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IoT based Student Attendance Management System using RFID and Face Recognition

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Abstract: *Attendance is for keeping records of number of students present in schools, colleges or in any organization. It is very important constituent in maintaining discipline among students in acollege and imparting quality education in schools, colleges. Complexity of this process increases even more with increase innumber of students. Biometric student attendance system increases the efficiency of the process of taking student attendance.Automatic wireless identification has been facilitated by IoT technology using electronic passive and active tags with suitable readers. In this paper the concept of a simple and portable approach of IoT is applied to student attendance that records the attendance using RFID and Face Recognition. This system aims to automate the awkward process of manually taking and storing student attendance records. It will increase the reliability of attendance records by preventing proxy attendance. As per the requirement by the teacher, the securely stored attendance records can be reliably retrieved. This concept is capable of eliminating time consumption during manual collection of attendance and an opportunity for the educational administrators to capture face-to-face classroom data for allocation of proper attendance scores and for further managerial decisions.*

Keywords: Biometric, RFID, Face Recognition, IoT, Attendance

I. INTRODUCTION

Classroom attendance system basically involves students submitting their attendance either orally or in the form of signature on paper. In these manual systems, redundancy of work happens.Maintenance of the bulk of paper work is difficult. As the no. of students in a class increases, this work increases. Hence, to maintain and monitor the students attendance lot of work force is required. Apart from this, proxy attendance in the attendance sheet may also happen. The soft-copy of attendance is required, for which we have to feed attendance into Excel or other similar software packages for monitoring, calculations and reports. This process is extremely time consuming and very much error prone to human.

II. CONCEPT OF INTERNET OF THINGS

2.1 What is IoT?

The Internet of Things (IoT) is a concept that describes a totally interconnected world. IoT is the integration of the different electronic sensors, pe-ripherals, etc. providing data or information of any sort into a physical network (Internet or local network) [1]. These different sensors could be RFID, providing digital output. It's a world where devices of every shape and size are manufactured with "smart" capabilities that allow them to communicate and interact with other devices, exchange data, make autonomous decisions and perform useful tasks based on preset conditions.

The IoT allows objects to be sensed or controlled remotely creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.The data collected from all the different devices, are stored in a centralized database. The relationship can be found in this database. If the data if there on the internet, the data analysis becomes easy and at the same time we can reflect a single change in multiple places. Since the data is available in database, it can be easily used by other sub-systems.

2.2 What Is RFID?

RFID is short for Radio Frequency Identification. Generally a RFID system consists of 2 parts: A Reader,and one or

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more Transponders, also known as Tags. RFID systems evolved from barcode labels as a means to automatically identify and track products and people.

2.3 Components of RFID

A typical RFID system is made up of three components: Tags (RFID ID Cards), Readers and the host computer.
Tag (RFID ID Cards): An RFID tag is comprised of a microchip containing identifying information and an antenna that transmits this data wirelessly to a reader.
Tags come in a variety of types, with a variety of capabilities. There are three options in terms of how data can be encoded on tags: (1) Read-only tags contain data such as a serialized tracking number, 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. Again, this may include a serial number, but perhaps other data such as a lot or batch number. (3) Full "read-write" tags allow new data to be written to the tag as needed—and even written over the original data. Examples for the latter capability might include the time and date of ownership transfer or updating the repair history of a fixed asset. While these are the most costly of the three tag types and are not practical for tracking inexpensive items, future standards for electronic product codes (EPC) appear to be headed in this direction.
RFID tags are further broken down into two categories:
- Active RFID Tags are battery powered. They broadcasta signal to the reader and can transmit over the greatest distances (100+ meters).
- Passive RFID Tags do not contain a battery. Instead, they draw their power from the radio wave transmitted by the reader. The reader transmits a low power radio signal through its antenna to the tag, which in turn receives it through its own antenna to power the integrated circuit (chip). Figure 1 shows various types of RFID tags.

