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Development of a Student Attendance Management System Using RFID and Face Recognition: A Review

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Abstract: ***Whole world and administrators of Educational institutions' in our country are concerned about regularity of student attendance. Student's overall academic performance is affected by the student's present in his institute. Mainly there are two conventional methods for attendance taking and they are by calling student nams or by taking student sign on paper. They both were more time consuming and inefficient. Hence, there is a requirement of computer-based student attendance management system which will assist the faculty for maintaining attendance of presence. The paper reviews various computerized attendance management system. In this paper basic problem of student attendance management is defined which is traditionally taken manually by faculty. One alternative to make student attendance system automatic is provided by Computer Vision. In this paper we review the various computerized system which is being developed by using different techniques. Based on this review a new approach for student attendance recording and management is proposed to be used for various colleges or academic institutes.***

Keywords: ***Attendance Management System, RFID, Face Recognition, MAC, Iris recognition, Biometrics, Fingerprint Reconstruction, NFC***

I. INTRODUCTION

According to Cobuild learners dictionary Attendance is the fact that someone is present at an event or go regularly to an institution, or the attendance at an event is the number of people who are present at it. Furthermore, if someone is in attendance of a place or event, they are present.

Empirical evidences have shown that there is a significant correlation between students' attendances and their academic performances [1]. There was also a claim stated that the students who have poor attendance records will generally link to poor retention [2]. This is also agreed by Mazza and Dimitrova where they both claimed that the students' attendances to the course may indicate their behaviours towards the subject where it can be used to judge their tendency and commitment to the course [3].

Attendances of every students are being maintained by every school, college and university. Faculty has to maintain proper record for the attendance. The manual attendance record system is not efficient and requires more time to arrange record and to calculate the average attendance of each student. Hence there is a requirement of a system that will solve the problem of student record arrangement and student average attendance calculation. The proposed system should store the absent and present student's attendance details in electronic format so that management of attendance becomes easy.

Old conventional methods for student attendance is still used by most of the universities. As this method is used, many students are helping their friends by signing in their attendance in case of their absent in the institute. So while this method is used, attendance records are analysed and maintained manually by the faculty to know the present and absent student list. The

faculty has to take attendance again if the attendance sheet is being lost and in this case absent students get chance to make their present in new sheet.

This procedure, besides being troublesome for lecturer, it will also affect students as time is expended on signing, verifying and submitting the attendance sheet manually. Therefore, a computerized system that can manage and help the lecturers to take attendance easily and maintain that attendance has to be developed. The faculty can easily access this system. Manipulation and management of student attendance data have to be taken care by the system so that the manual analysis of student attendance by the faculty will be removed. The system should automatically analyze all the data as it was transferred by the faculty.

There are some problems in conventional attendance tracking system like one is a student missing out their name, while the other leads to a false attendance record. Another issue of having the attendance record in a hardcopy form is that a lecturer may lose the attendance sheet [7]. For student attendance analysis, to obtain the student attendance percentage, manual computation has to be performed by faculty.

Technological improvements can be useful tools to help in the development of new systems to eliminate the disadvantages of the classical methods while enhancing its advantages.

All of this review has shown that in most of the higher academic institutions attendance records have primarily become the proxy to determine the student's success.

In this paper for student attendance, we present a unified management system using information technology for different purpose in an organization. Section-II proposes computer based student attendance. Section- III comprises of a survey done in the area of attendance taking and verification till now. Section-IV puts forward an approach for attendance management. Section-V concludes this paper.

II. COMPUTERIZE STUDENT ATTENDANCE SYSTEM

While the move towards the digital era is being accelerated every hour, biometrics technologies have begun to affect people's daily life more and more. Biometrics technologies verify identity through characteristics such as fingerprints, faces, irises, retinal patterns, palm prints, voice, hand-written signatures, and so on. These techniques, which use physical data, are receiving attention as a personal authentication method that is more convenient than conventional methods such as a password or ID cards. The biometric personal authentication uses data taken from measurements. Such data is unique to the individual and remains so throughout one's life. [20]

It is important to identify the correct tools to use in commercial and scientific studies. Barcode readers, Radio Frequency Identification (RFID) system, Bluetooth and NFC are just a few of the examples of such tools [4]. However, they were expensive when first introduced and therefore they had limited use.

