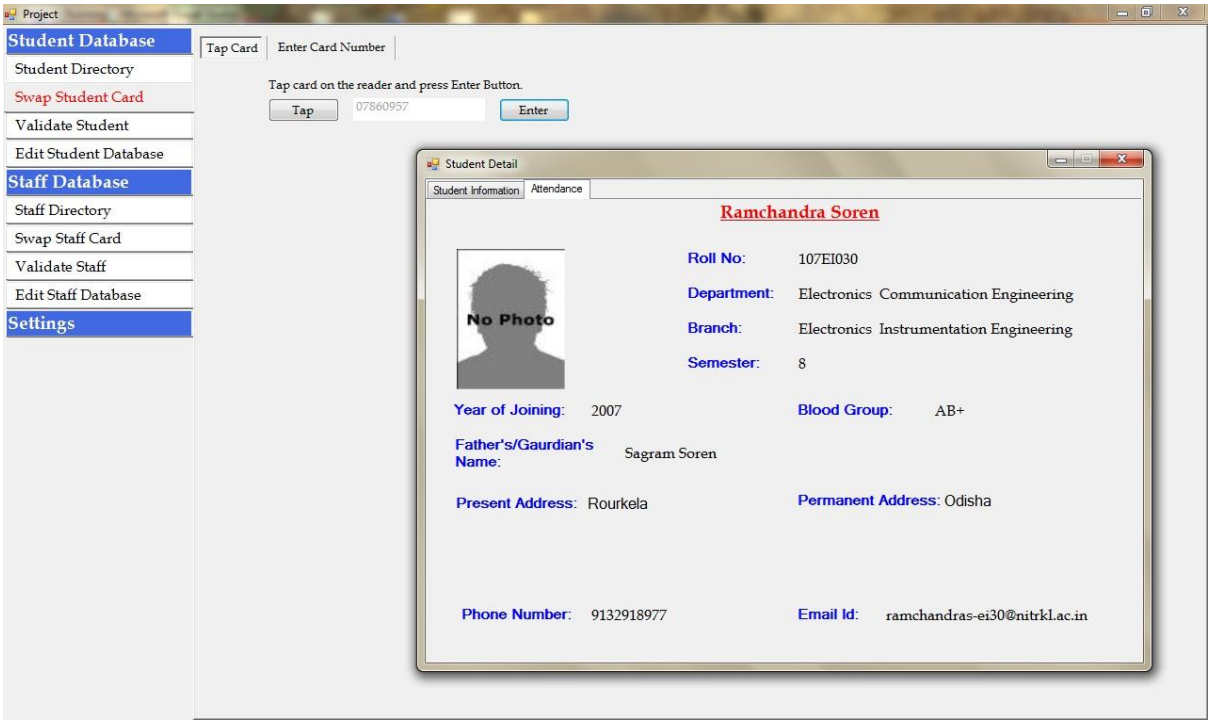


Fig 3.5 Student Info

We can also know the attendance of a student from the previous window.