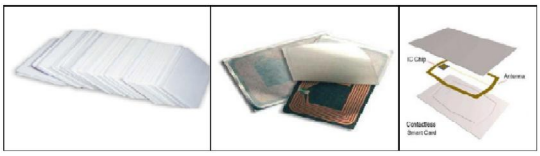

Figure 1: RFID Tags

Reader: An RFID reader is a device that is used to read RFID tag data. The reader has an antenna that emits radio waves; the tag responds by sending back data stored in it to Reader. RFID reader is displayed in figure 2.

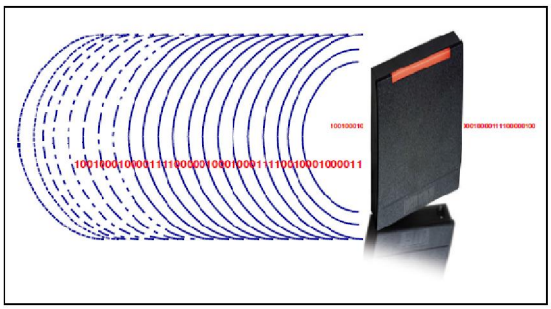

Figure 2: RFID Reader

Host Computer: It reads/writes data from / to the tags through the reader. It stores evaluates obtained data and links the transceiver to applications.

2.4 How RFID Works?

Figure 3 shows a typical RFID system. In every RFID system the transponder Tags contain information. This information can be as little as a single binary bit, or be a large array of bits representing such things as an identity code, personal medical information, or literally any type of information that can be stored in digital binary format.

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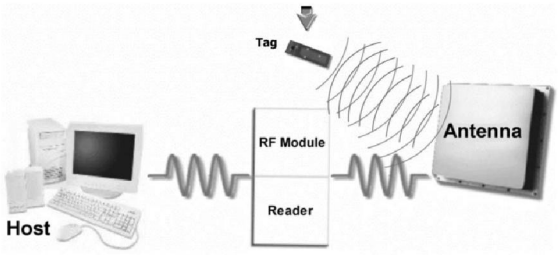

Figure 3: RFID Working Flow

2.5 Reason behind Selection of RFID in this Research

Companies can cut costs, improve customer service, reduce labor, increase accuracy, and improve production throughput by using RFID-enabled systems. Other benefits of RFID technology are as listed below.

- No line-of-sight contact necessary
  - The major advantage of all kinds of RFID system is that they work contactlessly and require no line of sight.
- Robust system
  - Transponders can be read through a whole number of substances, e.g. snow, fog, ice, paint, dirt, and in difficult constructional scenarios where barcodes or other optical reading technologies would be no use at all.
- Speed of an RFID system
  - RFID transponders can be read at remarkable speed even in difficult conditions, and in most cases respond in less than 100 milliseconds.
- Bidirectional communication
  - The reading/writing capability of an active RFID system is also a significant advantage in interactive applications, e.g. when tracking products in process or maintenance jobs.
- Reliability in tough environments
  - In difficult external conditions RFID has the advantage of being able to communicate contactlessly and without direct line-of-sight contact with the data medium. Where the transponder is doesn't matter either -- it can be read through substances like dust, paint or ice.
- Bulk detection
  - Active and passive systems working at HF and UHF frequencies detect a number of transponders in the field. This property is called bulk capability. In practical terms it means that every data medium needn't be scanned singly, but is automatically detected during a read operation

2.6 Face Recognition

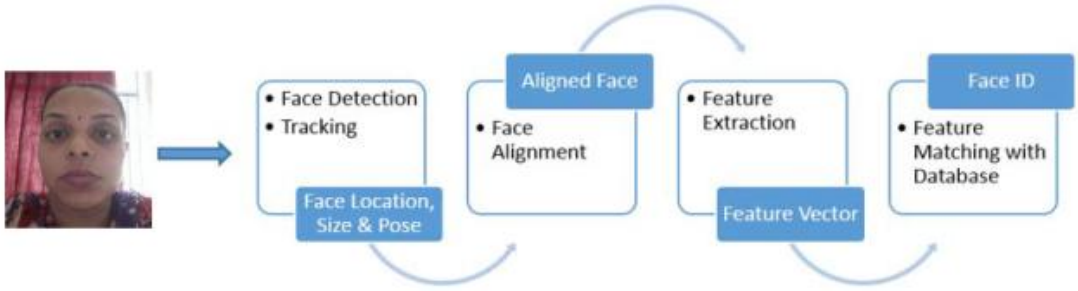

Figure 4: Face Recognition Process

The facial recognition process is similar to the general biometric recognition process, in the face-base biometric systems detection; alignment, feature extraction, and matching take place. The facial recognition process can be divided into two main stages: processing before detection where face detection and alignment take place (localization and