Nowadays, these technologies become cheaper and they can be used in various applications, such as, identification, counting, tracking or positioning. Barcodes and their readers are greatly used in markets to identify the sales objects.

For instance, in shopping centers, people load their shopping baskets with the products which are labeled with the barcode and then the cashier uses the barcode reader to identify the products and therefore the prices for individual product and the total price can easily be obtained for the customer. The use of new technologies could save precious time of the customer and the shop staff.

Nowadays, in the computerized verification process, many biometric techniques are there in the market. Biometric technologies enable automatic personal recognition based on physiological or behavioural characteristics (Prabakar, 2003). Biometric is defined as the "automated identification or verification of human identity through the measurement of repeatable physiological and behavioural characteristics" (Association of Biometric, 2004). Different types of biometric techniques are shown in the below figure. [25]

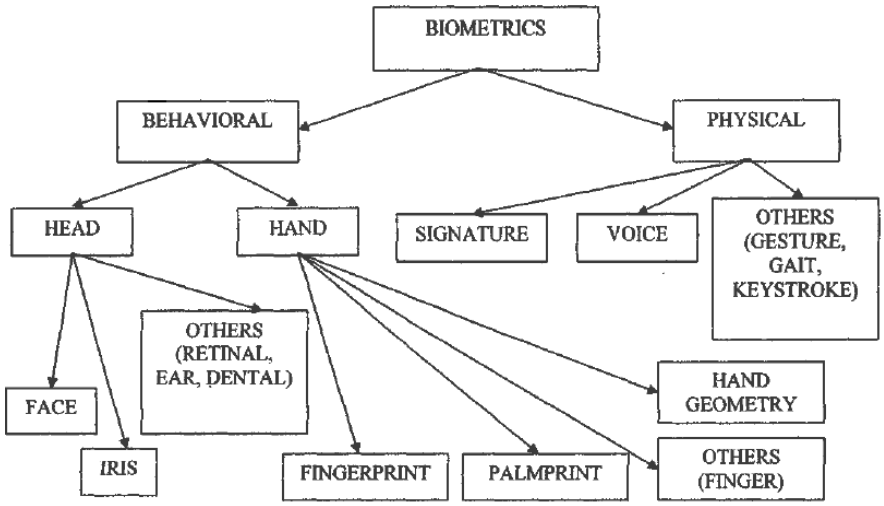

Fig. 1 Biometrics Techniques

In the absence of an automated time and attendance system, companies lose productivity, overpay employees, and become distracted by the manual tasks of time and attendance. [5]

III. Assessment of Different Attendance Management System

A. Computerized Attendance System

In 2008, Nucleus Research proposed the use of a computerized attendance system, which can eliminate human involvement, human data entry mistake, repetitive work. This system is going to increase productivity, reduced payroll error, and reduced payroll inflation, reduced overtime, retirement of legacy systems, Elimination of paper costs, and which can provide all the reports on demand. In this system, faculty has to take attendance manually, only these records have to be entered into the computerized system. But in this also, the problem of data entry mistake may occur [5].

A desktop application developed by Jain et al. [6], in which all the list of registered students in a particular course will be displayed when the lecturer start the application. The attendance registration is done by clicking a check box next to the name of the students that are present, and then a register button is clicked to mark their presence. But in this also, human involvement for attendance tracking is needed.

Another similar project was proposed, but in this case the student will have to register individually using a client server socket program from their device (laptop) [7].

Registering the attendance by proxy is eliminated in the first and second project since the lecturer will see each and every student in the class, while in the latter case student snapshot is taken by the client application. Even though in both projects the time wastage is also there, but still it is an improvement on the manual process since attendance data can be stored safely and reports can be easily generated.

