On Campus Student's Presence and Movement Indicators using RFID, GSM and Face Recognition

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Abstract—**The effective monitoring of student on an institutional campus is an essential activity. The proposed system uses RFID, GSM along with Face Recognition for monitoring and notifying the presence of students at the institution. For this, the students ID (Identification) card is tagged with an RFID passive tag and their facial features are registered into the system. Face Recognition is used for classroom attendance and RFID is used at the main entrance, laboratories, library, auditoriums etc. The presence of students at varius locations within the institution are identified using these technologies and this information is stored in a centralized server which can be accessed using a website. GSM modem is used for sending notification to the parents or guardians about the student's arrival and departure from the institution. The location of a student in the campus and the attendance percentage can be known through the website or by sending an SMS (short message service) to the system. An alert SMS is sent to the student, parent, guardian and the student's mentor when the attendance percentage reaches a certain limit.**

Keywords—**RFID, Face Recognition, GSM modem, attendance, monitoring, registering, notifying**.

I. INTRODUCTION

The proposed system uses the RFID, GSM and Face Recognition technology for recording the presence of a student in an institution and notifying the same to the guardian, parent and the mentor. As the RFID technology is becoming popular it is being used for the management of students at the institution in multiple ways. With the increase in the number of mobile subscribers the GSM has become an efficient medium for communication. The face recognition technology is also becoming increasingly popular. The capability of this technology has also increased over a period of time, due to which detecting and identifying multiple faces has been made possible. With the appropriate use of these technologies students of the institution can be managed effectively.

Fig 1 shows the overall architecture of the proposed system.
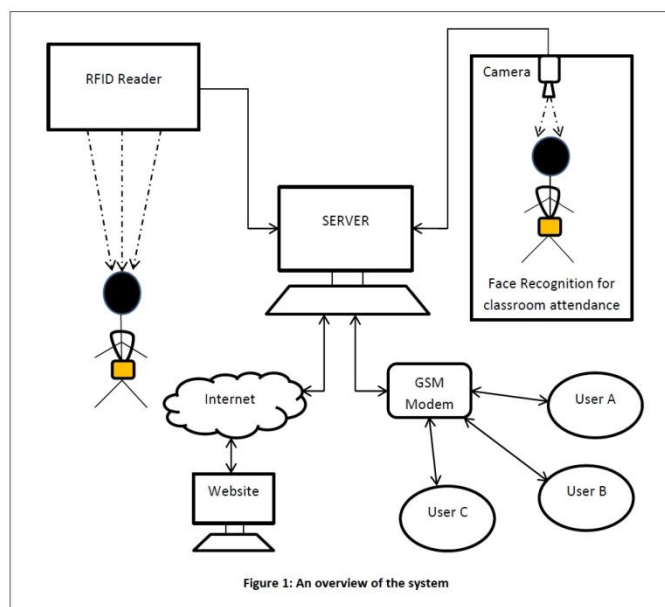

Figure 1: An overall system architecture

In Fig 1, the information collected from the RFID Reader and the Face Recognition is stored in the centralized server. The website is used to generate reports as well to identify the current location of a student by taking the roll number as an input. Notifications regarding alerts and warnings can be sent via GSM modem to different users such as the students, parents, guardians and staff. Requests can also be sent to the server via SMS by the users and a response is generated automatically based on the request.

