



PROJECT DOCUMENTATION ON

# ***Fingerprint Based Attendance System***

FOR

**INTERNATIONAL TECHNOLOGICAL UNIVERSITY**

**SEN 941 SOFTWARE ENGINEERING**

**FALL-2013**

# ACKNOWLEDGEMENT

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## **WORK STATEMENT**

The purpose of this project **Fingerprint Based Attendance System** is to organize, automate and track attendance records of students and staff of an institute. Managing attendance records of students of an institute is a tedious task. It consumes time and paper both. A lot of human effort is involved to make a note and maintain a student attendance sheet. Manual attendance taking and report generation has its limitations too: time wasted over responses of students, waste of paper, and possibility of forgery. The purpose of this project is to overcome these non-optimal situations. Attendance is marked after student identification. For student identification, a fingerprint recognition based identification system is used. Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and does not change in one's lifetime. This would improve accuracy of attendance records because it will remove all the hassles of roll calling and will save valuable time of the students as well as teachers.

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# 1. Introduction

## 1.1 Problem Statement

Designing an attendance management system based on fingerprint recognition and faster one too many identification that manages records for attendance in university like ITU, San Jose, CA.

## 1.2 Motivation and Challenges

Every organization whether it be an educational institution or business organization, It has to maintain a proper record of attendance of students or employees for effective Functioning of organization. Designing a better attendance management system for students so that records be maintained with ease and accuracy was key to the project. The previous approach of manually taking and maintaining the attendance records was inconvenient task. After having these issues in mind we develop an automatic attendance system which automates the whole process of taking attendance and maintaining. This would improve accuracy of attendance records because it will remove all the hassles of roll calling and will save valuable time of the students as well as teachers.

## 1.3 Using Biometrics

*Biometric Identification Systems* are widely used for unique identification of humans mainly for verification and identification. Biometrics is used as a form of identity access management and access control. So use of biometrics in student attendance management system is a secure approach. There are many types of biometric systems like fingerprint recognition, face recognition, voice recognition, iris recognition, palm recognition etc. In this project, we used fingerprint recognition system.

## 1.4 About fingerprint

Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and does not change in one's lifetime. Besides these, implementation of fingerprint recognition system is cheap, easy and accurate. Fingerprint recognition has been widely used in both forensic and civilian applications. Compared with other biometrics features, fingerprint-based biometrics is the most proven technique and has the largest market shares. Not only it is faster than other techniques but also the energy consumption by such systems is less.

A *fingerprint* is an impression of the friction found on the inner surface of a finger or a thumb. The science of fingerprint constitutes the only unchangeable and infallible means of positive identification known to man. The reasons why fingerprint are used for identification purpose are outlined below. These premises are supported by scientific research in areas such as biology, embryology, and anatomy to name a few. Ridge patterns and the details in small areas of friction ridges are unique and never repeated. Friction ridges develop on the fetus in their definitive form before birth. Ridges are persistent throughout life except for permanent scarring. Friction ridge patterns vary within limits which allow for classification.

Shown below, is a fingerprint pattern obtained from an optical sensor. The figure shows faint and dark lines emerging from a particular point and spiraling around it all over the finger.



*Figure 1 An image of a fingerprint created by the friction ridge stricture*



## 1.5 Fingerprint Recognition

Once the fingerprint is captured, the next step is the recognition procedure.

The recognition procedure can be broadly sub grouped into

- a) Fingerprint identification
- b) Fingerprint verification/ recognition

Fingerprint identification refers to specifying one's identity based on his fingerprints. The fingerprints are captured without any information about the identity of the person. It is then matched across a database containing numerous fingerprints. The identity is only retrieved when a match is found with one existing in the database. So, this is a case of one-to-n matching where one capture is compared to several others. This is widely used for criminal cases.

Fingerprint verification is different from identification in a way that the person's identity is stored along with the fingerprint in a database. On enrolling the fingerprint, the real time capture will retrieve back the identity of the person. This is however a one-to-one matching. This is used in offices like passport offices etc. where the identity of a person has to be checked with the one provided at a previous stage.

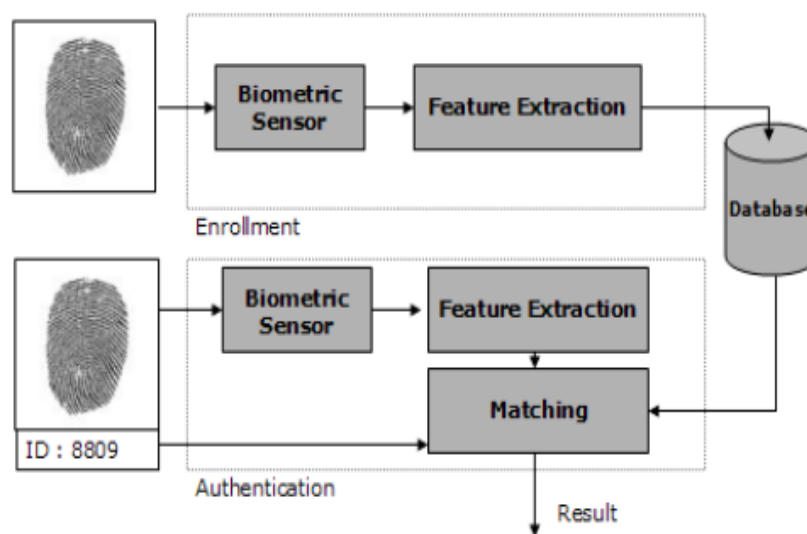
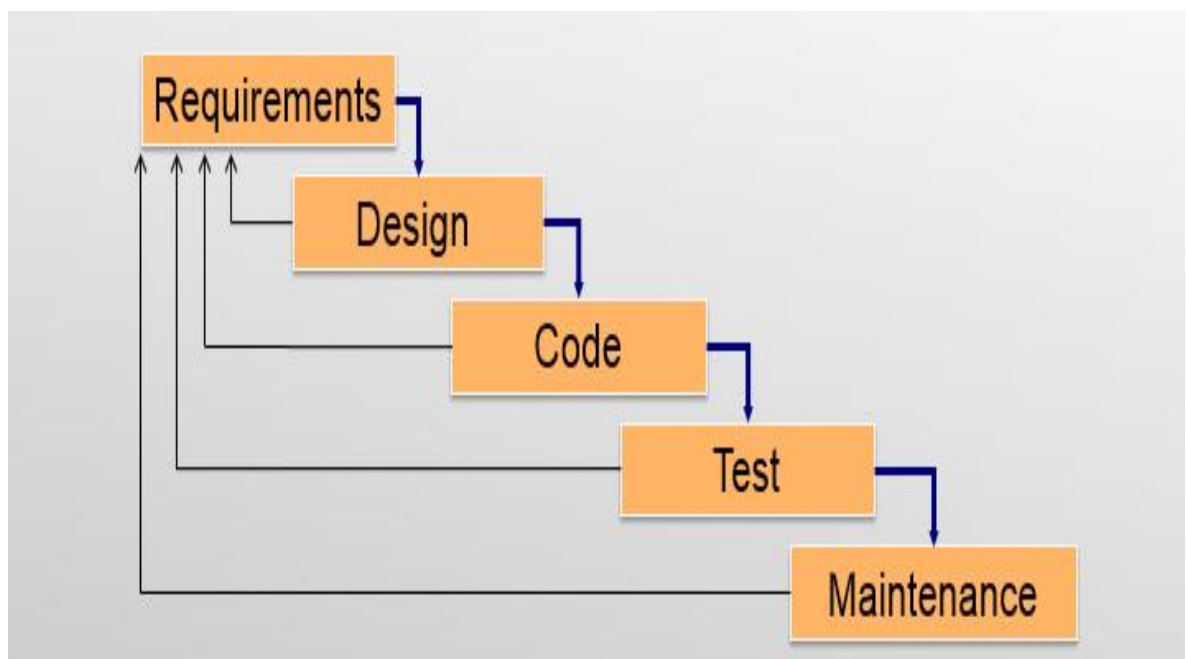


Figure 2 Fingerprint Recognition System

## 2. Approach

### 2.1 System Requirements

Requirements describe a system's behavior and what the system will do to meet the user/customer needs.



*Figure 3 Requirements engineering*

System requirements consists of:

- **Functional requirements** (Statements of services the system should provide)
- **Non-functional requirements** (Constraints on the services or functions offered by the system)

### 2.2.1 Functional requirements

- ✓ Student registration

The instructor/administrator shall be able to register each of the students' names, Contact details, their unique fingerprint into a database for proper identification later on.

- ✓ Identification of a student

The system shall be able to uniquely identify each student, faculty and staff members.

The identification shall be done when the student enters and exits the classroom.

The identification shall be done in real time.

- ✓ Storage of students identified.

The system's database shall be able to store all students' information.

After the identification period a text file is created with a record of the students' names, date and timestamps for the class.

- ✓ Display student's name after identification and sounds.

The system shall have the ability to display a message with the students name and an access granted or denied message to tell the student if their logon was Successful.

Audible sounds may be also played for successes and failures.

- ✓ Time stamping of identification.

An arrival time, exit time and date shall be associated with each attendance check in order to assure the student has been in attendance for the entire class period.

- ✓ Downloading data to Microsoft Excel.

The system shall be able to download the identification data to a Microsoft Excel Readable text file.

The data shall be formatted and opened in an Excel spreadsheet.

- ✓ Email Notifications to Professor and students in case of low attendance.

The fingerprint based attendance module shall allow college authorities to send email notification to Faculty, staff members and students community in case of low attendance than the minimum attendance required. Automatic Emails can also be enabled where attendance reports can be emailed to concerned person in a set cycle. System is built with SMS and email template and also provide user the option to built their own customized template.

- ✓ Attendance Management software shall be integrated with the organization's HR data

In a single click, users shall be able to view events like hours worked, no.of classes absent and present, on duty, overtime, and leave of an employee for date or month period can also be obtained from this Attendance Management system. The system will calculate the total working hours for each staff member and in accordance with their per hour pay rate generate their weekly and monthly pay structure. It can help identify the free riders in the team and acknowledge diligent workers.

- ✓ Scan of entire fingerprint with dual orientation

The system shall be smart enough to mark the attendance irrespective of the position of the finger. It will mark the attendance both ways. It's advanced and reliable image processing and encryption will capture attendance even if the finger is placed straight or upside down, it will capture and match the image.

- ✓ Access of system to Faculty members

The system shall have provisions to provide access to required staff members to change / add attendance manually if required. One of such access shall be granted to faculty members. In case a student by mistake fails to mark his / her attendance before entering the class, he / she can request to add their in time details manually

to the faculty members. There will be signs to indicate manual markings, however these will be incorporated in the database.

✓ Fast identification and verification process and response time

The system shall prompt to compare the fingerprint images to its stored database and match the same or report error in case of mismatches. The entire activity of capturing image, its verification with the stored data and marking of attendance will be completed in fraction of seconds.

✓ Alarming system in case of intentional damage made to device

The system shall contains in built alarming system to generate sound notification in case of any intentional damage being made by any person.

✓ Audio-Visual indications for acceptance and rejection of invalid fingers

The system comes with a small LCD device to generate Audio and Video indications while accepting or rejecting fingerprint images. This makes it all the more easier for the user to use the system.

✓ Fingerprint Module shall be directly interfaced with the serial port of the PC.

✓ Save fingerprint data - Huge databases are needed for storing many fingerprint samples.

✓ Backup fingerprint data - Fingerprint data is needed to be copied over to multiple backup databases so that in case of failure the system will still continue to operate as intended.

## 2.1.2 Non-Functional requirements

### ✓ Performance requirements:

- **Throughput** - At peak load, the system shall be able to capture and verify 20 fingerprints per second
- **Response time** -The total processing time taken by the system from scanning the fingerprint to updating the information online shall not be more than 10 seconds for 95% of the transactions.
- **Data Latency** - Reduce storage latency om database to less than 200 ms

### ✓ Security requirements:

- **Denial of service attacks** - The purpose is to make the attacked system unavailable to users. Any sort of down time could be devastating to organization.
- **Malware attacks** - Hardware and data loss can occur from virus and worms should be recoverable.
- **Data Confidentiality** - Customer database authorization works 99.9% of the time. e-mail encryption are secure 99.9% of the time

### ✓ Design Constraints:

- Database: Microsoft SQL Server 2008. The database shall be stored on the server.
- Operating environment: The system shall be able to function both indoors and outdoors at optimum temperatures of 20~25°C and humidity of 30~40%.
- Minimum computer hardware specifications: 2.3 GHz CPU speed, 2.0GB RAM, and at least 10 GB of hard disk space for database storage.
- Legal Constraints: Only the Dean of the organization (or any equivalent division) shall have authority to approve the installation of the system

- Economic: The cost of the fingerprint scanner is about \$100 per machine.
- Sustainability: The system life shall at least be 10 years or until a new version is released.
- Unit must be portable: The system shall be easily transportable to and from the class.

### **2.2.1 Safety Requirements**

- ✓ The system shall capture the fingerprint identifier from each stakeholder (student/employees/management staff etc.) without increasing the actual time by more than 60 seconds.
- ✓ The identifier shall be an accurate, relatively unalterable, unique physical characteristic that can be captured, recognized or verified, and stored and must be verifiable over an indefinite period of time.
- ✓ The method of capturing the biometric identifier shall be unobtrusive to the applicant. The method shall be socially acceptable and will not endanger the health, safety, or welfare of any applicant.
- ✓ All hardware configuration items delivered as part of the fingerprint based System should conform to the appropriate US Underwriters Lab standards for electronic devices and be so certified.

## 2.2 Feasibility Study

A feasibility study is carried out to select the best system that meets performance requirements.

### 2.2.1 Economic Feasibility

- The system being developed is economic with respect to School or College's point of view. It is cost effective in the sense that has eliminated the paperwork completely.
- The system is also time effective because the calculations are automated which are made at the end of the month or as per the user requirement.
- The result obtained contains minimum errors and are highly accurate as the data is required. The system is efficient and effective.
- Personal information would be easily managed by the database thus saving the storage space in files and cabinets.
- Improved employee services as efficiency in applying leaves, obtain their leave information quickly and obtaining other details regarding paychecks, short leaves and half days.
- The cost to develop, manage and maintain this system is low.

### 2.2.2 Technical Feasibility

- The proposed system will be developed in web bases and it is required to use web technologies appropriately.
- Servers: Microsoft IIS, Apache, Google Web Server, Apache Tomcat
- DBMS: Oracle, Mysql, Microsoft SQL server, Microsoft Access
- The system is developed using PHP as the main development language and Apache as the server due to high reliability and flexibility in between platforms. MySQL is chosen to be the database of the system due to its flexibility.
- All the chosen technology are widely used in the world and are available for free use. These technologies are all open source and do not require any registering or purchasing of any kind



### 2.2.3 Environmental Feasibility

- Within the system we would give access to user (students/ employees/ management/ administration) to access the privileges according to college/school culture and rules and regulations.
- User should be good about the system as it has user friendly environment.
- Daily attendance of employees and students according to class schedule which are gathered with the use of fingerprint machine are highly secured.