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normalization), and afterwards recognition occur through feature extraction and matching steps. In this research Face Recognition is used as verification process once RFID card is detected. Figure 4 shows the process of face recognition

III. SYSTEM ARCHITECTURE AND ITSWORKING PRINCIPLES

Figure 5 shows system architecture of the research. RFID reader and camera is mounted on the class door and these two devices are connected to computer system. Attendance system is installed on computer system and database is also maintained on this computer system. When user enters into the class, RFID reader reads data from the student ID card and passes data to computerized system. Then after digital camera is taking picture of student and verifying face of the student to already stored images.

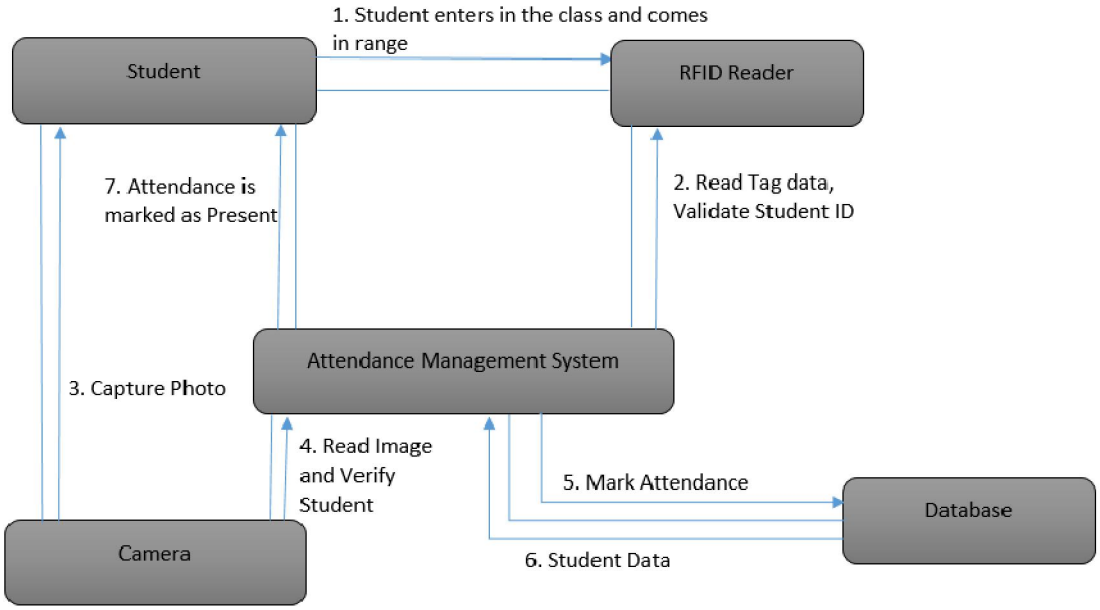

Figure 5: System Architecture

IV. IMPLEMENTATION

As an implementation of IoT based Student attendance System, few modules are generated. Which are listed below.

