A STUDENT ATTENDANCE SYSTEM WITH FINGERPRINT SCANNER INTEGRATION FOR STRATHMORE UNIVERSITY

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An information system project 2 proposal submitted to the Faculty of Information Technology in partial fulfilment of the requirements for the award of the bachelor's degree in Business Information Technology of Strathmore University

Faculty of Information Technology

Strathmore University

Nairobi, Kenya

Jan 2021

Declaration and Approval

I declare that this work has not been previously submitted and approved for the award of a bachelor's degree by this or any other University. To the best of my knowledge and belief, the work contains no material previously published or written by another person except where due reference is made in the work itself.

Student's signature:

……..…….. [*Signature*]

……..…….. [*Date*]

Approval

The work of 100786 was reviewed and approved *(for examination)* by:

Supervisor's signature:

……..…….. [*Signature*]

……..…….. [*Date*]

Abstract

Class attendance is a very crucial factor if a student wants to succeed. When a student attends class, they are able to engage in a form of learning known as active learning which is a type of learning where students engage with course materials, discussions etc. Strathmore University is a renowned institution that is associated with offering high quality education. However, Strathmore University has had challenges in recording class attendance using the manual signing sheets where students sign against their name after which the lecturer physically keys in the attendance into the system. This method proves to be a challenge as students are able to sign for each other that leads to dismal academic performance. The aim of this project is to develop a fully functional mobile-based system where student's attendance is captured accurately and signing for each other is avoided by the use of a biometric fingerprint scanner. The system methodology that will be used is incremental development. This is because there is great interaction between end users and the server. There is also high customer satisfaction and high product methodology. Functionality and usability of the system will be tested to help establish whether the system user needs are adequately realized. Through the use of a mobile-based system, which uses a biometric fingerprint scanner data, accuracy will be enhanced as well as solving the problem of students signing for each other.

List of Abbreviations

AMS- Academic Management System

DFD- Data Flow Diagram

GPS- Global Positioning System

ID- Identification

LCD- Liquid Crystal Display

MMI- Man Machine Interface

OOAD- Object Oriented Analysis and Design

PC- Personal Computer

QR- Quick Response

RFID- Radio Frequency Identification

SDLC- Software Development Life Cycle

SMS- Short Message Service

SQL- Structured Query Language

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Chapter 1: Introduction

1.1 Background

Class attendance is a crucial factor for a student if they want to succeed. When a student attends class, they are able to engage in a form of learning known as active learning. Active learning is a type of learning which involves actively engaging students with the course materials through various ways such as having discussions, case studies, problem solving etc. According to the article by Leslie (2019) active learning gives students a chance to develop a deeper understanding of critical thinking as well as analytical skills. Attendance in class is therefore an essential need for a student to be able to comprehend the information that is being relayed in class.

Strathmore University is a renowned institution that is associated with offering high quality education. According to an article by (Ngina, 2018.), the university was ranked the best among private universities. However, Strathmore University has had challenges in the management of class attendance of students. The current method used by the university to record attendance is by use of manual signing sheets that are passed around during class and the students are able to physically sign against their name. After that, the lecturer physically keys in the attendance into the system.

However, this method has proved to be inefficient because students can be able to sign for each other if their fellow students have not attended class which in turn leads to the frequent and recurring missing of classes among students. In addition when students miss classes, they end up performing poorly in their examinations. A study by Agwot (2015) shows that there is a direct correlation between student attendance and performance. Another challenge faced by this system is that the system takes up a lot of resources e.g printing paper that is needed for the signing sheets that the school has to cater for.

Moreover, when students do not attend class, it becomes rather difficult for a lecturer to be able to monitor their progress and also build their skills. Due to the challenges stated above in which the University faces, there is a need for a comprehensive

system which will be able to capture students' attendance accurately and address the issues.

1.2 Problem Statement

The current system used to record attendance in Strathmore University is by lecturers logging in to their attendance platform from which they print the signing sheet. The attendance list is then handed to students during class who then physically sign against their name. The attendance is then keyed in by the lecturers into the attendance platform. However, this method has proved to be inefficient because students can be able to sign for each other when their classmates have not attended class.