### 2.2.4 Legal Feasibility

Legal feasibility involves in verifying the legal viability of the proposed system:

- Government Constraints: Since the system is implemented in an educational institute, it may be subject to rules and regulations imposed and even funding constraints.
- Copyright Issues: Since the proposed system will be using open source software there will be minimal licensing and other related issues

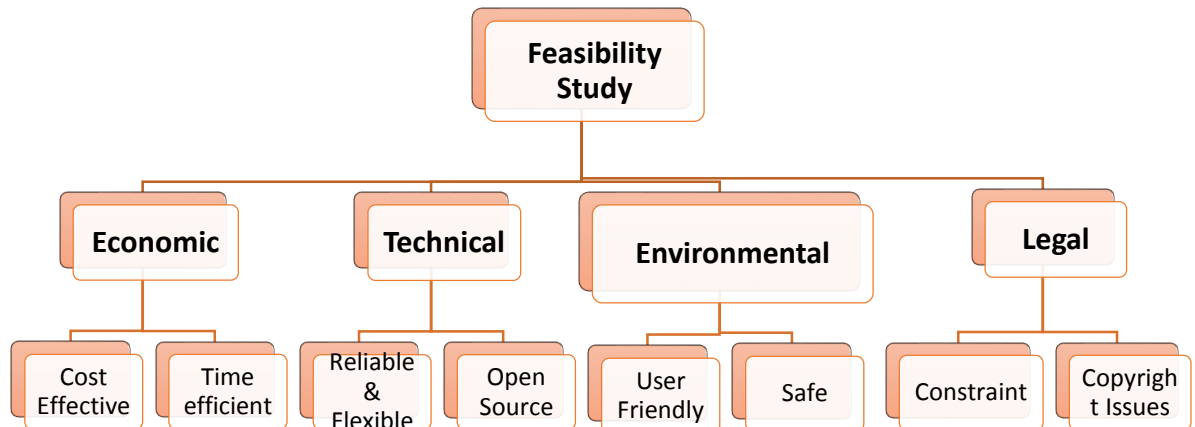


Figure 4 Feasibility Study

## 2.3 Hardware Requirements

- ✓ **Finger Print Sensor:** A fingerprint sensor is an electronic device used to capture a digital image of the fingerprint pattern. The captured image is called a live scan. This live scan is digitally processed to create a biometric template (a collection of extracted features) which is stored and used for matching.
- ✓ **Microcontroller:** A microcontroller can be considered a self-contained system with a processor, memory and peripherals and can be used as an embedded system.
- ✓ **Memory:** It is used for storing the no. of fingerprint for matching purpose.
- ✓ **Computer:** Fingerprint is matched when attendance is taken the data will go into the computer. And make the datasheet of particular each student with time and date. We will use RS232 cable for taken data from fingerprint system.
- ✓ **TCP/RS 232:** Along with our fingerprint machine there is a piece of RS232 cable supplied, connect one end of the RS232 cable with the RS232 outlet of fingerprint machine or control box, another one connect to PC serial port.
- ✓ **LCD Display:** LCD is used for display the each student information like name, id, class etc. when he/she will use fingerprint module for attendance

## 2.4 Software Requirements

- ✓ **Stand-alone machine operation**  
Database: MSDE 2000  
Operating system: WIN98/2000/ME/XP/NT/2003
- ✓ **Network operation**  
Database: MS SQL SERVER 2000 or higher, enterprise /standard edition  
Workstation: WIN98/2000/ME/XP/NT  
Server: WINDOW NT/2000/2003 SERVER

### 3. Vision Document

Fingerprint based Attendance System is a fingerprint identification mechanism to record and monitor staff and student attendance.

The system is made to realize different functions such as attendance remark, calculation and report printing. The remark can be made for reasons such as business leave, absence, marriage holiday and etc.; the checking and calculation can be made in accordance with different time periods, departments, individual or combination due to various reasons for absence, the report generation and printing function can be realized perfectly. It is secure, fast and reliable way of recording attendance as each user is granted different access level for security reasons. Just a quick touch of the registered finger marks your attendance whether entering or exiting the premise. Minor cuts or scars on your fingertips do not affect its performance.

It is expected to reduce attendance conflicts and unique biometric patterns on the fingers differentiate one staff from the other, thus no one can stand as a proxy in your absence. Real-time advantage allows for accurate time record based on actual time attendance. The power of the software lies in its ease to use with attractive user interface both for the front and back end users.

Its cost-effectiveness with no more spending on manual log books, punch card systems, proxy cards etc., gives an edge in the way you manage your employee and students. In addition the machine also does not require regular maintenance.

## 3.1 Scope

The increasing demand for reliable human identification in large-scale government and civil applications has boosted interest in the controlled, scientific testing and evaluation of biometric systems. Through this project our team intends to

- To conduct some research into different biometric devices.
- To acquire biometric fingerprint scanner devices (terminals)
- To design and develop the network infrastructure to link the devices to the school database.
- To develop the interface software that reads students attendance from the biometric devices and updates the database as and when the students scan their finger.
- To generate PDF or Excel reports for management

## 3.2 Stakeholders Description

### 3.2.1 Students

Students of the college will be the primary users of this technology. Every student will be giving his / her attendance using Fingerprint based attendance technology. For this every student has to be registered and each finger print entry should be updated on college database server. While registering every student is expected to submit the following information

- Personal details
- Course details
- Course duration
- Scanned visa copy
- Biometric Data

Registration can be done via the web interface provided and biometric information can be taken later. Once activated with the college all devices in the college will accept the biometric identification from the student and his attendance will be marked accordingly against the course he/she is taking.

### **3.2.2 College Administration**

Administrative staff in college plays a major role in using this technology. It is the administrative staff that will accept / reject the use of the system for capturing attendance in first place. The next step is to understand the usage of the system. It is the members of the staff who will deal with the system on daily basis. Proper training of the staff members is important to avoid errors while using the equipment.

System administrators must be equipped with sufficient system knowledge to minimize scanning issue caused by improper handling of system functions. Improper handling can create unnecessary confusion and inconvenience to users if the user's fingerprint got overwritten accidentally as a result of unawareness of fingerprint administrative process. For sites with multi terminals, system administrators must understand the logic of fingerprint replication functions for copying user records including fingerprint templates. They need to show due diligence while updating the personal and other details of the staff and students.

Managing database synchronization between terminal-and-PC and PC-to-terminal requires a systematic process to keep user records in-sync and updated at all times. Inappropriate download and upload handling and uncoordinated enrollment processes can cause the newly registered fingerprint templates to be overwritten. For example, if an administrator enrolls user fingerprints into multiple time clock machines, there is a high possibility some fingerprint templates being overwritten and even lost if it's carried out unplanned.

Although system administrator may read documentations provided to learn about software and hardware functions, the learning curve seems to take longer. Often system manual is helpful only if the administrator has already been on the job for some time coupled with some system experiences. For fresh administrators, the trainer is playing an important role to help administrators to jumpstart the fingerprint application process.

### **3.2.3 Lecturer and Other staff members**

Employee management is an aspect widely practiced in all workplaces. Day by day security breaches and transaction fraud increases, the need for secure identification and personal verification technologies is becoming a great concern to the organization.. Therefore, we present here efficient management of attendance using fingerprint identification for those area, where the biometric device are not available and attendance of employee is calculated at the last of month. First enroll the employee. Store all the necessary information including id, image and fingerprint into the database. When attendance is calculated, the daily fingerprints are matched with the stored fingerprint by using the scanner. If fingerprint is matched then attendance is accepted otherwise it is rejected. According to their attendance a monthly report is generated that gives complete details of their total working hours, Day in and out time details and total pay roll as per number of hours worked. Employees no longer punch their number into a computer. Manual calculations for each employee's time are not required.

### **3.2.4 Technical Staff**

The technical staff must ensure that the machine operates as it is designed to operate and gives error free attendance to students and staff members. It is the responsibility of the technical staff to ensure that the servers store data correctly and are able to produce same and match when asked for. The network between the server computers storing the data and the independent / local machines should be maintained at all times. In case of failures they should be able to provide for back option.

### **3.2.5 Librarian**

The librarian can now grant students books without checking their ID cards and getting the Library register signed by students for every book borrowed. The student details can now be validated using the fingerprint based technology. After the validation process is done the student will be asked if he / she is taking or returning the book. If the student is taking the book all the details like date, time, name of the book etc gets stored on the data base. While returning the software will calculate the number of days the book has been taken and fine if any.

### **3.2.6 Maintenance**

It is the responsibility of the maintenance personnel to ensure proper functioning of all the equipment including both the software component and the hardware component of the system. They have to be able to provide support in case of system failure and provide backup system or an alternative during the period when the original system is not working.

## 4. Project Schedule

Sl no	Task	Assigned to	Start	End	Duration (Days)
1	Project Ideas	All	09/10/2013	09/17/2013	7
2	Requirements Gathering, Purpose, Scope.	All	09/17/2013	09/24/2013	7
3	Vision Document	Amritha and Sneha	09/24/2013	10/01/2013	7
4	Functional and non-Functional requirements	Gautham and Sanjana	10/01/2013	10/08/2013	7
5	Feasibility Study	Shweta	10/01/2013	10/08/2013	7
6	Stakeholders Description	Raghu	10/08/2013	10/15/2013	7
7	Architecture Design	Gautham	10/15/2013	10/22/2013	7
8	Use Case and its Diagrams	All	10/22/2013	11/05/2013	14
9	UML Diagram	Sneha, Amritha, Sanjana	11/05/2013	11/19/2013	14
10	Test Plan	Shweta and Amritha	11/19/2013	11/26/2013	7
11	Project Presentation and reporting	All	11/26/2013	12/03/2013	7

## 5. Software Architecture Design

Finger print based attendance system framework is divided into three parts: Hardware/Software Design, Attendance Management Approach and On-line Report Generation. Each of these is explained below.

### 5.1 Hardware - Software Level Design

Required hardware used should be easy to maintain, implement and easily available. Proposed hardware consists following parts:

- (1)Fingerprint Scanner,
- (2)LCD/Display Module (optional),
- (3)LAN connection

Fingerprint scanner will be used to input fingerprint of teachers/students into the computer software.

LCD display will be displaying rolls of those whose attendance is marked. Computer Software will be interfacing fingerprint scanner and LCD and will be connected to the network. It will input fingerprint, will process it and extract features for matching. After matching, it will update database attendance records of the students.



*Figure 5 Fingerprint device*



## 5.2 Attendance Management Approach

This part explains how students and teachers will use this attendance management system.

Following points will make sure that attendance is marked correctly, without any problem:

1. All the hardware will be inside classroom. So outside interference will be absent.
2. To remove unauthorized access and unwanted attempt to corrupt the hardware by students, all the hardware except fingerprint scanner could be put inside a small cabin. As an alternate solution, we can install CCTV cameras to prevent unprivileged activities.
3. **Login Process:** When teacher enters the classroom, the attendance marking will start. Computer software will start the process after inputting fingerprint of teacher. It will find the Subject ID, and Current Semester using the ID of the teacher or could be set manually on the software. If teacher doesn't enter classroom, attendance marking will not start.
4. After some time, say 20 minutes of this process, no attendance will be given because of late entrance. This time period can be increased or decreased as per requirements.
5. **Logout Process:** After end of the class teacher mark attendance again and there after student
6. **Attendance** will be marked only if student login and log out.

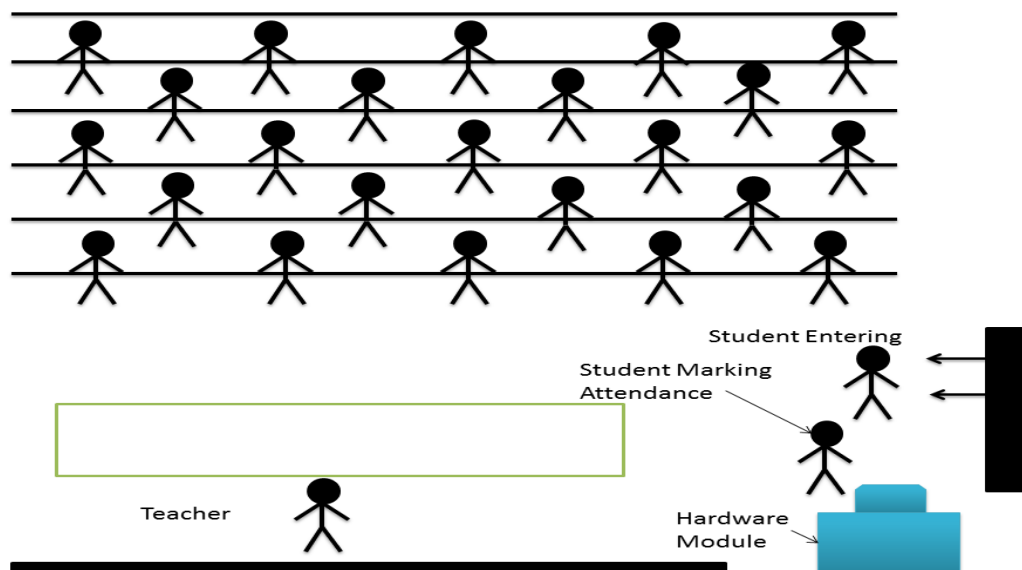


Figure 6 Classroom Scenario

## 5.3 On-Line Attendance Report Generation

Database for attendance would be a table having following fields as a combination for Primary field: (1) Day, (2) Roll, (3) Subject and following non-primary fields (1) Attendance,(2)Semester. Using this table, all the attendance can be managed for a student.

For on-line report generation, a website is hosted on Servers, which will access this table for showing attendance of students.