B. Bluetooth Based Attendance System

In 2013, Vishal Bhalla et al. [14], have proposed the attendance system which can take attendance using Bluetooth. In this project, attendance is being taken using instructor's mobile phone. Application software is installed in instructor's mobile telephone enables it to query student's mobile telephone via Bluetooth connection and through transfer of student's mobile telephone Media Access Control (MAC) addresses to the instructor's mobile telephone, presence of the student can be confirmed. The problem of this proposed system is student's phone is required for attendance. In case of students' absent if his mobile is given to his friend then also present is marked. So presence of student is not necessary only phone should be in coverage area.

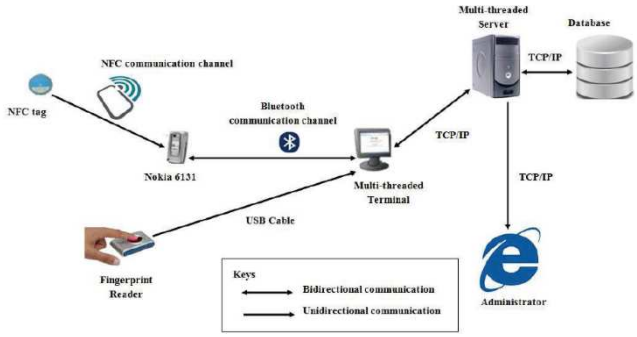

Fig. 2 Communication Architecture of the system

C. NFC based Attendance System

The NFC-based applications simplify various human day-to-day activities by simply touching an object fixed or integrated with NFC tag. For instance, SmartTouch is one of the early NFC projects that focuses on NFC technology which was coordinated by VTT Technical Research Centre Finland; applications in various areas were developed under this project such as mobile payment and ticketing, smart poster, attendance system for schools, home use, household access control and security, blood glucose meter, etc. [8].

In [23], author presents the implementation of an (AMS) Attendance Management System that is based on Bluetooth and NFC technologies in a multiuser environment. It uses fingerprint & the Bluetooth address of the NFC enabled phone of the user to authenticate the identity of the user. A Java based desktop application receives the NFC tag IDs, other information associated with the mobile phone and the user and submits them to an analyser for the interpretation of the user's behaviour. But in this case, student must be having NFC enabled phone to mark presence in the class room.

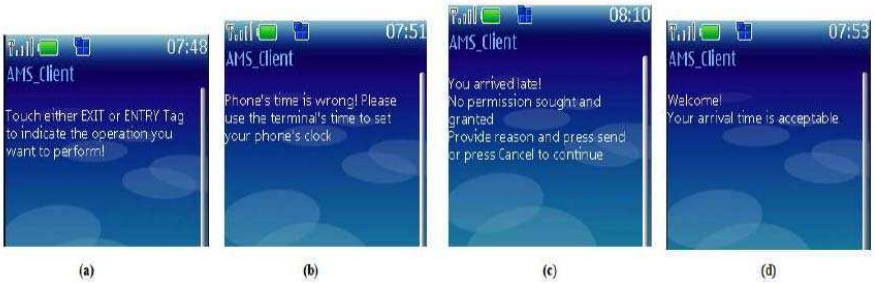

Fig. 3 (a) Touching a Tag (b) Phone's time does not match Terminal's time (c) User arrives late (d) Successful login after arrival

In [24], Media Anugerah Ayu proposed system in which a web based attendance system utilizing NFC technology is developed which is called as TouchIn System. In proposed system, two modes of operations will be used. Reader / Writer mode (like smart poster) and Peer to Peer mode (like android beam). In the attendance system each room has NFC reader which is connected to teacher's PC which is connected to the university's network. But again in this case, student must be having NFC enabled phone to mark presence in the class room. Which may be not possible for every students to have NFC enabled phone.

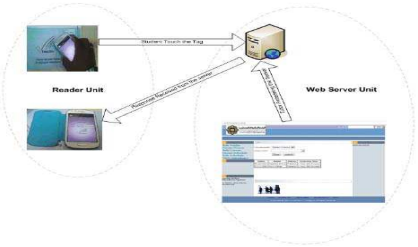

Fig. 4 System Overview

D. Fingerprint based Attendance System

Mohamed et al. [9] designed a fingerprint device that is used in fingerprint attendance system. The students mark their presence by placing their finger on the devices sensor.