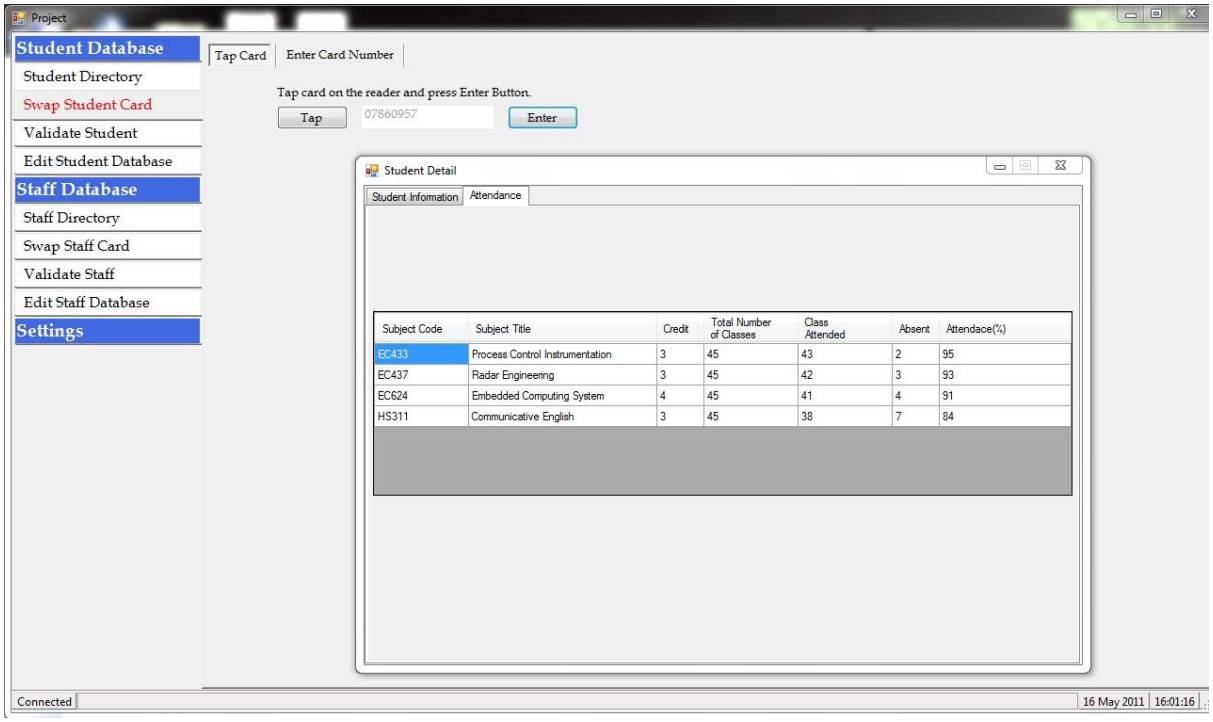


Fig 3.6 Student Attendance

If no information is added to the database for a particular tag, we can add it

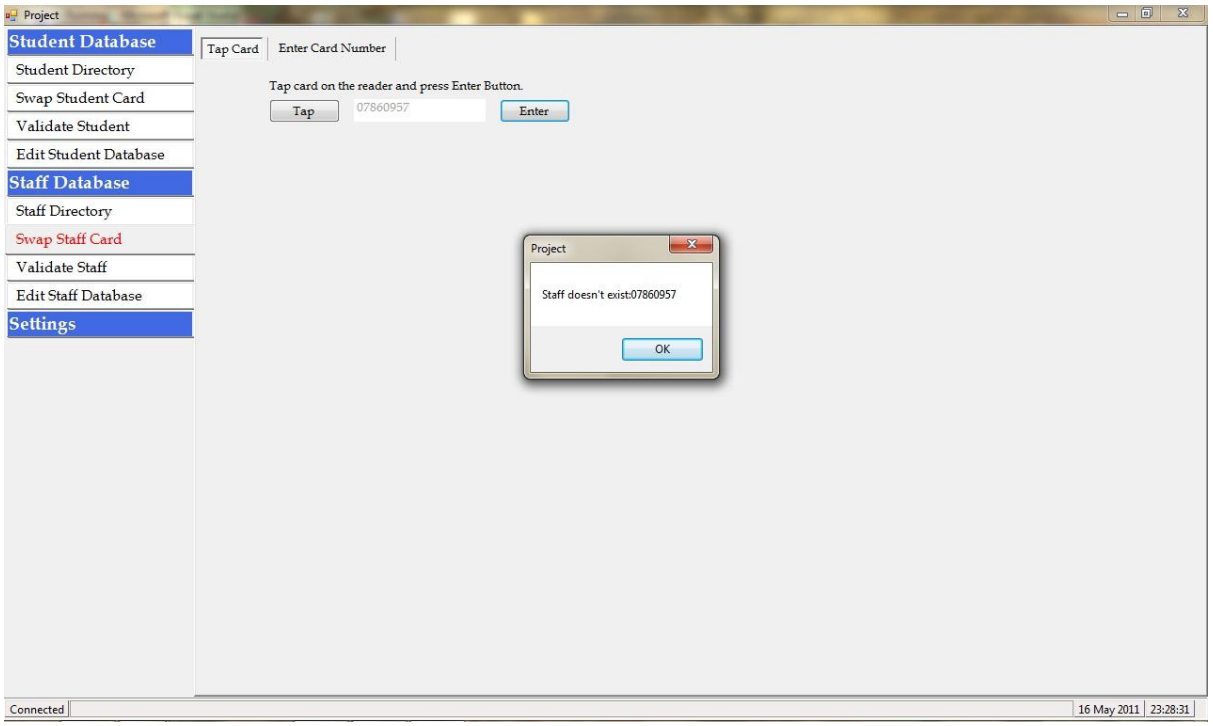


Fig 3.7 Staff Card tap

Here we can store information about faculties against a particular tag.