The sql queries will be used for report generation. Following query will give total numbers of classes held in subject CS423:

```
SELECT COUNT(DISTINCT Day) FROM AttendanceTable WHERE SUBJECT = CS423 AND Attendance = 1
```

For attendance of roll 107CS016, against this subject, following query will be used:

```
SELECT COUNT(Day) FROM AttendanceTable WHERE Roll = 107CS016 AND SUBJECT = CS423 AND Attendance = 1
```

Now the attendance percent can easily be calculated:

$$\text{Attendance} = \frac{\text{Classes Attended}}{\text{Class Held}} * 100$$



Figure 7 Login Form

## 5.4 Network management

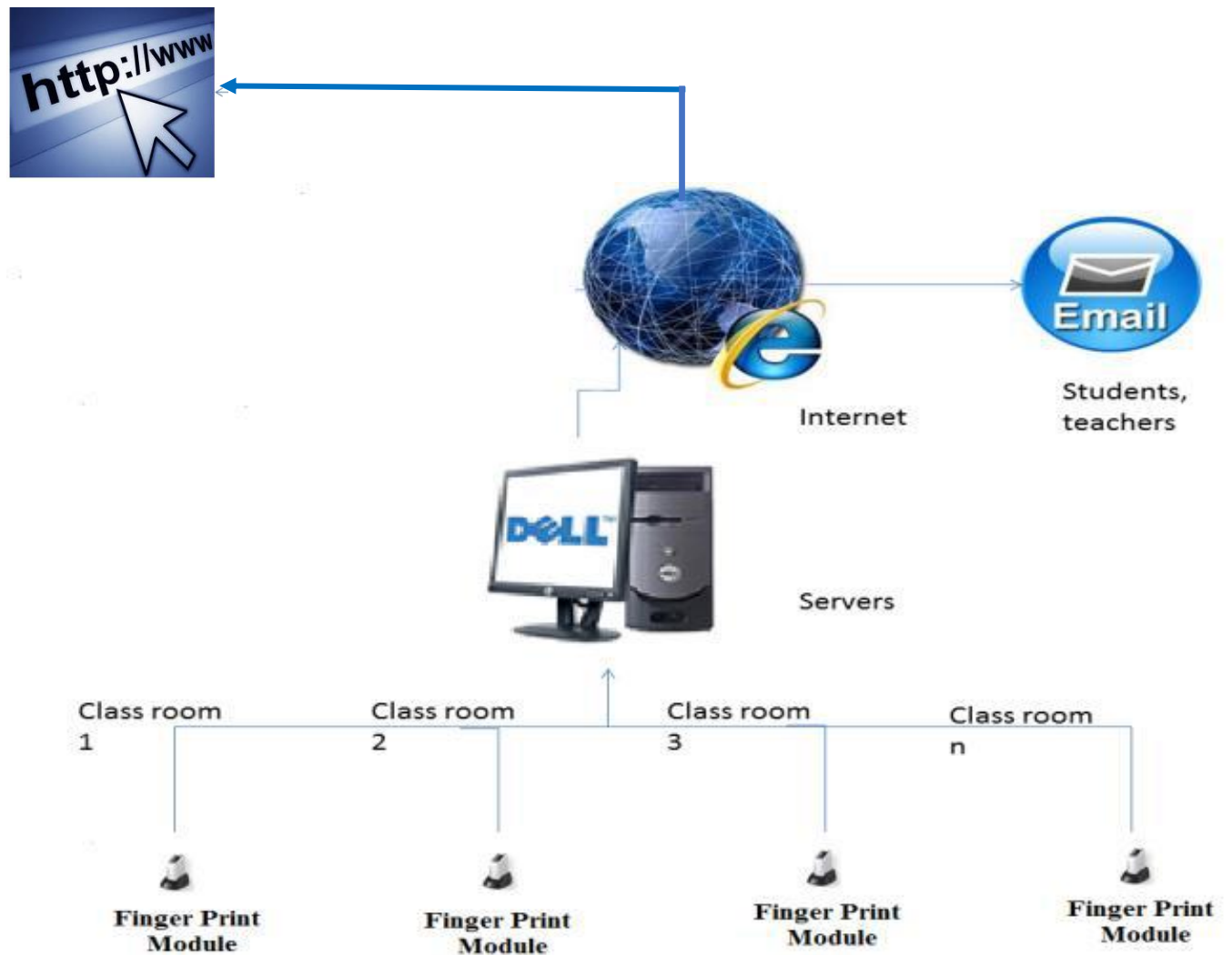


Figure 8 Network management

## 6. Use Cases

### 6.1 E-Attendance Use Case Diagram

**Use Case ID:** 01\_UCSTD

**Use Case Name:** E-Mail Notification to Student

**Use Case Description:** In Case of student attendance shortfall, E-mail notification is sent to him.

**Primary Actor:** Student

**Secondary Actor:** Administrator, Database server

**Precondition:**

1. All students mail id should be within the database records.
2. Active Network connection between the server and fingerprint device

**Post Condition**

1. E-mail sent to students having less attendance

**Normal Flow:**

1. Students marks the attendance while attending the class.
2. Student can log in to EMS to view his/her attendance and other details.
3. Student attendance is less than 70%, e-mail server will send a notification E-mail to student regarding shortfall in attendance.

**Alternate Flow:**

1. In case the student has attendance the class, but not updates in the database due to some technical fault, admin has right to update records.

**If Post condition fails:**

Admin will check the technical aspects and will make the needful changes.

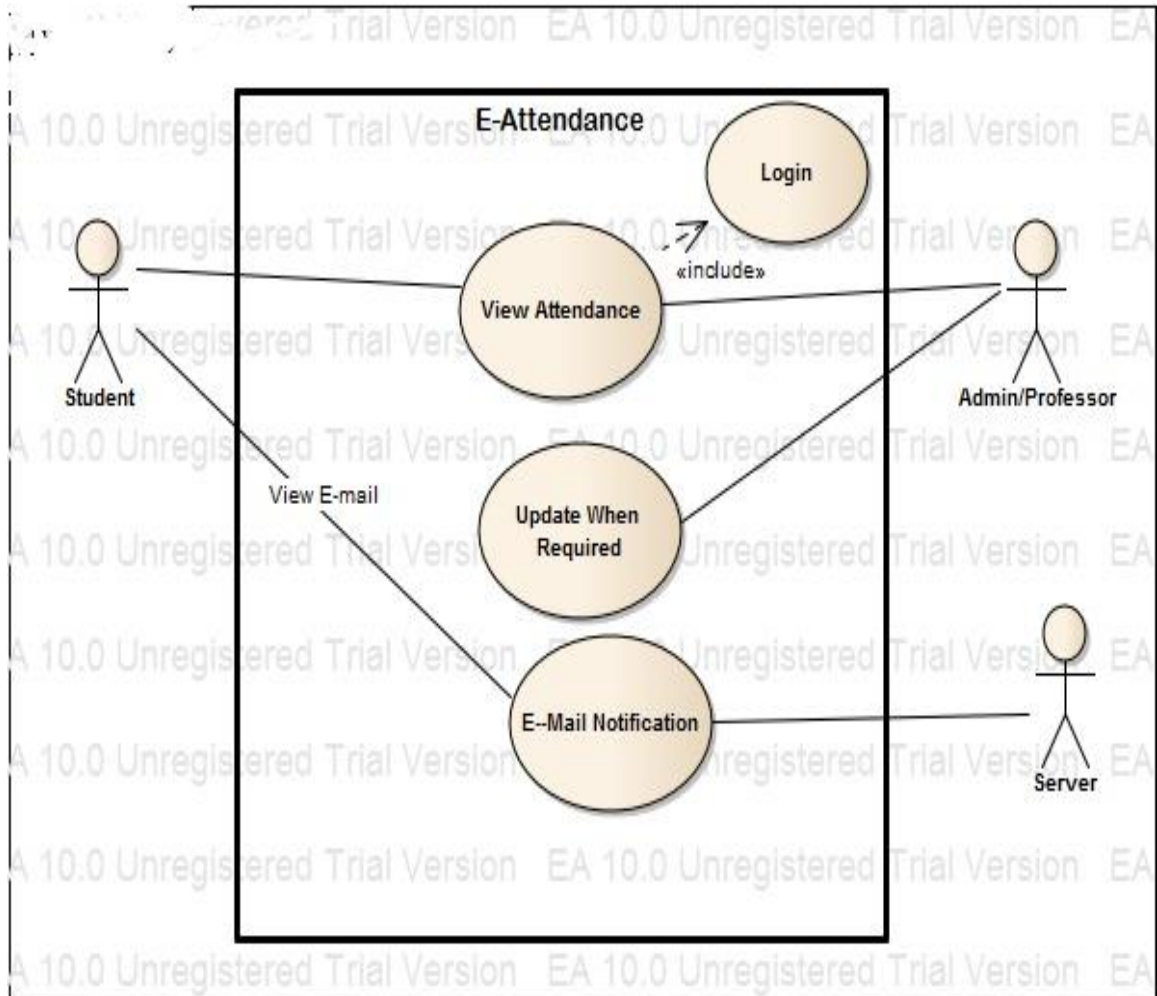


Figure 9 E-Attendance Use case diagram

## 6.2 Invalid/ not match Use Case

**Use Case ID:** 02\_UCSTD

**Use Case Name:** Invalid entry on fingerprint device

**Use Case Description:** In Case student is not able to mark attendance on device.

**Primary Actor:** Student

**Secondary Actor:** Administrator, Faculty

**Precondition:**

1. All students fingerprint should be within the database records.
2. Active Network connection between the server and fingerprint device.

**Post Condition:**

1. Student's problem of Invalid entry/Error mismatch has been resolved.

**Normal Flow:**

1. Students places the fingerprint on the device for marking attendance.
2. Student's fingerprint is not recognized on the device due to mismatch or technical fault.
3. Student asks faculty to mark attendance manually due to the problem.
4. If problem still persist, student can seek help from administration, as they maintain the device and have all rights to add, update and delete records.

**Alternate Flow:**

1. In case the student's fingerprint is **not available** in the records, he had to give the fingerprint match again for storage in the database.

**If Post Condition fails:**

Student will ask admin/faculty to mark attendance manually.

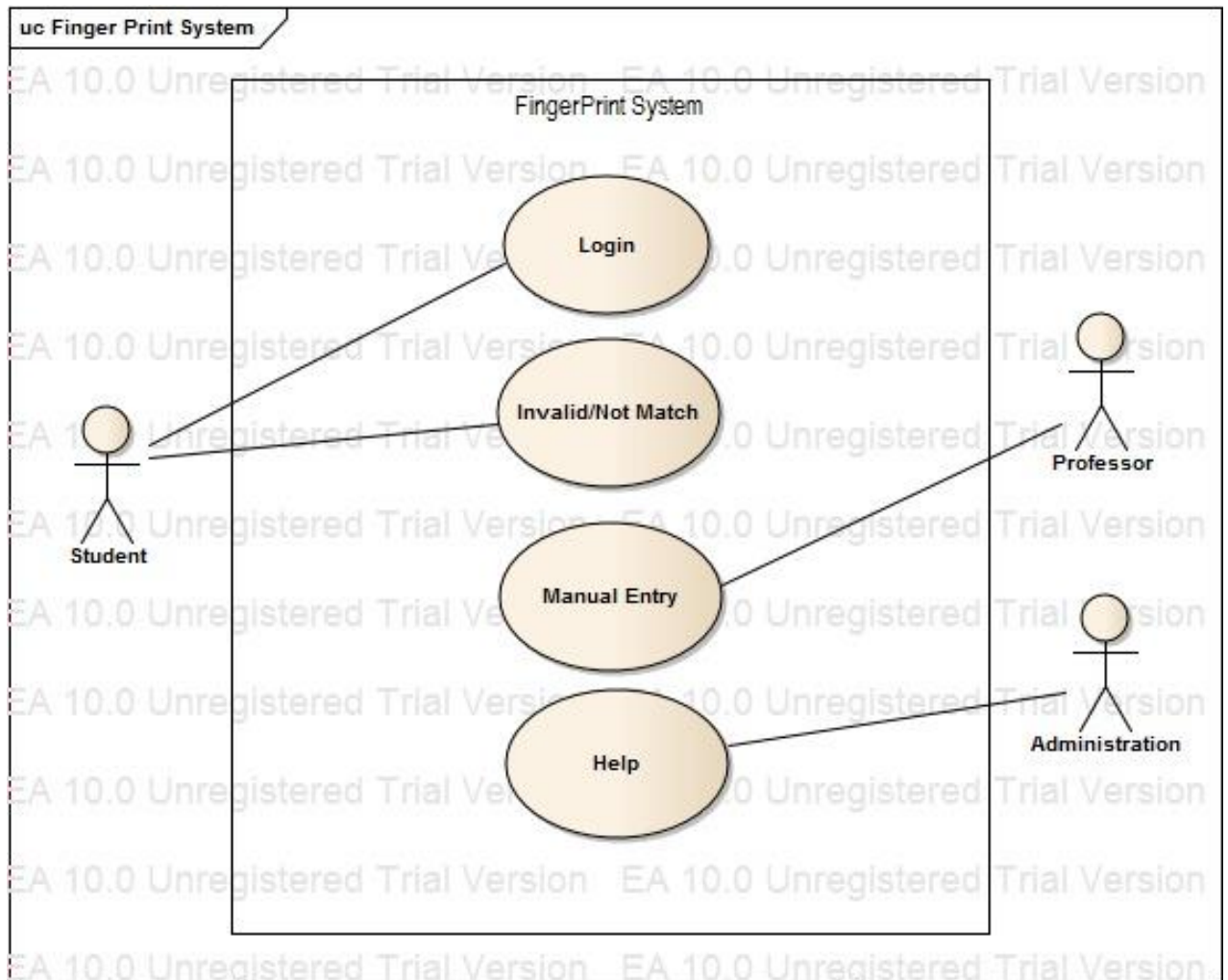


Figure 10 Invalid/Not match Use case diagram

## 6.3 Student Fingerprint Entry Use Case

**Use Case ID:** 03\_UCSTD

**Use Case Name:** Finger Print Entry

**Use Case Description:** The Use case describes the capturing of attendance of student using Finger Print Machine.

**Primary Actor:** Student

**Precondition:**

- 1) Student should register and provide fingerprint sample at the time of registration.
- 2) There should be active network

**Post Condition**

- 1) Student marks his / her attendance.

**Normal Flow:**

1. Student enters student ID in the system.
2. Student will give his fingerprint
3. System will verify the fingerprint
4. If valid match found, system marks student In – Time
5. Student will exit the system.

**Alternate Flow of Events**

1. If valid match not found, student will re-enter fingerprint
2. If valid match still not found attendance will be marked manually by Professor.

**If Post Condition Fails:**

Student will contact admin to mark his/her attendance manually or re-take the sample of fingerprint and save the updated one in database.