The system components are:

- Handheld device which was constructed and controlled by microcontroller (PIC18F4550) with components (fingerprint module, Real Time Clock RTC, buttons, Graphic Liquid Crystal Display GLCD, Memory, etc).
- Host computer with GUI application for managing the attendance, the application is used to transfer the students' data to the device. The attendance details can be accessed through USB interface and finally store in to the database. [9]

In this case problem is the fingerprint device, because it is damaged very frequently. Again for marking attendance students has to stand in long line and has to wait for turn for the fingerprint device.

In 2012, Josphineleela.R and Dr.M.Ramakrishnan proposed one system, in which attendance is being taken using fingerprint. This system can be used for student and staff. In this system the fingerprint is taken as an input for attendance management and it is organized into the following modules Pre-processing, Minutiae Extraction, Reconstruction, Fingerprint Recognition, Report generation. In this system, novel fingerprint reconstruction algorithm is used. This new algorithm reconstructs the phase image from Minutiae. [15]. Even though this system is good but again problem is same as above system.

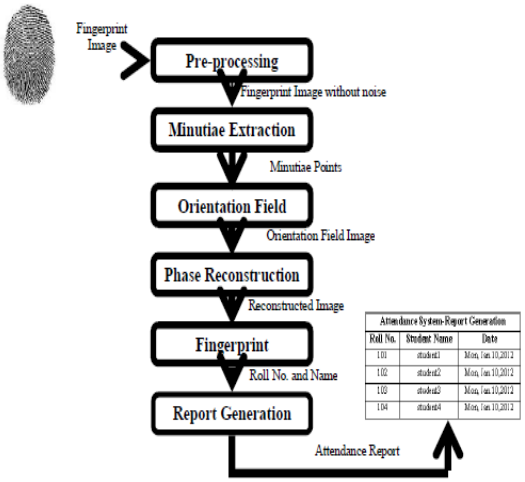

Fig. 5 System Architecture

In 2013, Seema Rao and Prof.K.J.Satoa proposed one new system for employee attendance using fingerprint. In this system, fingerprint verification is done using extraction of minutiae technique and the system automates the whole process of taking attendance. For employee fingerprint checking, it checks one fingerprint template with all templates stored in the database, like wise it checks for all employee which will take more time. The main problem in this case is it is very time consuming as it checks one fingerprint template with all templates stored in the database and it is very short distance. [16].

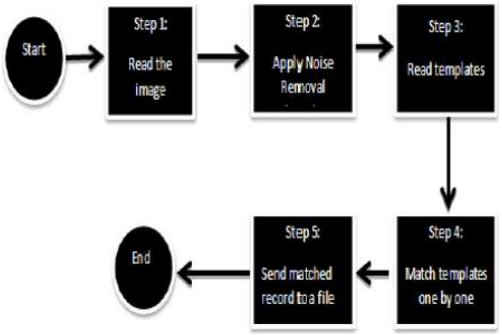

Fig. 6 Fingerprint recognition & authentication

In [17], fingerprint recognition based identification system is designed for student identification. This system is being designed for taking attendance in institutes like NIT Rourkela. In this system, fingerprint template matching time is reduced by partitioning database. Fingerprint scanner will be used to input fingerprint of teachers/ students into the computer software. Again this system is suffering from fingerprint device as well as for each and every class student has to stand in long line to mark attendance and it is very short distance.

E. Iris Based Attendance System

In 2010, Seifedine Kadry and Mohamad Smaili has proposed one system. In this paper, a wireless iris recognition attendance management system is designed and implemented using Daugman's algorithm (Daugman, 2003). This system based biometrics and wireless technique solves the problem of spurious attendance and the trouble of laying the corresponding network. It can make the users' attendances more easily and effectively. In this paper, RF wireless technique is being used for employee identification. It is too expensive. Main problem in this system is it is too expensive and it is very short distance as well as for every class student has to stand in long line of iris scanner for marking presence. [20]