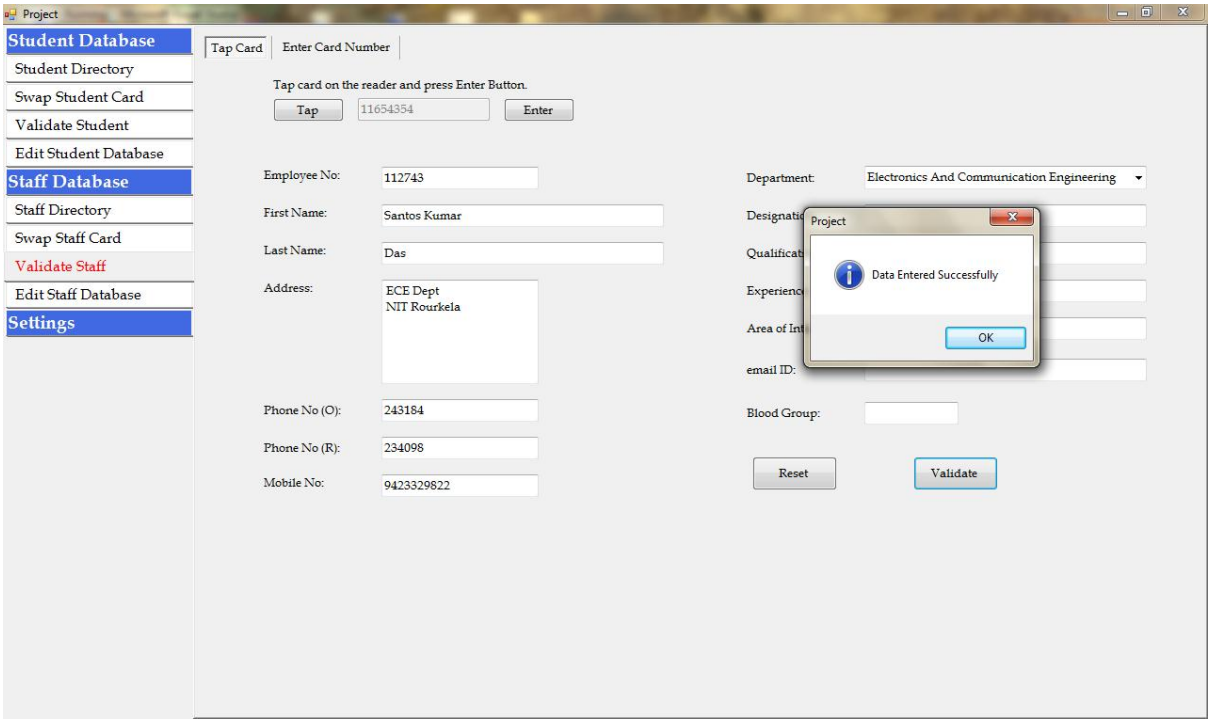


Fig 3.8 Staff Validation

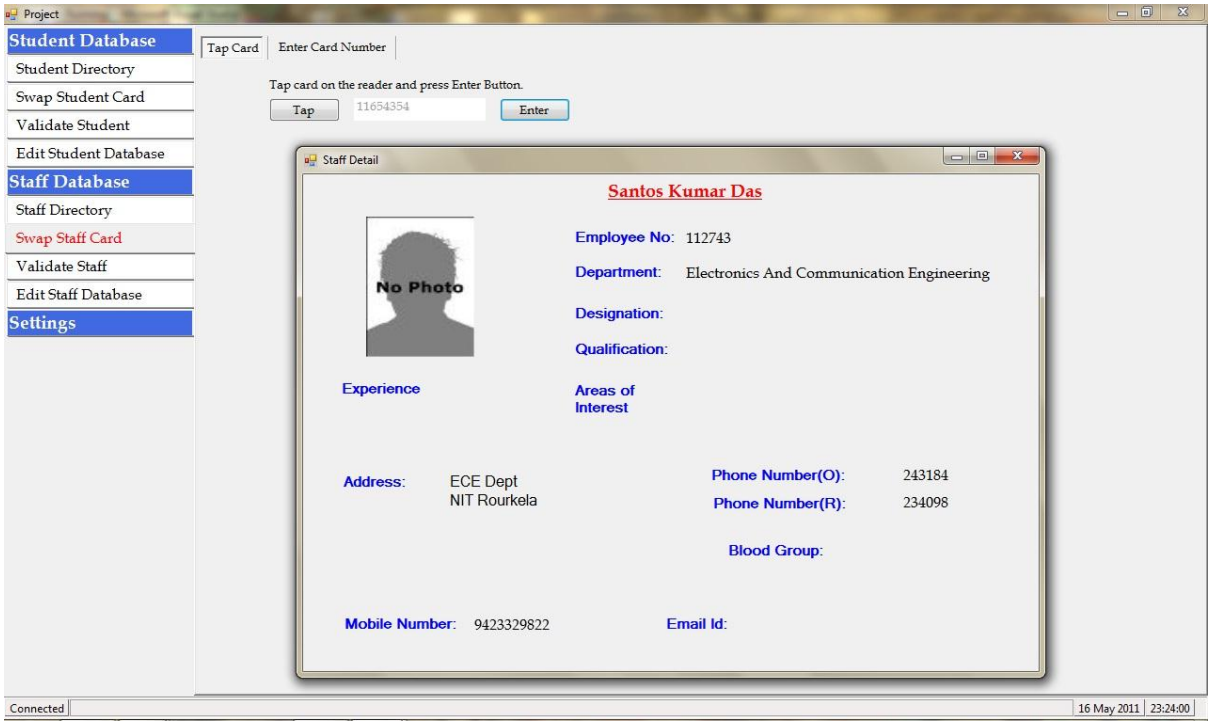


Fig 3.9 Staff Info

Here we can edit details in staff directory

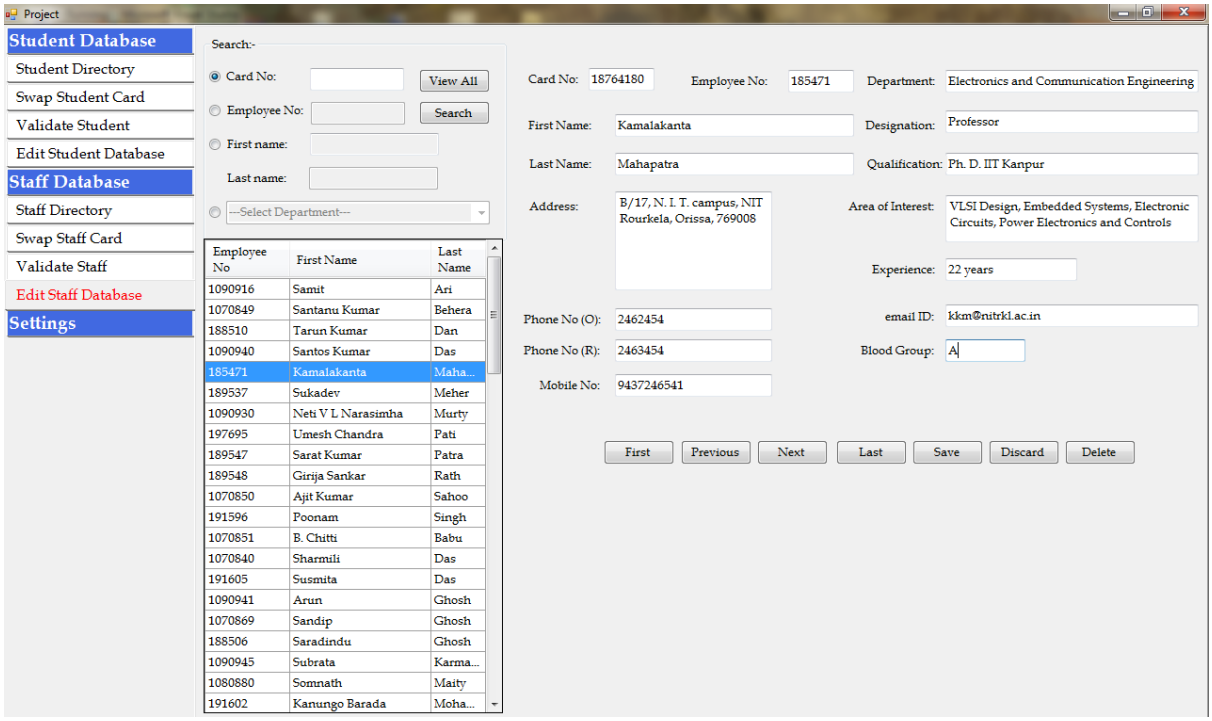


Fig 3.10 Staff Edit

**Discussion**

Apart from maintaining database, this application we developed, can be implemented in college/institute mainly for tracking attendance where each and every student would have a RFID tag attached to their Identity cards. The Reader can be planted in classrooms. This would certainly reduce time and labour which was involved in the manual process.

RFID may not be a new concept today but it certainly makes our work easier when it comes to management. Today we see RFID has almost taken over the barcode system and has its application in many fields like inventory control, retailing, payment system, security system etc. Many of the consumer applications and benefits of RFID are still several years away which would certainly find new and innovative ways.

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