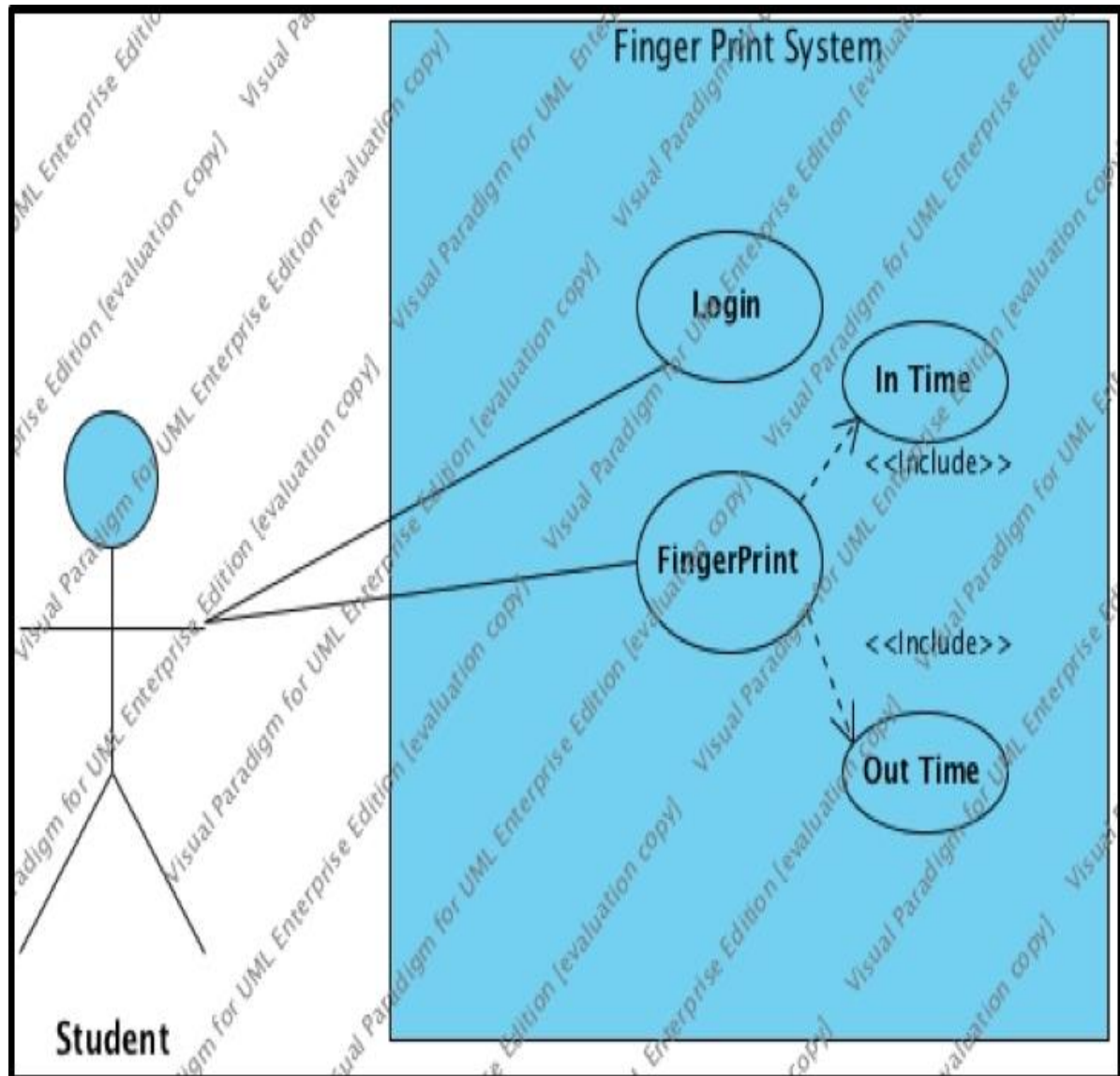


Figure 11 Student Finger Print Entry Use case diagram

## 6.4 Student Registration Use Case

**Use Case ID:** 04\_UCSTD

**Use Case Name:** Student Registration process

**Use Case Description:** The Use case describes the registration process of student.

**Primary Actor:** Student

**Secondary Actor:** Administrator

**Precondition:**

1. Student should secure admission in college.
2. There should be active network.
3. Fingerprint machine should be working.

**Post Condition**

1. Student fingerprint is saved in system.

**Normal Flow:**

1. Student will give his personal details including his fingerprint at the time of registration.
2. Student will give his fingerprint.
3. System will save the fingerprint and student personal details.
4. Administrator will add student record in the system.

**If Post Condition fails:**

Student has to re-submit the sample of fingerprint in order to mark attendance.

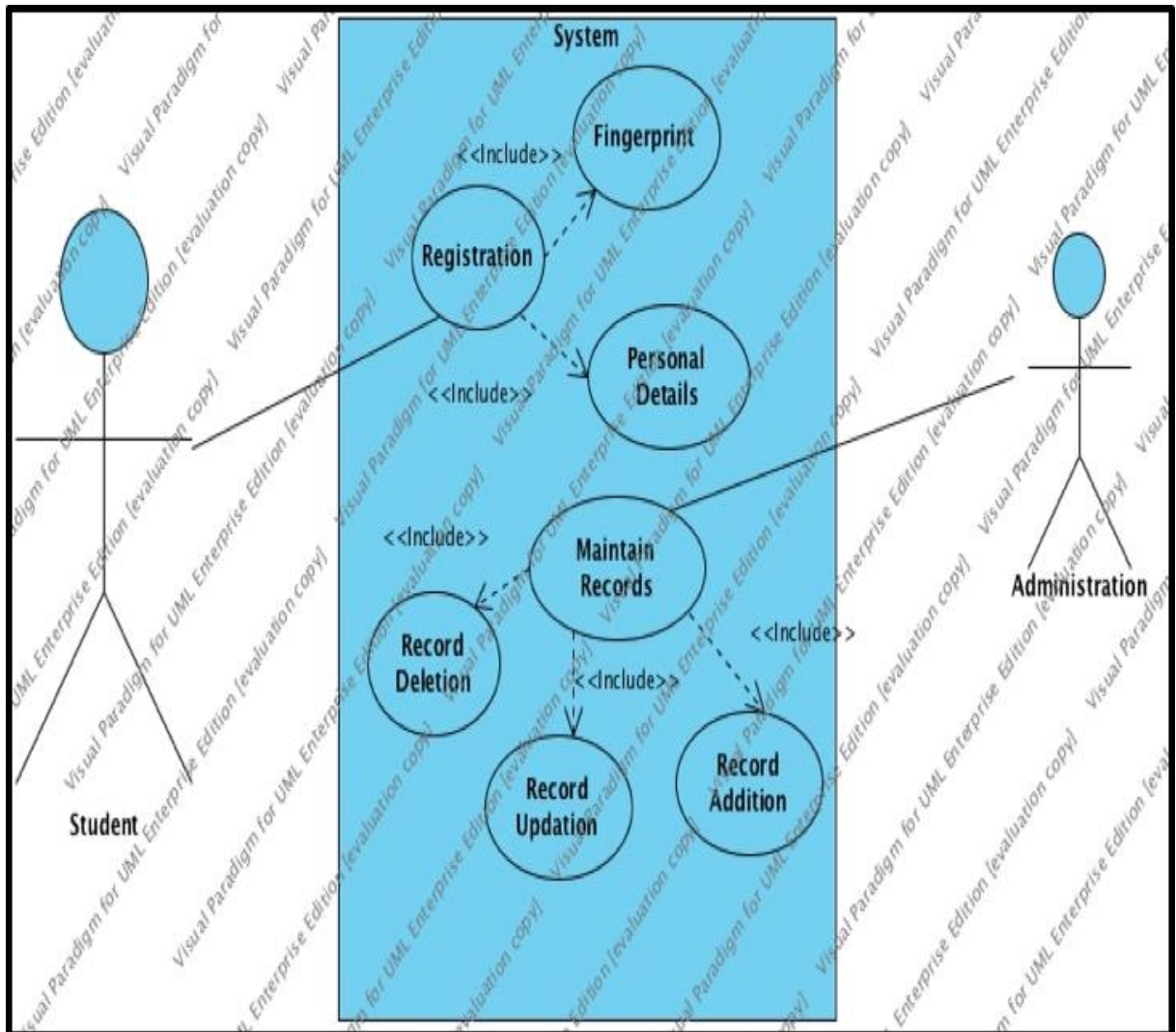


Figure 12 Student Registration process Use case diagram

## 6.5 Non-Teaching Staff Use Cases

**Use Case ID:** 05\_UCNTS

**Use case Name:** Fingerprint Entry Non-teaching Staff

**Use Case Description:** The Use case describes the capturing of attendance of non-teaching staff using Finger Print Machine.

**Precondition:**

1. Non-Teaching staff provides fingerprint sample on the day of joining
2. There should be active network

**Post Condition:**

1. Non-Teaching staff marks his / her attendance.

**Normal Flow:**

1. Non-Teaching staff places his finger on the fingerprint reader
2. System verifies the fingerprint
3. If valid match found, system marks Non-Teaching staff In – Time

**Alternate Flow:**

1. If valid match not found, Non-Teaching staff re-enters the fingerprint
2. If valid match still not found, then Non-Teaching staff contacts the admin.

**If Post Condition fails:**

Staff members either will contact admin to manually mark attendance or re-submit their sample fingerprint to get them updated for the next marking of attendance.

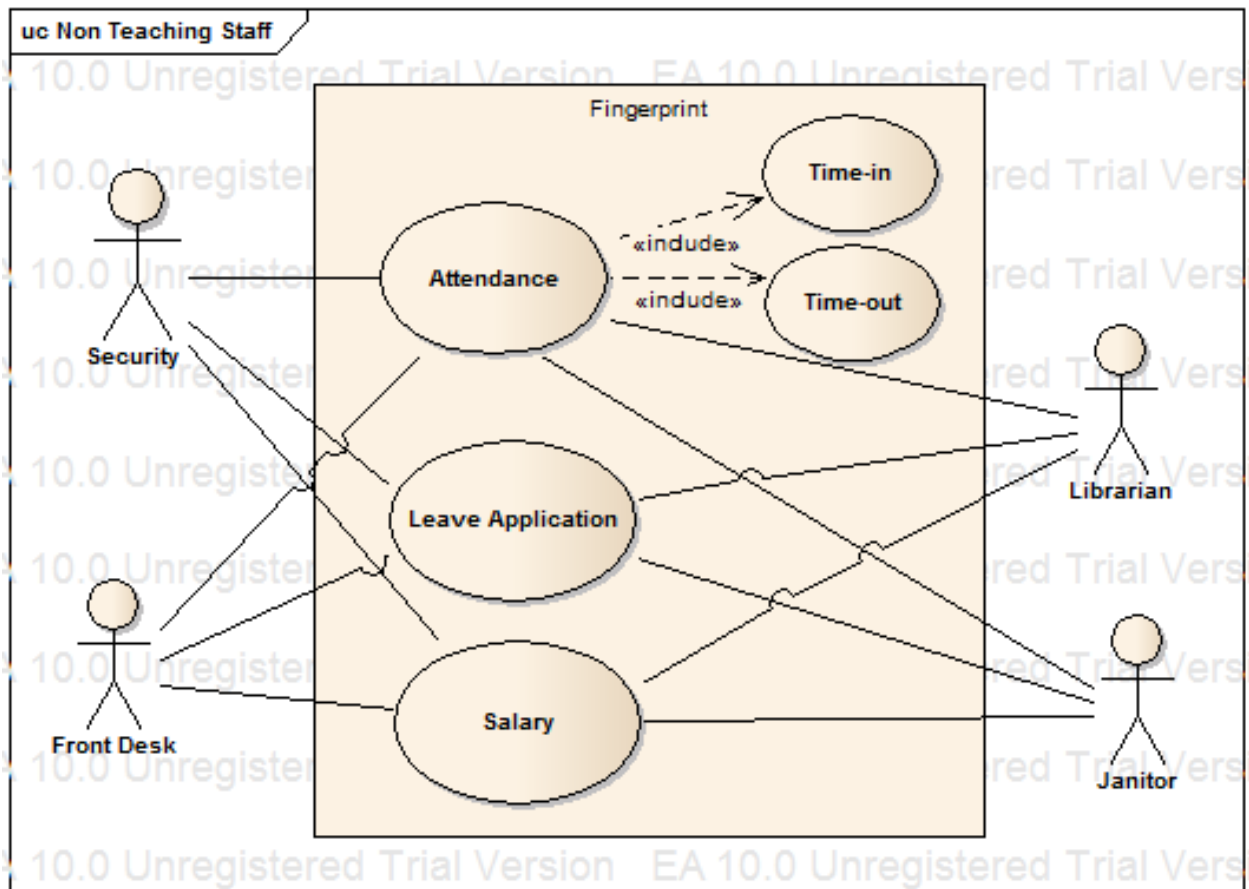


Figure 13 Fingerprint Entry Non-teaching Staff Use case diagram

## 6.6 Admin Use Case

**Use Case ID:** 06\_UCADMN

**Use case Name:** Admin Fingerprint System

**Use Case Description:** The Use case describes the key roles admin performs in implementing fingerprint reader

**Precondition:**

1. Admin should have rights to access database and make changes with high level of security
2. There should be active network

**Post Condition:**

1. Able to manage users with all details updated
2. Ensure effective management of fingerprint reader

**Normal Flow:**

1. Admin captures the sample of new user to make entry in the database
2. After verification, saves it.
3. Admin manages the session to login, logout and error handling job for all users.
4. Admin also view all the logs, save them and handles E-mail alerts for students if shortfall occurs
5. Admin has right to delete user if user is no longer part of college, can update their details as well

**If Post Condition fails:**

If admin is unable to create, update, delete users or any other problem will contact the vendor to check in.