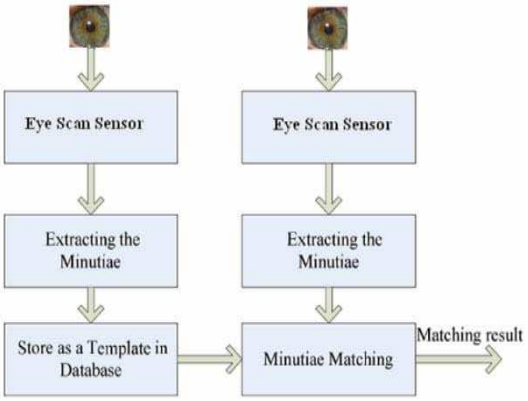

Fig 7 Iris recognition verifying process

F. Face Recognition based Attendance System

In [18], Student attendance is being taken using one of the bio-metric technique. i.e. Face Recognition. Since Iric and Fingerprints are very short-distance biometrics but our application requires a person to be at a medium distance from the camera, which is fixed at the centre of the classroom near the black board, so that the view of the camera covers the entire classroom. The model is developed with the help of real time OpenCV library. The proposed system comprised of using the Viola Jones algorithm for detecting the human faces and then the detected face is resized to the required size, this resized face is further processed by using linear stretch contrast enhancement and finally it is recognized using a simple PCA / LDA. Once recognition is done, automatically attendance will be updated in an Excel Sheet along with his name, date and time. An html file is automatically updated by our system so that a remote authenticated user can access the attendance file. The main problem in this system is recognised face has to be compared with all the entries stored in the database.

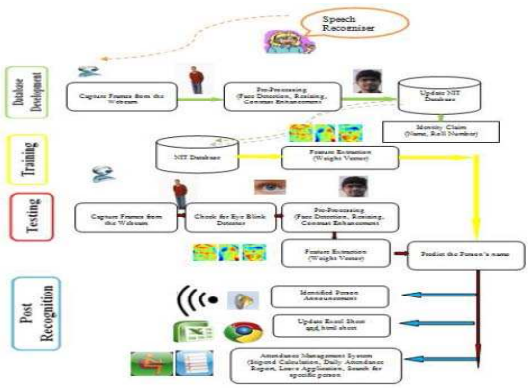

Fig. 8 Proposed System Model

In [19], Attendance Management System (AMS) can be made into smarter way by using face recognition technique, where we use a CCTV camera to be fixed at the entry point of a classroom, which automatically captures the image of the person and checks the observed image with the face database using android enhanced smart phone. It is typically used for two purposed. Firstly marking attendance for student by comparing the face images produced recently and secondly, recognition of human who are strange to the environment i.e. an unauthorized person. For verification of image, a newly emerging trend 3D Face recognition is used which claims to provide more accuracy in matching the image databases and has an ability to recognize a subject at different view angles. Again in this research, the problem is of comparison of captured image with images of all students which is time consuming.

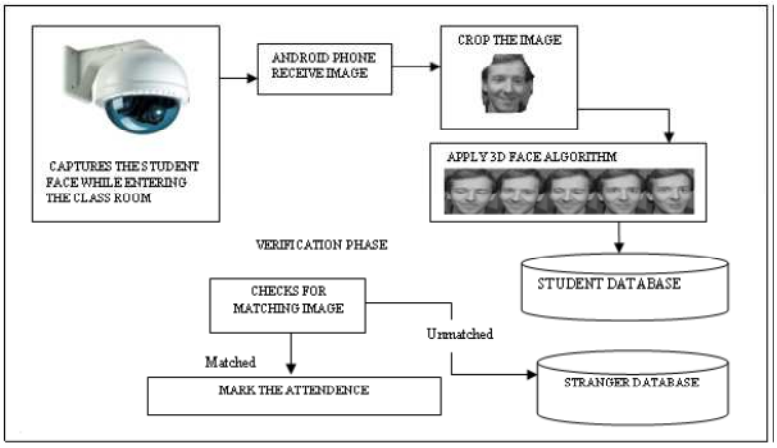

Fig. 9 Architecture diagram for smart application for AMS using Face Recognition

G. Mobile Based Attendance System

In [21], author tried to implement a system which overcomes the limitations of the existing approach by taking the attendance through teacher's mobile phones is one step forward to sustainable development. Doing the same work on mobile phone not only saves our resources but also enables the user to get easy and interactive access to the attendance records of student. This system is implemented only on S60 Symbian platform. So all Symbian based mobile phones are supported by the system. The drawback of this system is teacher must be having S60 Symbian platform phone and again human involvement for attendance tracking is there.