- Login Module
- System Setting module
- Faculty Registration Module
- Student Registration Module
- Student Images Registration Module
- Lecture Detail Module
- Start Lecture Module

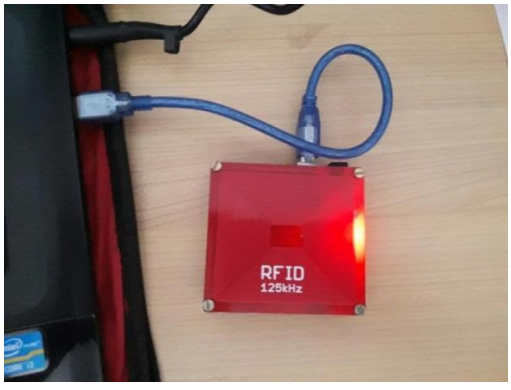

Figure 6: RFID connection with system

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Along with the above modules, various kind of reports are generated by the system which will be used by for management purpose. Figure 6 shows how RFID reader is connected to computer.

Basically two types of users are there in this system and they are Admin and Faculty. RFID and camera must be attached to the system before using it. To identify and to log in to the system one has to provide his/her user name and password. If any of them is not correct then the respective message is been shown to the user. The following module will take this information and tell the system which type of user is logged in and who is the user.Login module of the attendance management system is displayed in figure 7.

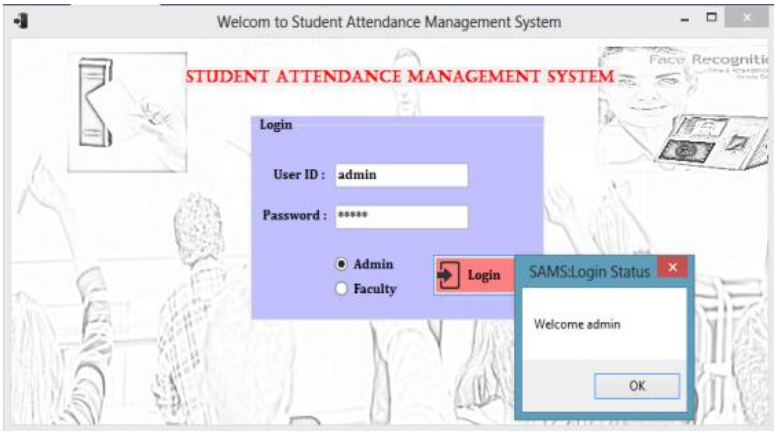

Figure 7: Login Module

On successful log in by the admin, Student Registration Screen shown in figure 8 will appear after configuration, in which admin is supposed to set all configuration regarding RFID and camera. Once configuration is done, then admin can enroll new students and faculty members as well as he/she can update or delete existing. Student ID card is having RFID facility. One RFID card can be allocated to only one student.The same card will be further used at the time of attendance in the class. Using the same module, RFID card can be assigned to each student.

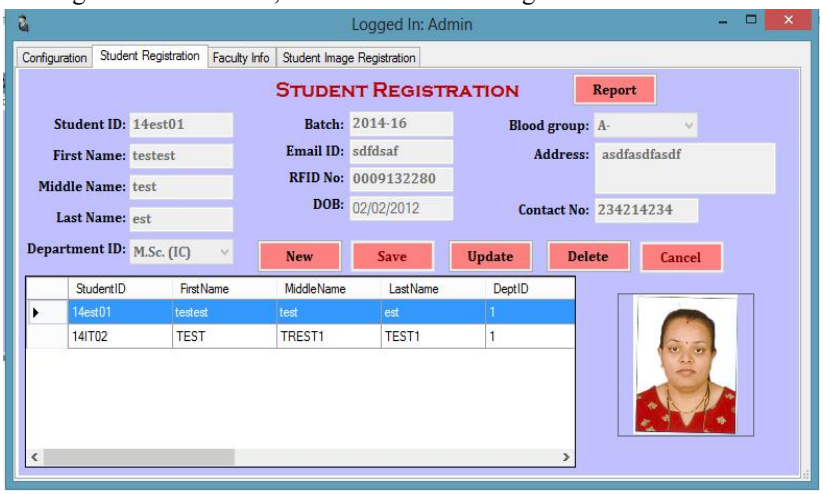

Figure 8: Student Registration

Based on student registration, Student ID card report is also generated using Report button in the above module.This will be used to stick on RFID card. Student ID card report is shown in figure 9.