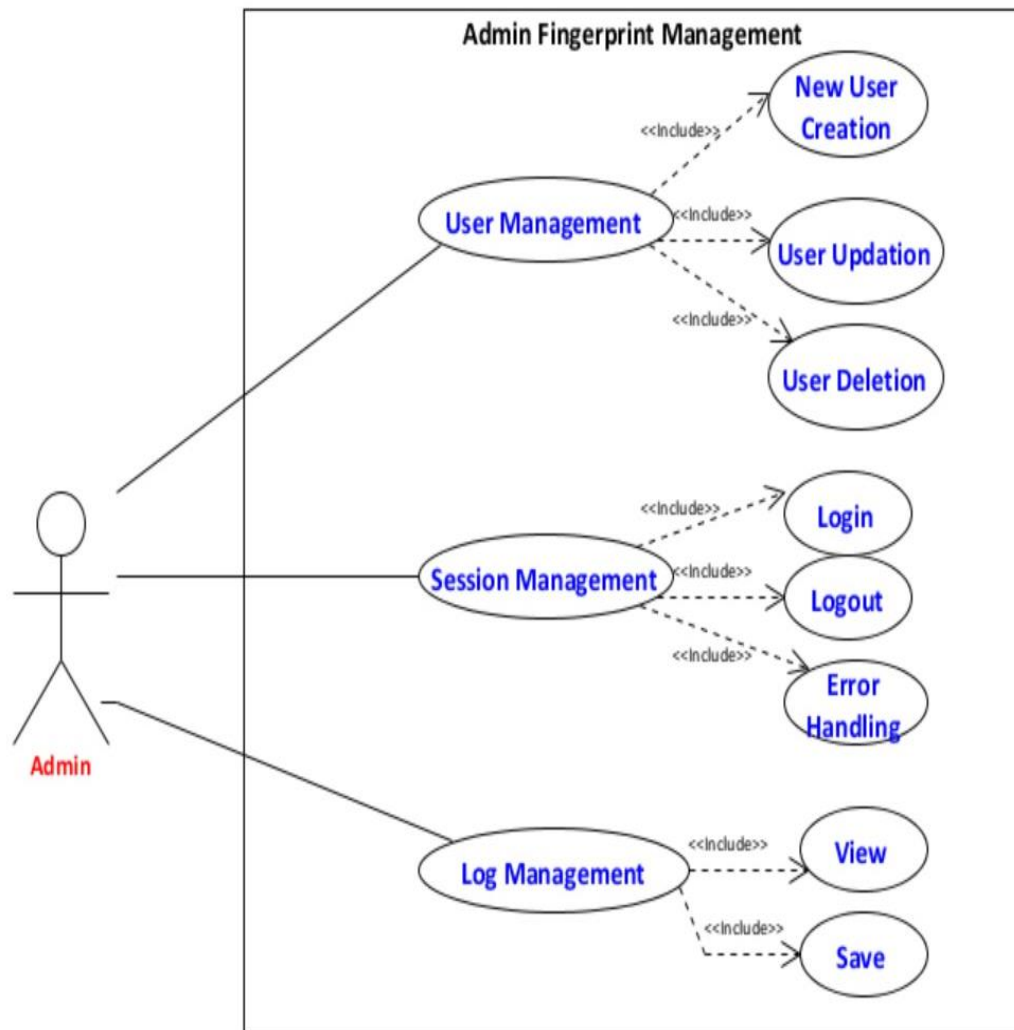


Figure 14 Admin Fingerprint System Use case diagram



## 7. UML Diagrams

### 7.1 Class Diagram

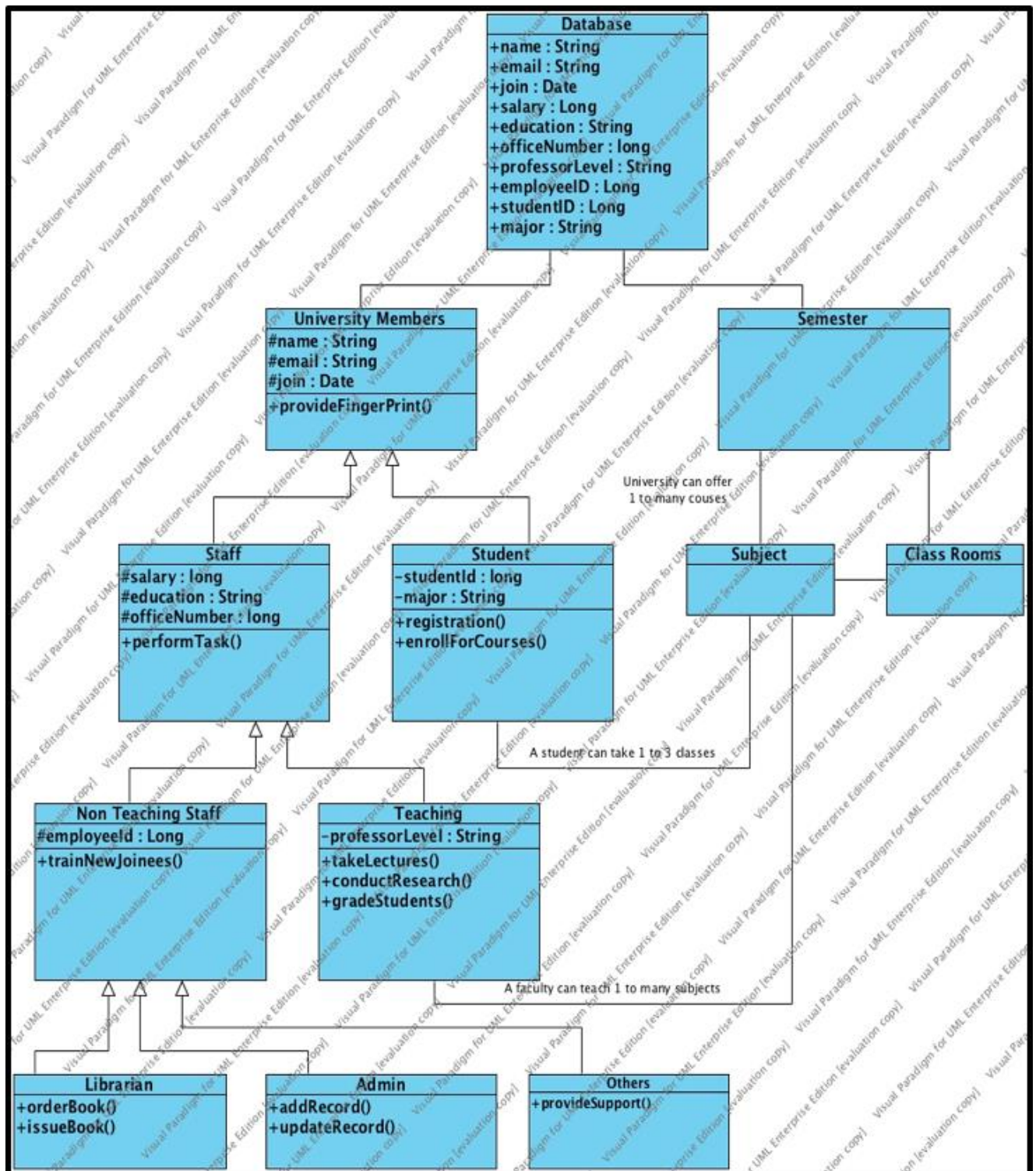


Figure 15 Class Diagram



## 7.2 Generalization Diagram

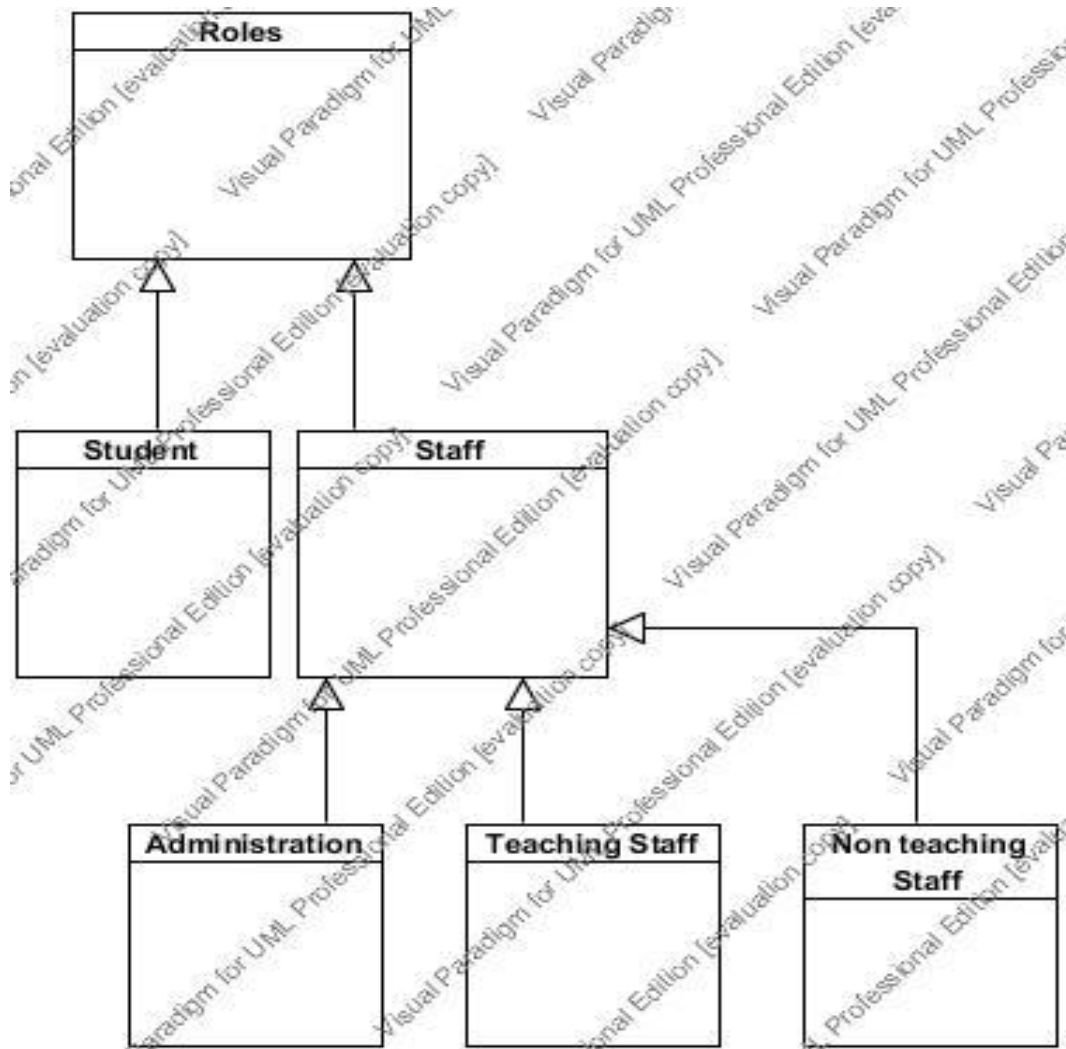


Figure 16 Generalization Diagram

## 7.3 Activity Diagram

### 7.3.1 Capturing Finger Print (At the time of Registration)

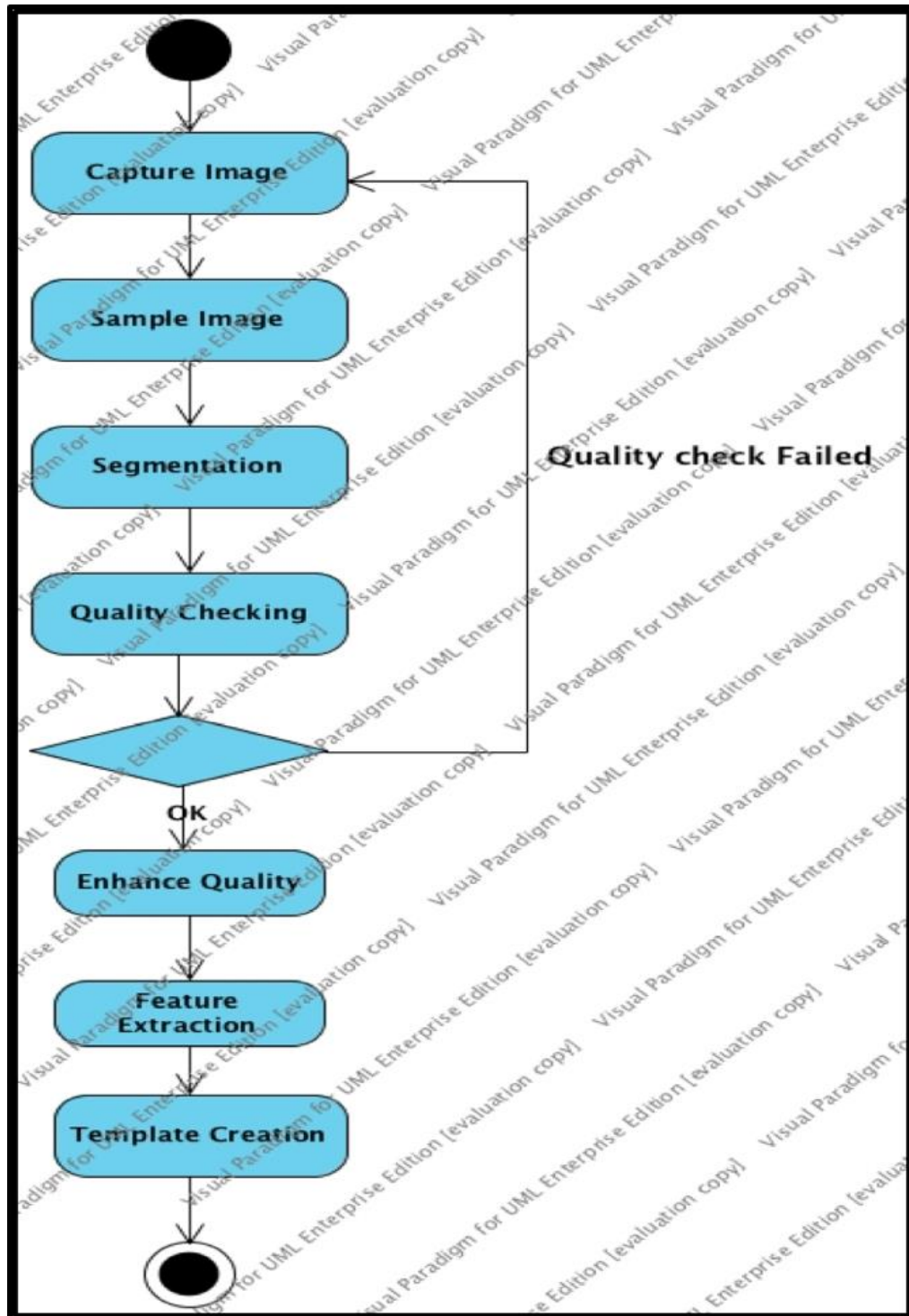


Figure 17 Activity Diagram

### 7.3.2 Marking Attendance

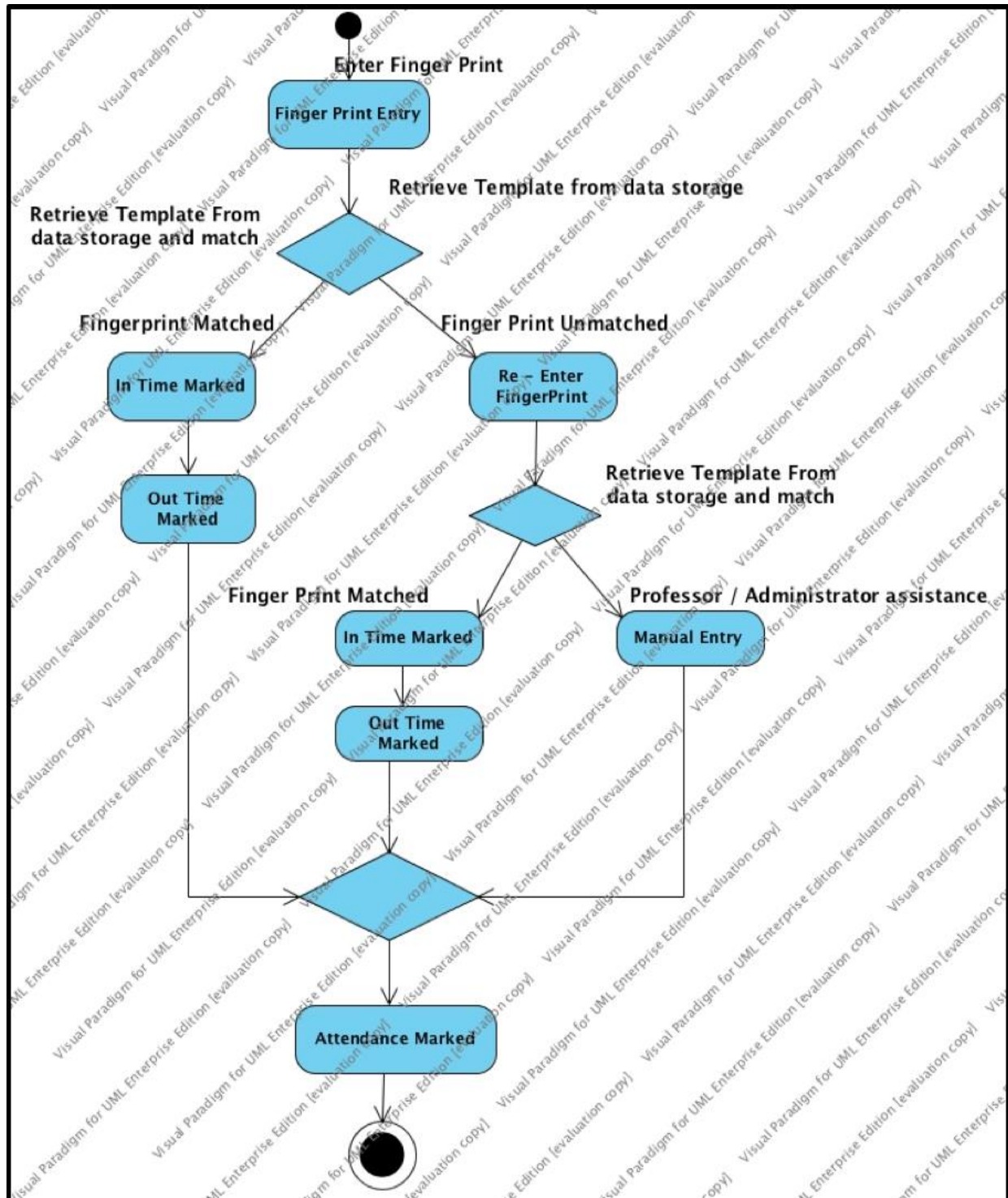


Figure 18 Marking Attendance Activity Diagram

## 7.4 Sequence Diagram

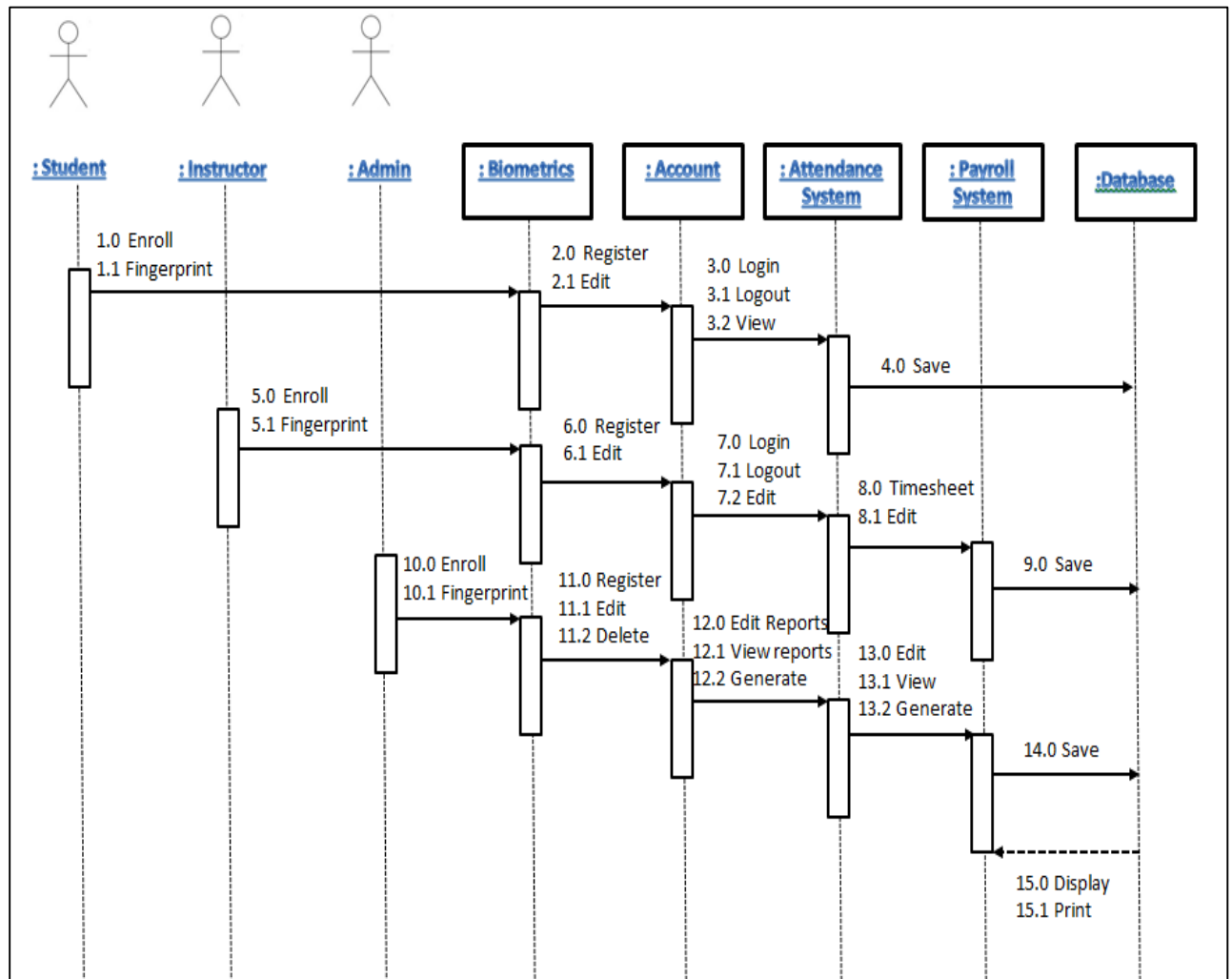


Figure 19 Sequence Diagram

## 7.5 Collaboration diagram

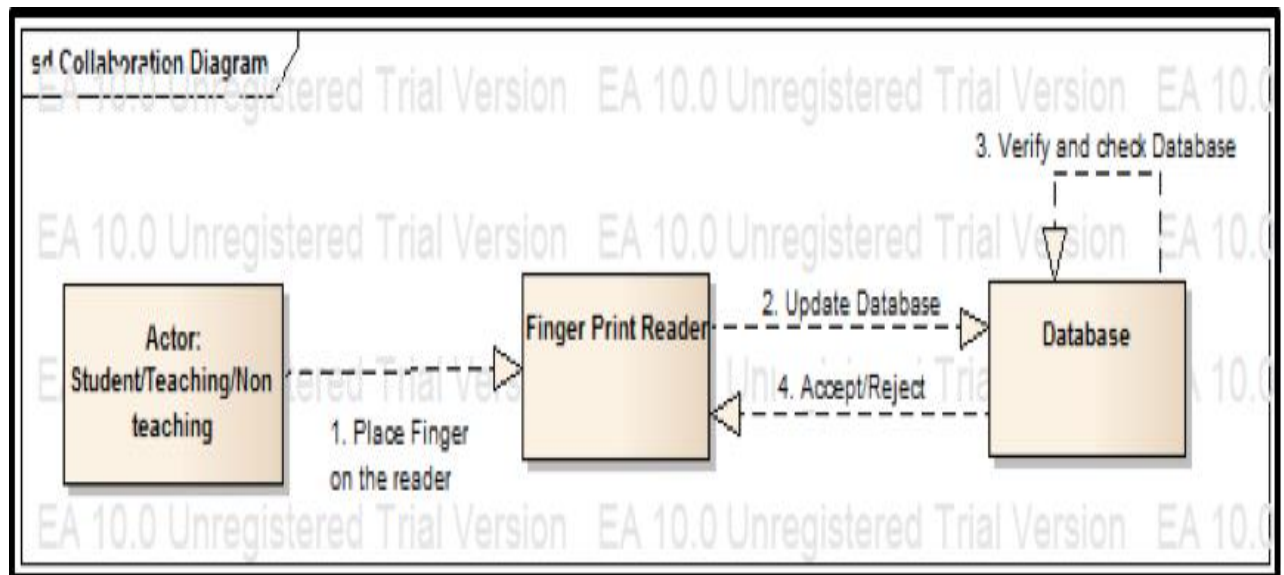


Figure 20 Collaboration diagram

## 8. Test Plan

### 8.1 Introduction

Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints. A fingerprint recognition system usually consists of building a database which stores fingerprints to be verified or matched, capturing fingerprint images real-time with a device, processing the captured image and verifying this image with fingerprints in the database for marking attendance of students, processing salaries for staff members.

The Fingerprint Recognition System can take a fingerprint image in real-time using a fingerprint device. It is also able to process the fingerprint image taken from device. One of the main functions of the Fingerprint Recognition System is to verify the captured image with the images stored in the database. The users will have ability to enroll and verify their fingerprint themselves.

The Fingerprint Recognition System will do the following:

- ✓ Provide enrollment function to new users, and Create a fingerprint template file with users' employee ID.
- ✓ Provide verification function to verify the users' identity.
- ✓ Log out the system

### 8.2 Test Plan Objectives

This Test Plan for the Fingerprint Recognition System supports the following objectives:

- ✓ Define the activities required to prepare for and User Acceptance testing.
- ✓ Communicate to Client the System Test strategy.
- ✓ Communicate to Client the various Dependencies and Risk

## 8.3 Scope

- **Data Entry**

The Fingerprint Recognition System should allow the admin to enter employee and student information from any compatible PC workstations running Windows98 or higher. The system will be menu driven and will provide prompting message to help direct the staff and student through various options.

- **Match Fingerprint**

Each staff and student will need to enter the employee ID and press the fingerprint device to input the fingerprint. The system will give the result.

## 8.4 Test Strategy

The test strategy consists of a series of different tests that will fully exercise the Fingerprint Recognition System. The primary purpose of these tests is to uncover the systems limitations and measure its full capabilities. A list of the various planned tests and a brief explanation follows below.

### 8.4.1 System Test

The System tests will focus on the behavior of the Fingerprint Recognition System. User scenarios will be executed against the system. Overall, the system tests will test the integrated system and verify that it meets the requirements defined in the requirements document.

### 8.4.2 Unit Test

- **Black Box Test**

In considering the inputs for our equivalence testing, the following types will be used:

1. Legal input values – Test values within boundaries of the specification equivalence classes. This shall be input data the program expects and is programmed to transform into usable values.

2. Illegal input values – Test equivalence classes outside the boundaries of the specification. This shall be input data the program may be presented, but that will not produce any meaningful output.

The equivalence partitioning technique is a test case selection technique in which the test designer examines the input space defined for the unit under test and seeks to find sets of input that are, or should be, processed identically.

➤ **Performance Test**

Performance test will be conducted to ensure that the Fingerprint Recognition System's response time meet the user expectations and does not exceed the specified performance criteria.

➤ **Database Test**

Tests will be conducted to check the accuracy of the user fingerprint template file. These tests will ensure that no features are missing, and the .fpt file can be used as matching or verification purpose.

➤ **User Acceptance Test**

The Payroll department will perform User Acceptance Testing. The purpose of these tests is to confirm that the system is developed according to the specified user requirements and is ready for operational use. At the end the User Acceptance Test, we will do the survey to everyone who uses the system. We will gather all suggestions from user to improve our system in the future.



## 8.5 Test Cases

Sl.No.	Test Case Name	Steps	Expected Result
1	Match Fingerprint for verifying user identity	1. Student should give finger print sample for both the hands. 2. Save the details and fingerprint sample in the database. 3. Student should place finger on the device and login for attendance. 4.Attendance successful should come on screen of the device	1. Administrator should be able to verify the match with the identity of the student