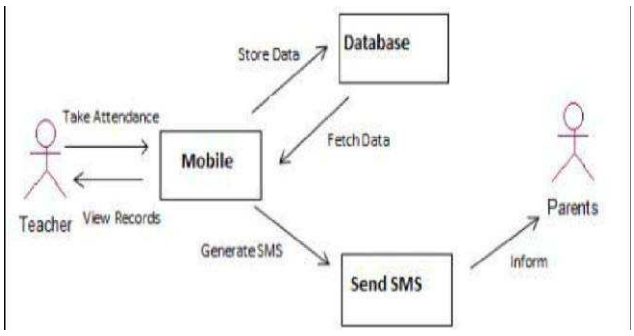

Fig. 10 Overall System Architecture

In [22], student information tracking system is being developed in Android to manage student attendance on mobile. This system allows teachers to take attendance, edit attendance, view student's bunks, send important documents in pdf format such as exam time table, question bank etc. and also helps teaches to inform students about the events that college is going to organize. This system is mobile independent. This system can be installed on any mobile which is having Android as OS. The problem of this system is it is developed on for Android platform so it cannot run on iOS or any other mobile OS as well as it is very time consuming to mark student attendance in mobile.

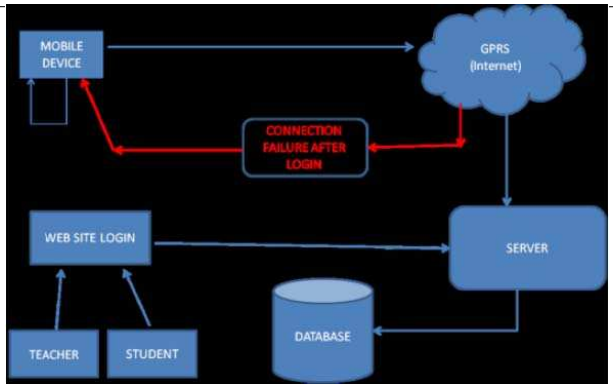

Fig. 11 Application Flow

H. RFID based Attendance System

BIS [10] presents a commercial system based on RFID for attendance management for schools and colleges. The system can send SMS and email alert to parents/guardians of the students automatically. The student will register at the gate by touching RFID device with their RFID tag and send the data to BISAM server in the school. The server will process the attendance data and send an SMS to the parents/guardians of the absentee student through BISAM SMS gateway server. The system also has Time Manager Software for managing employees' attendance and HR related functionalities. The problem in this research is there is verification is not done. So proxy attendance may be marked.

In [11], [12] RFID reader was designed with microcontroller, transceiver chip, serial communication IC, LCD, USB interface, power supply module, etc as components. When a staff member touches the reader with their card the data is sent to PC manager application which will validate the data and extract information like staff ID and access time into the database. Again same problem as above system is being faced by this research [11].

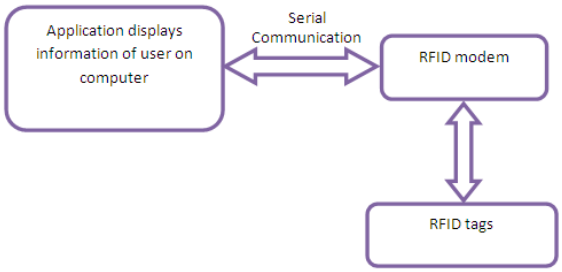

Fig. 12 Functioning of the System

While in [12], when a student touch the reader it sends the data to the microcontroller for comparison with the ID stored in the microcontrollers memory; if ID exist the name, ID and attendance will be displayed on the LCD then transfer the data to PC via RS323 port [12]. Also [13] proposed another system based on RFID where the RFID terminal read the student ID, date and time; and store it into a database in an online server. The problem in this research is there is verification is not done. So proxy attendance may be marked.