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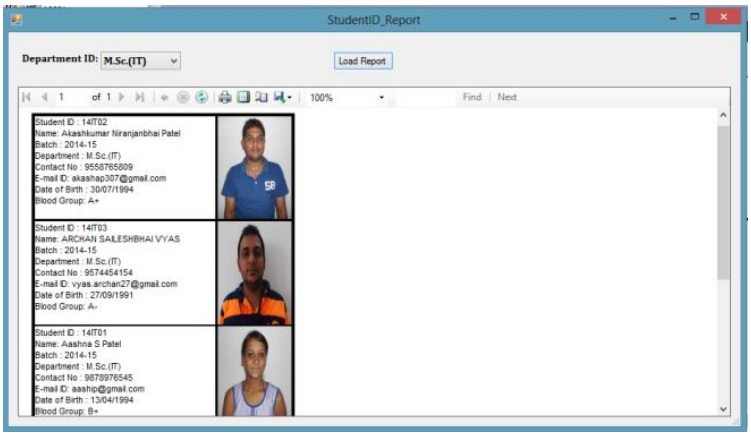

Figure 9: Student ID Report

Once the student registration is made successful, now images of students have to be stored for face recognition purpose. Face recognition technique will be used for verification purpose.Student Image registration module shown in figure 10 will be used to store images of students at different angels. Image of the students are stored in a specific path along with a particular file name and then the path is stored in the database.

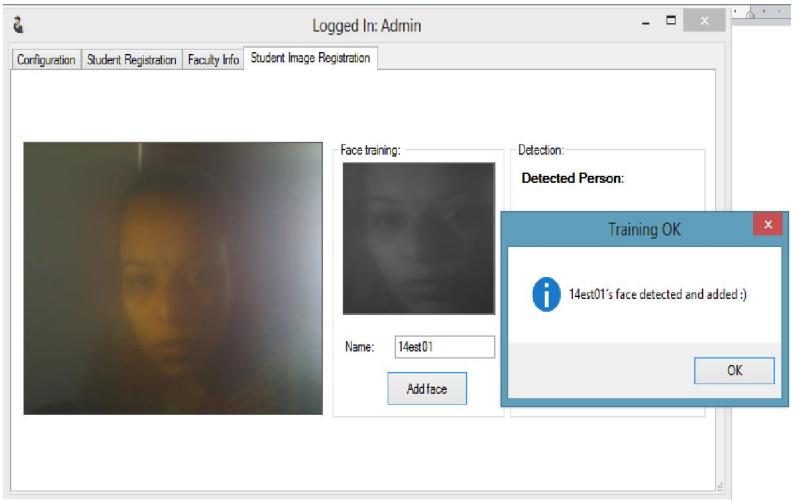

Figure 10: Student Image Registration

Faculty can use this system to take the attendance. First of all faculty has to make entry for every lectures in various classes. Figure 11 shows Faculty lecture details module.