II. BASICS OF RFID

The fundamental function of a radio frequency identification system is to use wireless communication to identify an object. RFID technology's primary advantage is that it does not require a line of site to detect an object, and hence therefore can simultaneously identify multiple objects within an area. A typical RFID system consists of a reader, tag, antenna and computer or server. The basic components of a RFID tag are a printed metal inlay, which serves as a small antenna, and a microchip, which contains the unique identification number on that tag. The communication process begins when the reader, acting as an interrogator, transmits a signal at a specific frequency through its antenna. If a tag is found within the range of this antenna, it broadcasts a signal containing a unique identification number back to the reader, notifying that the tag is within the range. Generally, a tag is attached to an object of interest and here it is the student's ID card, and a computer database is used to link the tag's identification number to the student's ID card to be tracked or located. Fig 2 and Fig 3 shows two broad categories of RFID systems- passive and Active RFID systems[1].
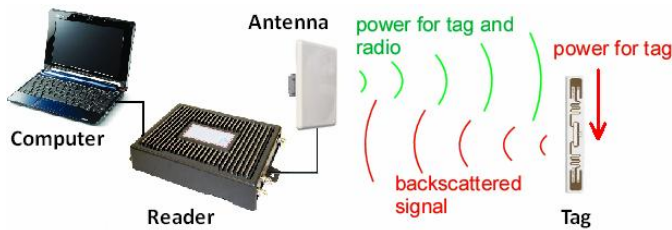

Figure 2: Passive RFID System

In a passive system, the signal transmitted from the reader powers the tag's integrated circuit (IC) and the tag reflects the signal in the form of backscatter. This reflected signal is modulated by the tag to transmit its unique identifier which is linked to the database.
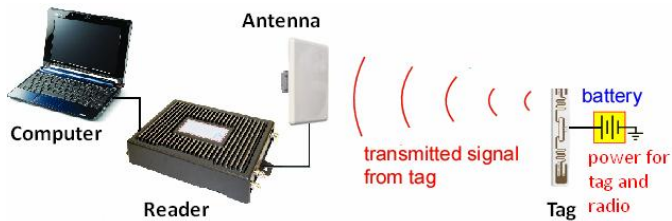

Figure 3: Active RFID system

An active RFID system is battery powered, but unlike the other systems, it transmits its signal continuously, and does not need to be activated by the signal from the reader. Thus, the reader only needs to listen to the signal from the active tags[2]. This system is more expensive than the passive system.

Radio frequencies of these systems range from very low frequency (VLF) to extremely high frequency (EHF) [5]. Table 1 shows the four basic ranges of the RFID frequencies.

Table 1: RFID Frequencies

		Range	Uses
LF	Low Freq	30 kHz to 300 kHz	125 kHz
HF	High Freq	3 MHz TO 30 MHz	13.56 MHz
VHF	Very High Freq	30 MHz to 300 MHz	Not used for RFID
UHF	Ultra High Freq	300 MHz to 3 GHz	866 MHz, 915 MHz

III. BASICS OF GSM MODEM

A GSM modem is a wireless modem devised to work with a GSM wireless network. It is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone[4]. A GSM modem can be an external device, a PC Card or a PCMIA Card. It can be connected to a computer using a serial cable or a USB cable to communicate over the mobile network. These GSM modems are not only used more frequently to provide mobile internet connectivity but also can also be used to send and receive SMS and MMS messages. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

IV. BASICS OF BIOMETRICS

Biometrics is the automatic recognition of a person using distinctive physical characteristic or personal trait that can be used to identify an individual or verify the identity of an individual. Facial recognition is a biometric. Other examples of biometrics include: iris scan, retinal scan, voice and fingerprint recognition. Biometrics are mainly used for authentication purposes.

A. Role of Face Recognition

Capturing still images of an individual is a contact-free process, giving facial recognition an advantage over other biometrics because it can be used without the subject being aware of. This allows facial recognition to be used largely in the area of security and surveillance to monitor the presence of known criminals or terrorists.

The process of facial recognition can be broken into five general steps.

a) Obtain the image of an Individual
b) Locate the face from the image and isolate it from the rest of the image.
c) Extract the facial features such as the spatial geometry of the eyes, nose and mouth
d) Compare the template to the database with known faces
e) Compute and declare matches

Various methods have been proposed for face detection and some of them are AdaBoost algorithm [7], Support Vector Machines (SVM) [9] and Haar Cascade classifier [7]. The efficiency of the face recognition algorithm can be increased based on fast detection algorithm and high accuracy. In all the above methods, Viola and Jones[6] proves to be 15 times faster than any other technique at the time of release with 95% accuracy and 17fps. Our system utilizes this algorithm for the detection of faces in the classroom. Face recognition techniques can be broadly of three types. Holistic based approach which takes the whole face region as an input for face detection system, other is Feature based which uses geometric features like mouth, nose, eyes, eye brows and cheeks and the third one is Hybrid approach which takes both the local features and the whole face as input. Statistical methods such as Linear Discriminant Analysis (LDA), Principal Component Analysis (PCA), Neural Networks, Eigen-faces and Fisher face have been used for recognition of faces [11]. Illumination invariant [12] algorithm is utilized for removing the lighting effect inside the classroom.