IV. PROPOSED APPROACH FOR STUDENT ATTENDANCE MANAGEMENT

As a survey of above section, in most of all the research, system is being developed only using one technology i.e. only attendance is being taken. Whereas we are planning to use two technology, one is for attendance taking and one is for verification. So there is no chance for proxy attendance as well as it also increases accuracy of the system.

In Proposed System, Attendance will be taken using RFID technology and attendance verification will be done by face recognition. Even though there are many technologies available for attendance taking like manual, Bluetooth, Infrared, Wi-Fi, NFC and computerize then also we select RFID technology. The main reason is all the above technology is having many loop halls which will be cover by RFID. Same way there are different technologies for attendance verification then also we select

Face recognition technology. The main reason is all the above technology is having many loop halls which will be cover by Face Recognition.

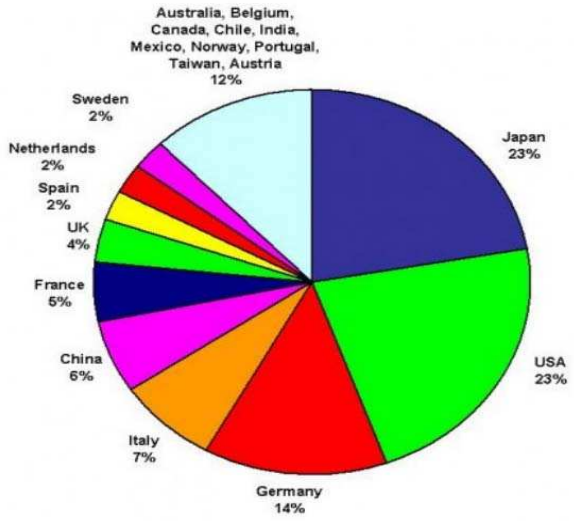

Fig. 13 Apparel RFID 2009-2019: IDTechEx

Figure 13, represents a diagrammatic view of the RFID technology being adopted across the globe. This has been taken from the market research report namely, Apparel RFID 2009-2019, IDTechEx report [140]. This explains how hundreds of organizations throughout the world are now using RFID in their products ranging from clothes to the cases and pallets. It also states that "The benefits are powerful and wide ranging from improving customer service and efficiency - including reducing stock outs - to combating counterfeiting, theft and misplacement and automating sorting processes and stock takes".

RFID has a capability of reading of several labels simultaneously automatically. They identify each product individually and can contain information like student ID. RFID is not requiring direct line of sight. RFID is having Longer Read range than other technologies. Likewise RFID is having many more advantages over other technologies.

As in this system, Face Recognition is selected for attendance verification because iris and fingerprint is requiring short distance reading whereas face recognition is having long distance reading. Camera result is much higher than fingerprint reader machine. The main problem of fingerprint machine is, the reader of it is not working for long time.

RFID system operational principle:

Absolutely key part of the technology is RFID Tags; RFID tags do not need to contain batteries, and can therefore remain usable for very long periods of time (maybe decades). The scanning antennas can be permanently affixed to a surface; handheld antennas are also available. They can take whatever shape you need; for example, you could build them into a door frame to accept data from persons or objects passing through.

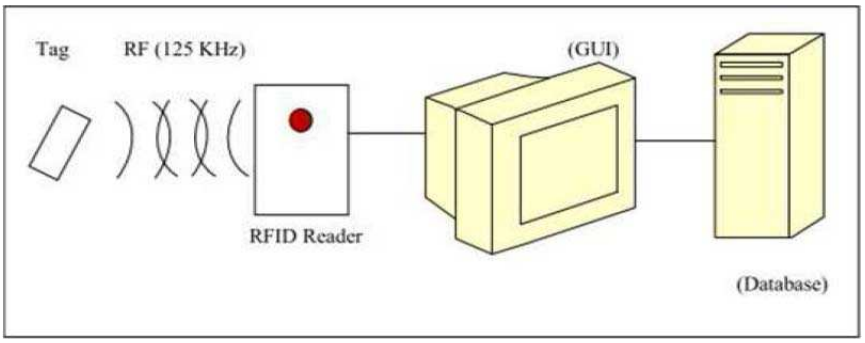

Fig. 14 RFID system Operational principle

As illustrated in above figure, each student is having identity card in which RFID Tag is mounted. RFID Tag itself contains some data which is being read by RFID reader. This Reader is passing tag data to the server.