2	Capture Fingerprint	1. Student is asked to place his finger on the screen of the fingerprint capturing device 2. It should accept the sample and pop up appear on screen. 3. Fingerprint accepted	1.Device should accept and capture fingerprint of all students and staff
3	Save Fingerprint	1. After capturing of the fingerprint, device should save it to the connected database for attendance and salaries of the student and staff.	1. Device should save it to the database successfully with active network connection
4	E-mail verification Notification	1. Database should automatically calculate the attendance with the help of formulas. 2. In case attendance is less than 70%, e-mail should be sent to all the corresponding Mail id's.	1. Student having attendance shortfall should receive an Email Notification

5	Attendance without fake student ID	1. After login enter some fake student id. 2. Message prompt on screen Invalid ID	1. Should not allow student to further mark attendance unless correct student id is entered.
6	Scanning of fingerprint on locked screen	1. Don't login on the screen. 2. Try to mark attendance on the locked screen of the device.	1. It should take the impression of the staff or student without login on the device.
7	Unregistered Finger	1. Login on the device. 2. Try with unregistered fingers, someone whose fingerprints are not in the database.	1. Device should display error message like Not a valid match.
8	Speed Test	1. After login and entering the employee id or student id. 2. Don't put finger before 30 seconds. 3. After 30 seconds put the finger print.	1. Device should not recognize the finger print and display message enter id again.
9	With gloves on hand, or oily , wet, dry finger	1. After login on the device and entering the student id or employee id. 2. Try to mark attendance by wearing gloves on hand or oily fingers or wet or dry fingers.	1. System error message "Invalid user" or "Try again"

## 9. Team Meetings

### 9.1 Introduction

#### **Date and time**

- Occurs every Tuesday effective 9/10/2013 until 12/03/2013
- from 4.45 PM to 5:45 PM

#### **Location**

- Class room 102

#### **Agenda**

- Project Updates
- Action Item (AI ) / task Follow up
- Project Discussion
- Risk analysis
- New Ideas!

#### **MOM (minutes of meeting)**

- One person will take minutes of meetings
- As per student id or alphabetical order

## 9.2 Minutes of meeting

**Date** : 10/01/13  
**Time** : 5-6 PM  
**Prepared By** : Sanjana Penmetsa

### **Attendees:**

Amritha Bhat  
Gautham Pai  
Sanjana Penmetsa  
Shweta Verdia  
Sneha Gang

### **Agenda:**

- Discuss the project progress
- Outline the contents of the project.
- Share individual ideas and knowledge gained on the topic.
- Assign tasks for the following two weeks.

### **Notes:**

- Discussed about the overall contents of the project. Used previous projects as a reference.
- Assigned topics/tasks to each individual to compile for the project document.
- Have to list the individual tasks assigned to everyone (Sneha has the document)

### **Action Items:**

- Each member of the team will be updating the status of their task in the next two weeks

**Date** : 10/08/13  
**Time** : 5.15 - 6 PM  
**Prepared By** : Shweta Verdia

**Attendees:**

Amritha Bhat  
Gautham Pai  
Sanjana Penmetsa  
Shweta Verdia  
Sneha Gang  
Raghu

**Agenda:**

- Discuss the project progress
- Review of task given to each member
- Knowledge sharing - functional/non - functional requirements
- Feedback and suggestions by team members on project

**Notes:**

- Discussed about the project schedule and Gantt Chart
- Every member presented the work task done by them on the project till now and decided on the next week task

**Date** : 10/22/13  
**Time** : 5-6.15 PM  
**Prepared By** : Sneha Gang

**Attendees:**

Amritha Bhat  
Sneha Gang  
Gautham Pai  
Sanjana Penmetsa  
Shweta Verdia  
Raghu

**Agenda:**

- Discuss the project progress and things yet to be done.
- Assign tasks for the following weeks.

**Notes:**

- Discussed about the role attributes of each stakeholder, design of user interface and high level use cases.
- Assigned topics/tasks to each individual to compile for the project document.

**Action Items:**

- Each member of the team will be working on Use cases for following week.

## 10. Risk Analysis

Risk analysis should be performed as part of the risk management process for each project.

The fingerprint based attendance system also involves certain risk factors. Suppose there is a student trying to punch the fingerprint wearing gloves, system does not respond to such scenario.

The finger cannot be greasy or oily or dirty while punching the fingerprint to the reader. The system will be unable to retrieve or update data to or from database in case of any network issues.

The system will be unable to retrieve or update data to or from database in case of power outage.

Also the system will be unable to retrieve or update data to or from database in case of database crash.