Fig 4 shows a generic face recognition system for classroom attendance that consists of Image capture, Image enhancement, Face detection, Face Recognition and Attendance Management [13].
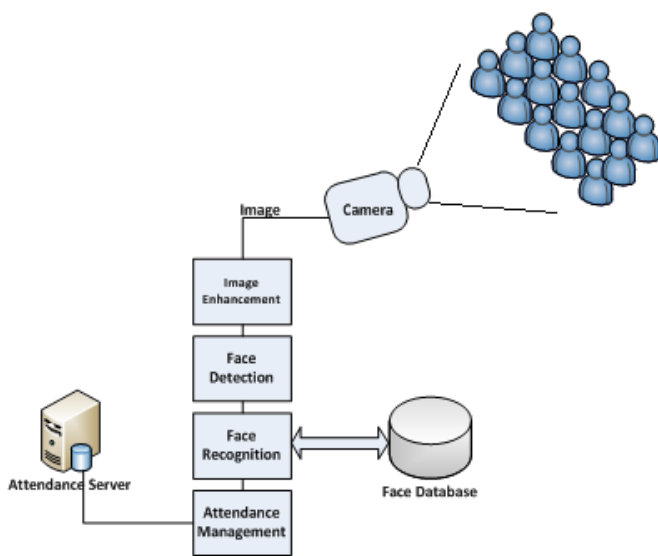

Figure 4: Classroom attendance using Face Recognition

V. RFID IN PROPOSED SYSTEM

The RFID readers are used at the main gate, student center, auditoriums, library and at various junctions within the institution where it is applicable. These readers are always kept on and they record the tags that pass through their interrogation zone. Then this information is passed on to the centralized server and stored indicating that the particular person was at that location at a particular instance of time.

A. Advantages

- More number of tags can be read in a short period of time.
- Physical contact is not required
- Identifying a person is effortless.
- Time efficient.

B. Disadvantages

Main drawback is that is that it authenticates only a card and not the person.

VI. GSM IN PROPOSED SYSTEM

A GSM modem is used for sending and receiving of SMS. Various alerts and notification that are mentioned in the following sections are sent in the form of SMS through the GSM modem. The location of a person or his attendance percentage can also be known by sending an SMS to the system. The system also pings all the devices connected to it at regular intervals and notifies the technician if there is a problem.

VII. FACE RECOGNITION IN PROPOSED SYSTEM

Attendance is a big concern in a student's life. Lack of attendance may stop a person from attending the University exams, discontinuation or doing the semester all over again. Finger print doesn't prove to be efficient for classroom attendance since it has a lot of disadvantages like time consuming, dirty finger is difficult to be captured, if outer layer of finger tips is eroded then finger prints would no longer be visible making the system more difficult. Hence Face Recognition is the best option for attendance.
The steps involved in the algorithm are as follows[13]:

a) Image Acquired
b) Histogram Equalization
c) Noise Removal
d) Skin Classification
e) Face Detection
f) Face Recognition
g) Attendance

In the first step the image is captured by the camera, due to different lightings there would be illumination effects on the image. Hence using histogram equalization the brightness or the darkness in the image is removed and contrast is enhanced for quality results. Sources of noise may occur which can be removed using various techniques like FFT, Low pass filter or Median Filter. Then the next step is skin classification which identifies the skin color and removes the other background images which enhances the detection and accuracy of Viola and Jones[6]. After the classification of skin, face is detected based on the integral image and cascade classifier. Face is extracted after detection and it is compared with the image in the database. If both the images are the same then the attendance is marked.