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 normalization), and afterwards recognition occur through feature extraction and matching steps.

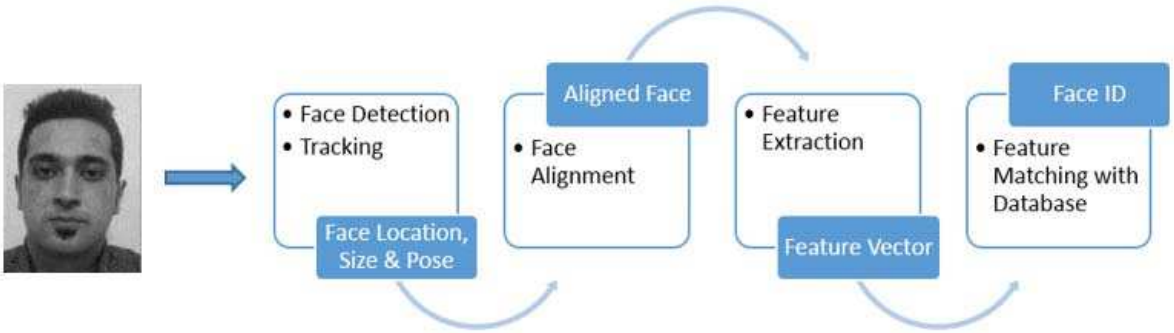

Fig. 15 Overall Process of Face Recognition

Proposed System:

The proposed system is a generic application design to automate and enhance the manual work of recording and reporting in real-time, the Time and Attendance System in universities. A Log is maintained in the Database. Log contains RFID Tag Id and Captured Image by Camera. If both Student Id fetched from RFID Tag and Captured Image is matched, presence is marked as "Present" else it is marked as "Absent".

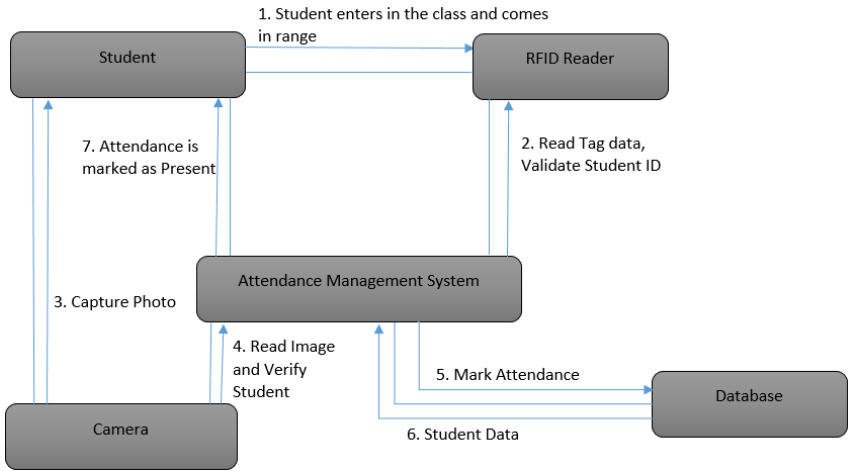

Fig. 16 Processing of Proposed System

V. CONCLUSION

This paper presents an analysis of different technologies which are used for attendance making system. Traditionally student attendance is taken by professor and it will waste too much time of lecture. Too much proxy attendance can be recorded in manual system. This can be replaced with computerized system. RFID will take auto attendance for all the students entered in the class which will remove the time loss of professor. On the other hand Face Recognition will verify the student which will remove the proxy attendance.

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