## 11. Project lesson learned

- ✓ How essential it is to perform feasibility study before proceeding with a project so that you don't invest time, money and resources unnecessarily on a project.
- ✓ Proper and complete requirements is the foundation for a successful software.
- ✓ Gathering requirement and keep in mind Are we trying to solve the right problem and are we trying to solve the problem correctly is essential part of project throughout.
- ✓ We learned the importance of Vision document and how it helps in assuring that everyone working on the project is working towards a single objective.
- ✓ Learnt about the generalization and specialization concept which is important part of software engineering.
- ✓ Leaned how to draw State transition, class and activity diagram using tools like Visual Paradigm, Enterprise Architect.
- ✓ The use of biometric technology in our project made us explore more on the concept, thus get a clear picture of fingerprint technology.
- ✓ Also creating test plan to plan set of activities in advance and conduct them systematically.
- ✓ Test cases to ensure to uncover errors.
- ✓ The weekly meetings gave us a chance to swap ideas and skills.
- ✓ It is important to understand team dynamics, strengths and weakness of each team member while working in team.



## 12. Glossary

### **Activity Diagram**

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency.

### **Authentication**

To establish the authenticity of is to prove genuine.

### **Aggregation**

Several things grouped together or considered as a whole

### **Biometric:**

Refers to the identification of humans by their characteristics or traits.

### **Class Diagram**

In software engineering, a class diagram in the Unified Modeling Language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations, and the relationships among objects.

### **Context**

The Environment, economic condition, human factors, technology, constraints, and ambience in which the system will be deployed and used.

### **Constraint**

A limitation or Restriction

### **Collaboration Diagram**

It is an illustration of the relationships and interactions among software objects in the Unified Modeling Language (UML).

### **Fingerprint**

An impression or mark made on a surface by a person's fingertip, esp. as used for identifying individuals from the unique pattern of whorls and lines.

### **Image Sampling**

Converting the analog scan of the fingerprint image to its digital equivalent of highest quality.

**Image Segmentation**

Process of partitioning an image into multiple small fragments to change the representation of image so that it becomes easier to analyses.

**Pre-condition**

Those conditions that must be present in order for a use case to start.

**Post-condition**

Post-condition describes the state of the system after a use case has run its course.

**Stakeholders**

A person or group that has an investment, share, or interest in something, as a business or industry.

**Sequence Diagram**

A sequence diagram is a kind of interaction diagram that shows how processes operate with one another and in what order.

**Synchronization**

The relation that exists when things occur at the same time

**UML**

Unified Modeling Language.

**Use case**

A use case is a software and system engineering term that describes how a user uses a system to accomplish a particular goal.

**Verification**

The evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition. It is often an internal process. Contrast with validation.

**Validation**

The assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It often involves acceptance and suitability with external customers. Contrast with verification."

## 13. Conclusion

This project mainly comprised of development of attendance management system and Fingerprint identification system. Attendance management is helpful in saving valuable time of students and teachers, paper and generating report at required time. This project presented a framework using which attendance management can be made automated and provided online. A general implementable approach to attendance management was proposed using LAN. Further, an idea for using portable devices along with Wireless LAN or mobile 3G network was suggested.

Fingerprint Identification System used for student identification is faster in implementation than any other biometric Fingerprint identification systems.

Overall, fingerprint based attendance system is reliable, cheap, portable, easy to use and involves less maintenance cost.

# Fingerprint Based Attendance System

SEM 941 SOFTWARE ENGINEERING

Date: 03<sup>rd</sup> Dec 2013

Presenters:

Amritha Bhat	(83601)
Gautham Pai	(84075)
Raghvendra	(84807)
Sanjana Penmetsa	(84407)
Shweta Verdia	(84224)
Sneha Gang	(84114)

Dept. / Author / Date

## Agenda:

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- Introduction
- Biometric and Fingerprint
- Architecture and System Design
- Requirements
- Stakeholders Description
- Feasibility Study
- Use Cases
- UML Diagrams
- Test Plan
- Risk Analysis
- Conclusion



Dept. / Author / Date

## Introduction:

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Every organization whether it be an educational institution or business organization, it has to maintain a proper record of attendance of students or employees for effective functioning of organization.

### **Present Attendance System (non-optimal)**

- All work is done on paper → waste of paper
- Manual control → Taking Attendance, Tracking, Maintenance, Reporting, Communication
- Time consuming → Roll Calling.
- Difficulty in report generating → At the end of semester the students who don't have 75%
- Possibility of forgery / manual computation produces errors
- Proxy Attendance

For the stated reason, an efficient attendance management system using biometrics (finger Print) is designed.

## Biometric and Fingerprint:

---

Biometric Identification Systems are widely used for unique Identification of humans mainly for verification and Identification. Is used as a form of identity access management and access control.

Fingerprints are considered to be the best and fastest method for biometric identification.

- They are secure to use
- Unique for every person and does not change in one's lifetime.
- Implementation of fingerprint recognition system is cheap.
- Easy and accurate up to satiability.
- Faster than other techniques
- Energy consumption by such systems is too less.



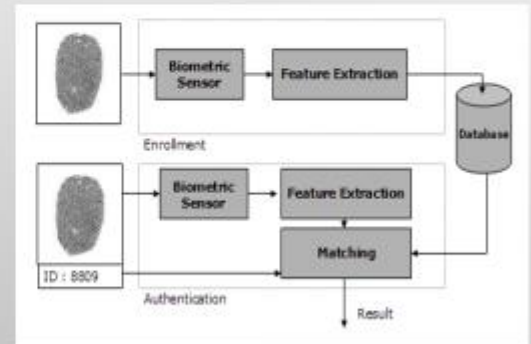
## Fingerprint Based Attendance System :

The purpose of developing attendance management system is to computerize the traditional way of taking attendance.

This system takes attendance electronically with the help of a finger print device, identification of student, records of the attendance are stored in a database.

### How Fingerprint Recognition works?

- ✓ Fingerprint scanner will scan finger using sensor
- ✓ Remove noises and enhance their quality.
- ✓ Extract features like minutiae and others for matching.
- ✓ If the sets of minutiae are matched with those in the database for marking attendance etc.



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## Architecture and System Design:

### ➤ Hardware Architecture

1. Fingerprint scanner
2. Processor Module
3. PC based Server-Client Software Management Module

### ➤ Software Architecture

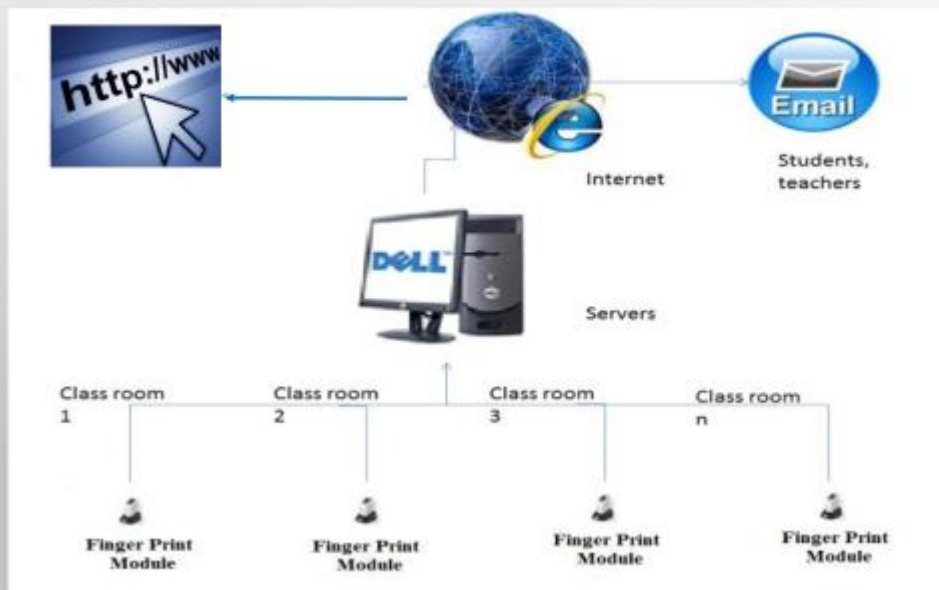
1. Data Base
2. Application Program

### ➤ Methodology

- ✓ Enrolment
- ✓ Authentication
- ✓ Online report generation

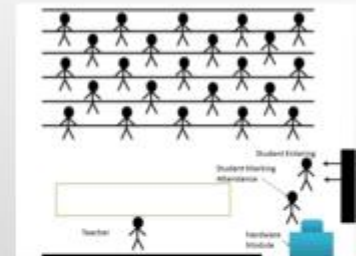
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## Network management:



## Classroom Scenario:

- ✓ All the hardware will be inside classroom. So outside interference will be absent.
- ✓ Installed CCTV cameras to prevent unprivileged activities.
- ✓ Login Process: When teacher enters the classroom, the attendance marking will start. Computer software will start the process after inputting fingerprint of teacher. It will find the Subject ID, and Current Semester using the ID of the teacher or could be set manually on the software. If teacher doesn't enter classroom, attendance marking will not start.
- ✓ After some time, say 20 minutes of this process, no attendance will be given because of late entrance. This time period can be increased or decreased as per requirements.
- ✓ Logout Process: After end of the class, teacher marks attendance again and there after student should log out.
- ✓ Attendance will be marked only if student login and log out.



## On-Line Attendance Report Generation:

The sql queries will be used for report generation.

Following query will give total numbers of classes held in COURSE SEM 941:

➤ `SELECT COUNT(DISTINCT Day) FROM AttendanceTable WHERE COURSE= SEM941 AND Attendance = 1`

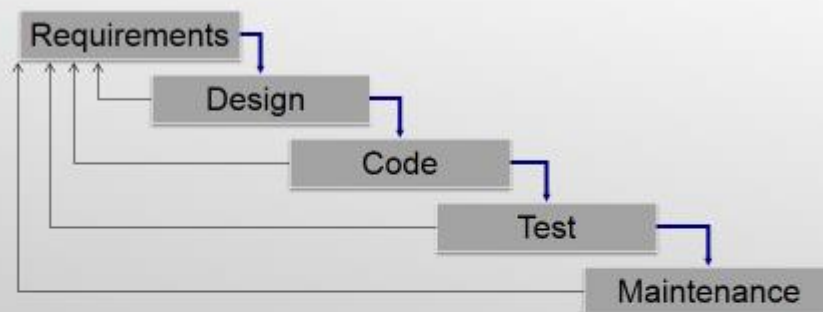
For attendance of student id 84075, against this subject, following query will be used:

➤ `SELECT COUNT(Day) FROM AttendanceTable WHERE Id= 84075 AND COURSE= SEM941 AND Attendance = 1`



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## Requirements Engineering:



- Requirements describe a system's behavior and what the system will do to meet the user/customer needs.
- Categories:
  - **Functional** – Identifies the interaction between the system and its environment, independent of implementation.
  - **Nonfunctional** – Constraints that limit implementation options



## **Functional Requirements:**

---

- Student registration
- Identification of a student
- Storage of students identified
- Display student's name after identification and sounds.
- Time stamping of identification
- Downloading data to Microsoft Excel
- Email Notifications to Professor and students in case of low attendance
- Scan of entire fingerprint with dual orientation
- Access of system to Faculty members
- Save and Backup fingerprint data

## **Non-Functional Requirements:**

---

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>• <u>Performance Requirements:</u><ul style="list-style-type: none"><li>- Throughput</li><li>- Response time</li><li>- Data Latency</li></ul></li></ul>  | <ul style="list-style-type: none"><li>• <u>Security Requirements:</u><ul style="list-style-type: none"><li>- Denial of service attacks</li><li>- Malware attacks</li><li>- Data Confidentiality</li></ul></li></ul>  |
| <ul style="list-style-type: none"><li>• <u>Design Constraints:</u><ul style="list-style-type: none"><li>- Database</li><li>- Operating Environment</li><li>- HW Specifications</li><li>- Legal constraints</li><li>- Economic</li><li>- Sustainability</li><li>- Portability</li></ul></li></ul> | <ul style="list-style-type: none"><li>• <u>Safety Requirements:</u><ul style="list-style-type: none"><li>- Safe State</li><li>- System reset</li><li>- Manual Shutdown</li><li>- Fingerprint Identifiers - accurate, relatively unalterable, unique physical characteristics</li></ul></li></ul> |

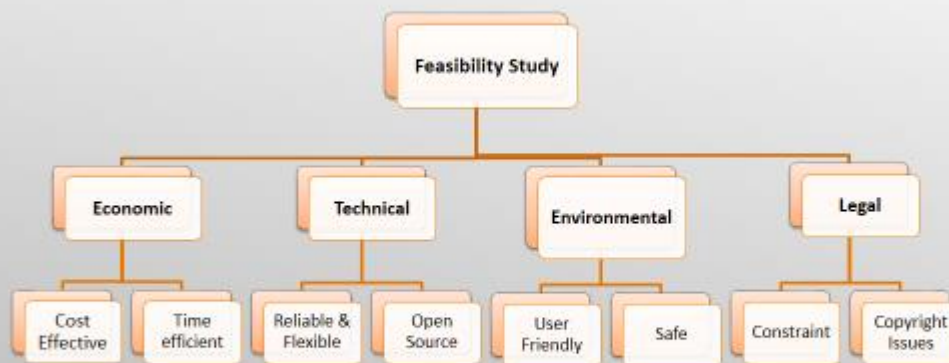
## Requirements:

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- The instructor/administrator shall be able to register each of the students' names, contact details, unique fingerprint into a database for proper identification later on.
- The system shall be able to uniquely identify each student, faculty and staff members.
- The arrival time, exit time and date shall be associated with each attendance check in order to assure the student has been in attendance for the entire class period.
- The fingerprint based attendance module shall allow sending email notification to faculty, staff members and students community in case of low attendance.
- In a single click, users shall be able to view hours worked, no. of classes absent and present, on duty, overtime, leave of an employee for date or month period.
- At peak load, the system shall be able to capture and verify 20 fingerprints per second
- The total processing time taken by the system from scanning the fingerprint to updating the information online shall not be more than 10 seconds for 95% of the transactions.
- The system life shall at least be 10 years or until a new version is released.