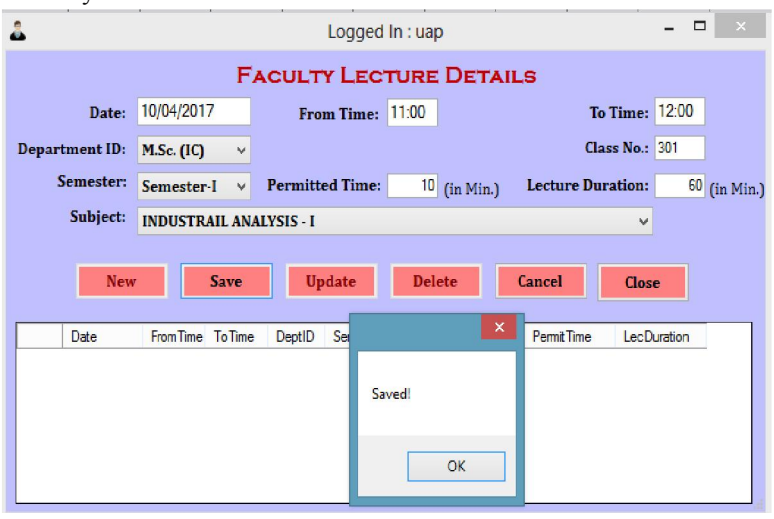

Figure 11: Lecture Details

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In this module, lecture start time, end time and permit time is there. In few colleges, faculty will allow 5 to 10 min. late students to attend class. For the same in this application provision is made using permit time. RFID card is mounted on the door of the classroom along with the camera. When student passes from the door, RFID reader will detect the card and it will fetch respective student ID from the database. On successful detection of RFID card and if student is moving from outside to inside class then student photo will be taken by the camera and it will be matched against already stored photos. But over here camera captured photo will be matched against images of only that student and not with all the students. By this way optimization is done in this system.RFID card will be detected every time when students passes through the door of the classroom. But camera is only taking photo of the student at the time when student is entering into the class. This all the things will be done by start lecture module shown in figure 12.

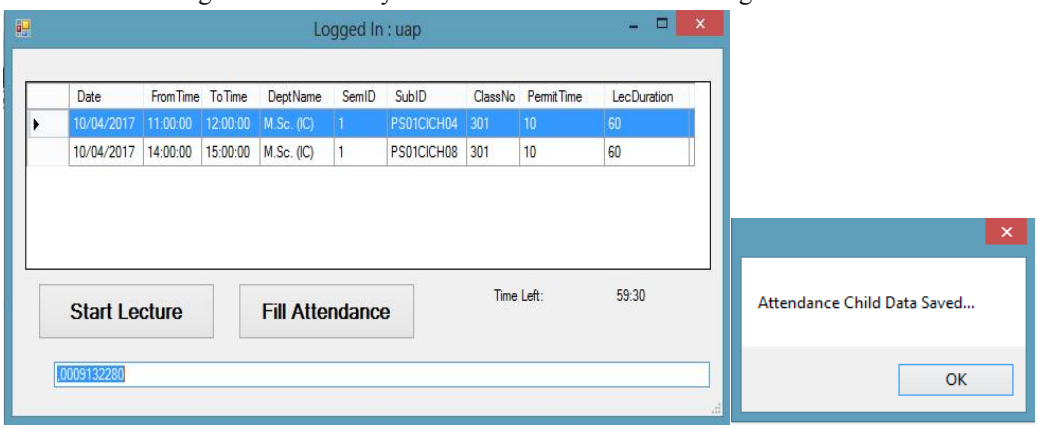

Figure 12: Start Lecture

Based on the entries of above module, attendance of the student is decided. Test cases for attendance will be given below. Based on it student attendance is marked in the database. E.g. Lecture time is 10:00 am to 11:00 am and faculty has given 10 min. as permit entry time in the lecture then student attendance will be decided based on logic shown in figure 13.

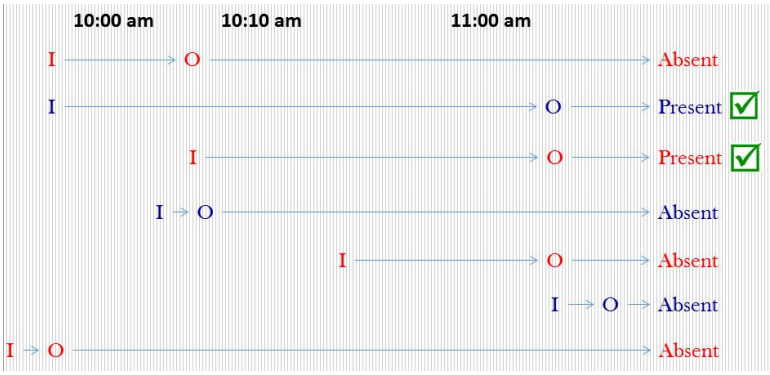

Figure 13: Attendance Test Cases

Based on the attendance stored in the database, reports can be generated.

V. CONCLUSION

To maintain the attendance systemwe use IoT.The main aim of this system is to retrieve the complexity in manual attendance system, when no. of students in the class is increased. Here we are using RFID and Face Recognition is used for verification purpose.We can avoid cheating and maintain discipline in all environments.

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