A. Advantages

- It takes minimal amount of time compared to the Finger print and other existing system.
- Accurate and Fast Identification
- High usability and security
- Proxy attendance is highly impossible

VIII.   IMPORTANCE OF .NET FRAMEWORK

The application will be built using Vb.Net and the website will be built using Asp.net.

A. Advantages of .Net Framework

i.   Consistent Programming Model :

There is a slight syntactical differences between .NET accessing data with a VB .NET and a C# .NET. Though they are different from each other, still both the programs need to import the System. Data namespace, both the programs establish a connection with the database and both the programs run a query and display the data [8]. The .NET Class Library, a key component of the .NET Framework explains the unified means of accomplishing the same task. Regardless of the programming language the developer uses, .NET Class Library provides the functionality to all .NET languages resulting in a consistent object model.

ii.Direct Support for Security :

Security is a major concern when an application accesses data on a remote machine or has to perform a privileged task on behalf of a non-privileged user. With .NET, method level security can be enabled by the developer and the system administrator which enhances the security level. It uses industry-standard protocols such as TCP/IP, XML, SOAP and HTTP over distributed application communications. This makes distributed computing more secure.

iii. Simplified Development Efforts:

In Web applications, for example if a developer needs to present data from a database in a Web page with a classic ASP. He has to write the application logic and presentation logic in the same file. ASP.NET and the .NET Framework simplify the development by separating the application logic and presentation logic thus making it easier to maintain the code. They are written separately such as to eliminate the need to mix HTML code with ASP code. ASP.NET can maintain the state of the controls, such as contents in a textbox. Another advantage of creating applications in .NET is debugging where the Framework simplifies it with Runtime diagnostics which helps us to track the bugs and to determine how well an application performs. Event Logging, Performance counters and tracing are three main types of Runtime diagnostics.

iv. Easy Application Deployment and Maintenance:

Deployment of applications is easier in a .NET Framework. In a very simple method, to install an application, just copy the application along with the components it requires into a directory on the target computer. The .NET Framework handles the details of locating and loading the components an application needs.

IX.   OVERALL FUNCTIONING OF THE SYSTEM

Initially the system records the presence of a student at the main entrance and sends a SMS to the parent or the guardian informing that the student has reached the institution. Then another SMS is sent to the parent or guardian when the student attends his first lecture. This is to indicate that the student is physically present and he has not sent his card through another student. If the time between the student being identified at the main gate and his class room attendance crosses a limit an alert is sent to the authority. This is to indicate that the student has entered the institution but he has not attended his lectures. An alert is sent if a student is not noticed at the main gate but attends his lecture since this indictes that the student has entered the institution through unauthorized means.

The attendance is manually initiated by the teacher at every lecture this ensures that the student attends all his lectures. Attendance is also initiated when the student enters the laboratory. This ensures that the student attends all his lab sessions.

Location of the student can be known by providing the roll number at the web site or by sending a SMS to the GSM modem that replies with the last known location [5]. The attendance percentage of a student can also be known the same way. An SMS is sent to the parent or guardian, mentor and the class teacher if the attendance percentage of the student reaches a certain limit. This facilitates timely notification to provide counseling to the student and saves

4

him from getting detained. Various reports such as the attendance percentage of the students, the amount of time spent by the student within the institution, specifically at the laboratory, browsing centre, students centre, library and class room is generated.

X.   CONCLUSION

The proposed student management system using RFID, GSM and Face Recognition is efficient since the drawback of the RFID technology is compensated by the advantage of the Face Recognition and simultaneously the drawback of the biometric technology is compensated by the RFID technology. This combination facilitates to monitor the presence of a student in the institution and to calculate the attendance accurately which eliminates the chances of missing the attendance. This is an ongoing research and more methods can be used to improvise the system. The disadvantage of this system is that face recognition is a developing technology for class room attendance and it is not 100% accurate.

XI.   REFERENCES

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