## Feasibility Study:

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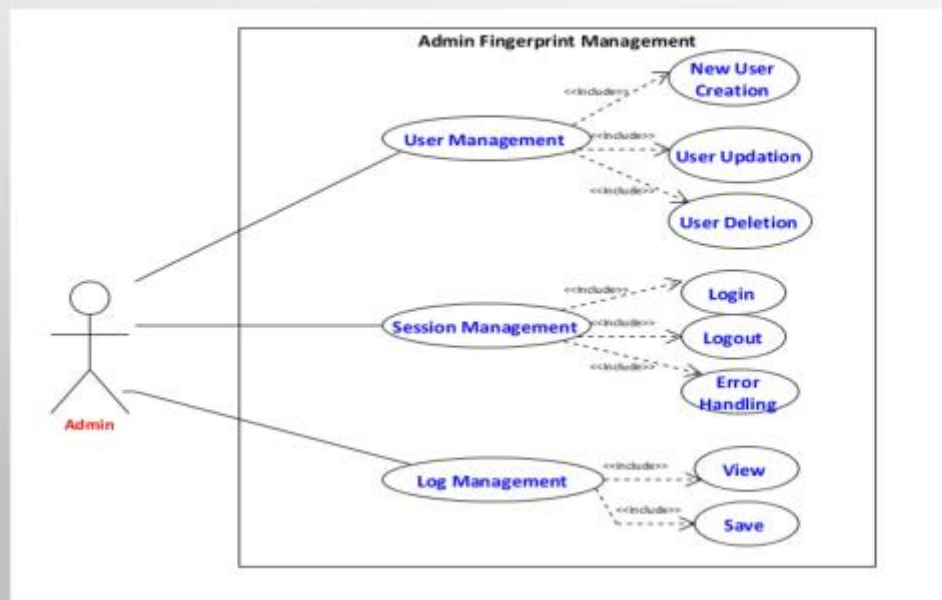
## Use Cases:

### Elements of Use Cases Diagram

- Actors
- Use Cases
- System Boundary
- Relationship
- Association



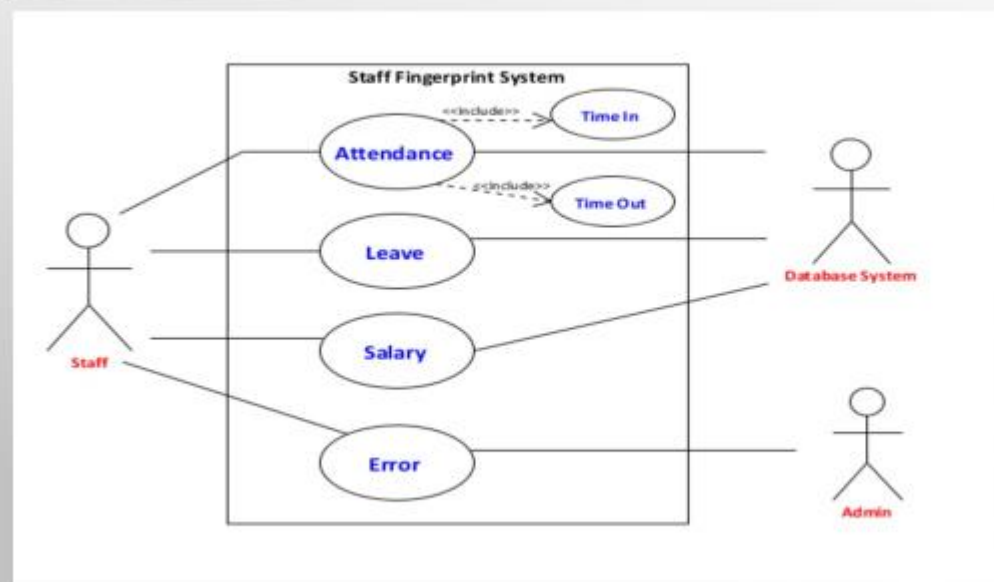
## Admin Use Case Diagram:



## Admin Use Case Narrative:

Titles	Description
Use case ID	UC 01
Use Case Name	Admin Fingerprint Management
Actors	a. Primary : Admin
Description	This Use Case describes the key roles admin performs in implementing fingerprint reader
Precondition	a. Admin should have rights to access database and make all sort of changes with high level of security b. Active network connection
Postcondition	a. Able to manage the users with all details updated in the system b. Ensure effective management of reader
Normal Flow	a. Admin captures the sample of new user to make entry in the database b. After verification , saves it. c. Admin manages the session to login, logout and error handling job for all users. d. Admin also view all the logs, save them and handles E-mail alerts for students if shortfall occurs e. Admin has right to delete user if user is no longer part of college, can update their details as well.
Alternate Flow	a. If admin is unable to create, update, delete users or any other problem will contact the vendor to check in.

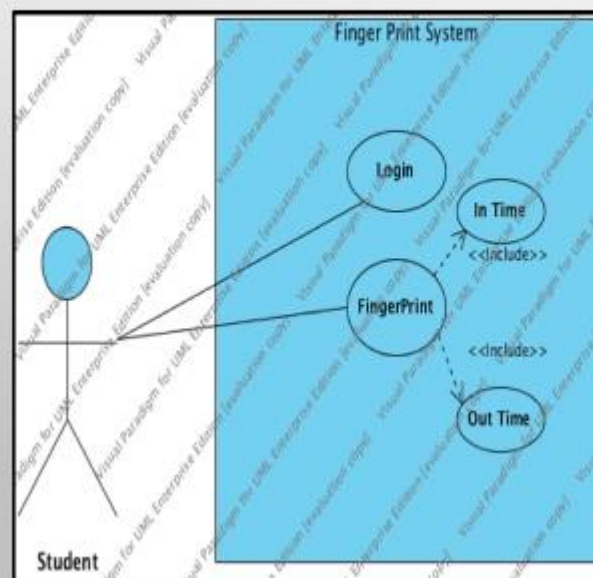
## Staff Use Case Diagram:



## Staff Use Case Narrative:

Titles	Description
Use case ID	UC 02
Use Case Name	Staff Fingerprint system
Actors	a. Primary : Staff b. Secondary: Database system, admin
Description	This Use Case describes the usage of fingerprint system Staff
Precondition	a. Sample fingerprint should be present in database b. Active network connection
Postcondition	a. Staff able to mark attendance
Normal Flow	a. Staff places his finger on the fingerprint reader b. System verifies the fingerprint c. If valid match found, system marks Time- In d. At the time leaving, steps a to b are performed again. e. If valid match found, system marks Time –Out d. Attendance details from database are used for evaluation staff's salary
Alternate Flow	1. If valid match not found/ error, staff re-enters the fingerprint. 2. If valid match still not found/ error, then staff contacts the admin.

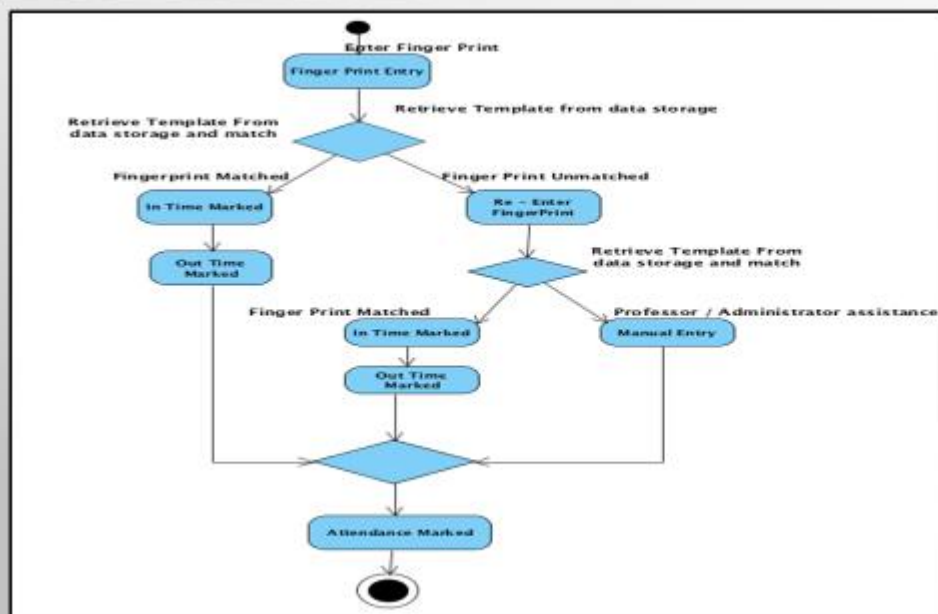
## Student Use Case:



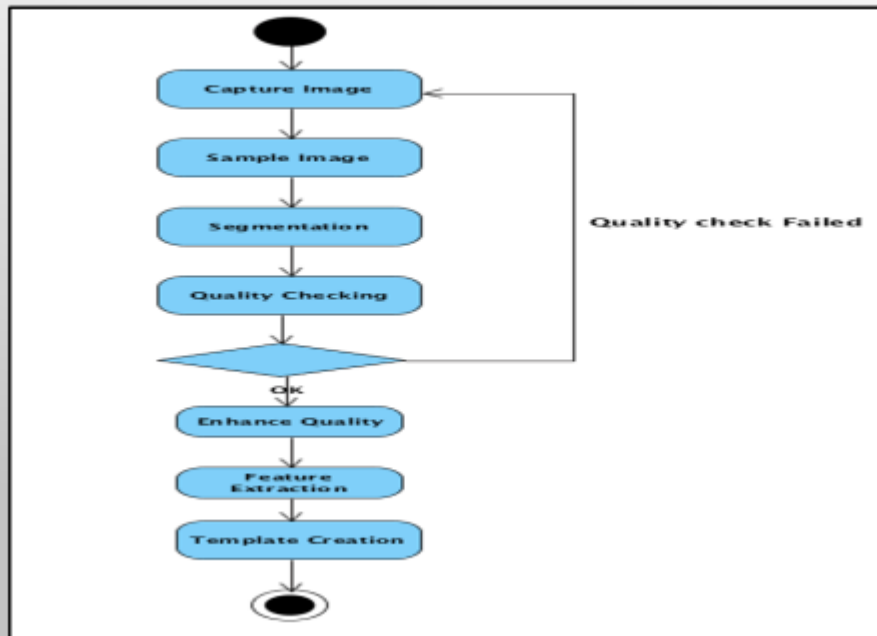
## Student Use Case Narrative:

Titles	Description
Use case ID	UC 01
Use Case Name	Student Fingerprint system
Actor	Primary : Student
Description	This Use Case describes the usage of fingerprint system by students
Precondition	Active network connection
Postcondition	a. Student is able to mark attendance
Normal Flow	a. Student places his finger on the fingerprint reader b. System verifies the fingerprint c. If valid match found, system marks Time- In d. Student will mark attendance while leaving e. If valid match found, system marks Time –Out
Alternate Flow	1. If valid match not found/ error, student re-enters the fingerprint. 2. If valid match still not found/ error, then student contacts the faculty.

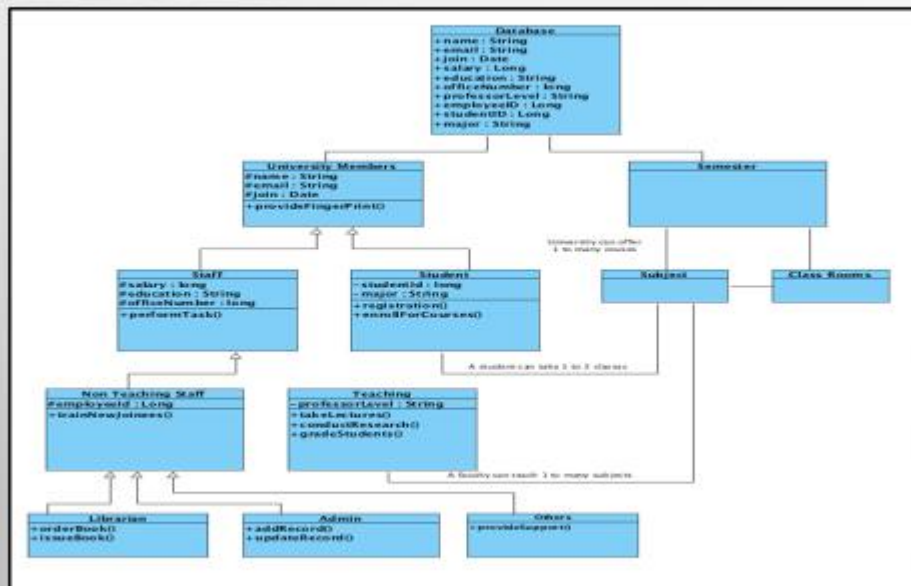
## Activity Diagram:



## Image Processing Activity Diagram

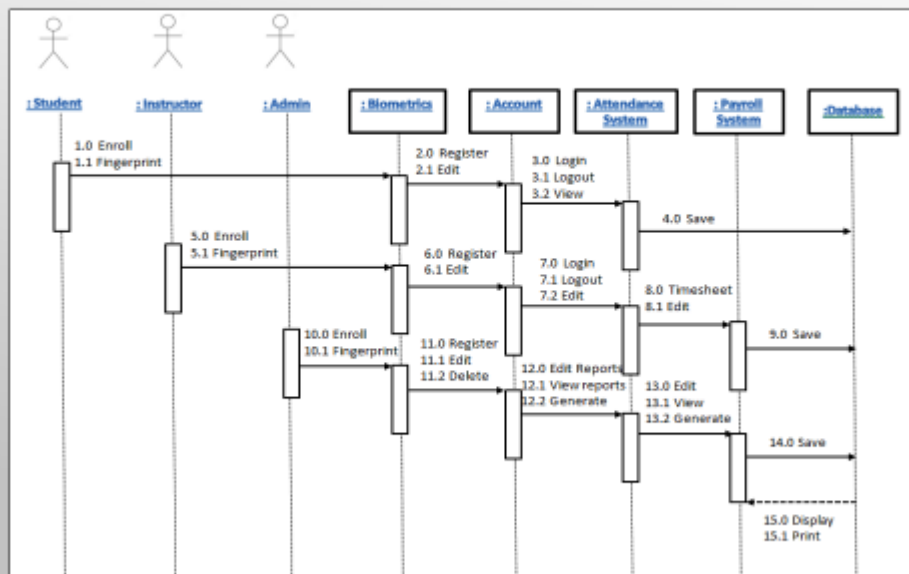


## Class Diagram:





## Sequence Diagram:



## Test Cases Classification:

1. Sanity Test cases
  - ❖ Includes General/Basic functionality test cases of the system
2. Performance Test cases
  - ❖ How fast system responds to the inputs
3. Stress test cases
  - ❖ Stress the system with multiple inputs back to back
4. Negative Test cases
  - ❖ Wrong inputs to the system



## Test Cases:

### ✓ Sanity Test cases

Test case #	Test case	Expected result
1	Capture Finger print of the user	System should capture and store finger print in the data base
2	Match finger print of a valid user	Accept user only if the finger print matches valid user
3	E-mail notification	Email sent to student if attendance is < 70%

### ✓ Performance Test cases

Test case #	Test case	Expected result
4	System response speed test	System should respond with valid result in < 30 seconds

## Test Cases:

### ✓ Stress Test cases

Test case #	Test case	Expected result
5	Place finger of a valid user on the reader back to back – Many times	System should not crash – and should display "please wait" till the processing of 1 <sup>st</sup> input is complete
6	Place finger of a invalid user on the reader back to back – Many times	System should not crash – and should display "please wait" till the processing of 1 <sup>st</sup> input is complete – Should display Invalid user after this

### ✓ Negative Test cases

Test case #	Test case	Expected result
7	Invalid/Unregistered user	System should display – "Invalid user"
8	Greasy/oily finger	System should display – "Invalid user"
9	Finger with gloves	System should display – "Invalid user"
10	Placing finger in wrong orientation	System should display – "Place finger again"

## Risk Analysis:

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- ❖ User places greasy/dirty finger
- ❖ User places finger with gloves on
- ❖ Network issues – system will be unable to update/retrieve data to/from data base
- ❖ Power outage - system will be unable to update/retrieve data to/from data base
- ❖ Data base crash - system will be unable to update/retrieve data to/from data base

## Conclusion:

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- ❖ Low cost installation
- ❖ portable machine
- ❖ Saves cost of paper and labor
- ❖ More Reliable
- ❖ Easy to use
- ❖ Less maintenance cost

## Questions....?

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Thank You