When students miss class, they miss out on important information that a lecturer is teaching which results in dismal academic performance. Reviews from the article by (Lukkarinen et al., 2016) showed that there are students who miss class because of compelling reasons and those with no reason. The students who miss class because of compelling reasons end up studying independently and passing their examinations but those with no reason usually have a significant drop in their academic performance.

In addition to students lagging behind on academics, students who do not attend class are likely to get in trouble with the law. A study by Rodel Community Scholars at Arizona University who tracked students from kindergarten, through high school and university found drop out patterns that were linked with the attendance. Another challenge caused by the current method is that it consumes a lot of resources, which the university caters for such as printing paper. A study by Richard (2011) stated that manual systems usually take up more effort, resources as well as physical space.

Lastly, when students sign for those who are not in class, the lecturer is unable to gage their progress as well as help them build their skills. Therefore, there was a need for a comprehensive mobile-based system that will be able to capture students' attendance accurately and also prevent signing for each other through the use of biometrics.

1.3 Aim

The aim of the project was to develop a fully functional mobile-based system where students' attendance is captured accurately and signing for each other is avoided though the use of a biometric fingerprint scanner.

1.4 Specific Objectives

I. Identify the problems that the lecturers experience when taking attendance using the manual signing sheets.
II. Review platforms/technologies that are used in the recording of student attendance in universities.
III. Develop a mobile-based system that will be able to capture students' attendance accurately and also prevent students signing for each other through the use of a biometric fingerprint scanner.
IV. Test the developed information system using black box testing.

1.5 Justification

In order to avoid dispute on attendance, the system will provide a more accurate and valid account of attendance. This is because the system will be able to authenticate the attendance of the students through the use of a fingerprint scanner and students will not be able to sign for each other. In addition, the risk of errors and data inaccuracy will be eradicated by the use of this system. Lastly by use of this system, the University will be able to save up a lot of money, which is used in resources such as printing paper.

1.6 Scope and Limitations

The scope of this project is to be able to understand the challenges that lecturers face by using the manual signing sheets to capture class attendance for the students.

After understanding the problem, an information system should be designed and developed where students' attendance is captured accurately and students will not be able to sign for each other through the use of a biometric fingerprint scanner.

The limitation of this project is that since the system will be a mobile-based system, which may require phones with GPS tracking, not all students may have smartphones or even phones at all thus making it difficult to be able to track their attendance.

Chapter 2: Literature Review

2.1 Introduction

This chapter aims to review the class attendance system that is used in Strathmore University. We study the correlation between class attendance and student performance. Lastly, we also study other class attendance systems that exist and challenges faced with these attendance systems.

Using exceptional writings that are made by researchers, one is able to acquire information from them and draw conclusions based on what one has read.

2.2 Current Class Attendance System Used in Strathmore University

The current system used to record attendance in Strathmore University, is by lecturers logging in to their attendance platform from which they print the signing sheet. Once the attendance list is printed, it is then handed over to students to sign against their name during class time. In order to curb falsification of signatures, some lecturers usually opt to call out the class register. Waithira (2018)

Thereafter, the lecturers then keys in the records in the AMS system. The AMS system is a module whereby a student is able to get access to features such as checking their course work marks, checking their attendance, checking their progress report, downloading their exam card which is a requirement needed when doing examinations and also finding out whether they have paid for school fees. When a student checks their attendance on the AMS system and they find that they have missed 33% and above of their classes, the student is not allowed to sit for their end of semester examinations.

2.2.1 Problems Encountered During the Recording of Class Attendance in Strathmore University

Capturing of class attendance using manual sheets has proved to be a challenge in Strathmore University. Reviews from the article by Arulogan et al (2013) showed that firstly, paper-based methods of recording class attendance are prone to a lot of errors such as transcription errors. This occurs when one is transferring records from paper to computer systems. In addition, the article by Hingorani et al (2012) showed that this mode of capturing class attendance has no means of corroboration as it then results in the outcome of students signing on behalf of other students who may have failed to attend class. This leads to incorrect and flawed representation of the actual numbers of students who attend class.

Another challenge encountered by lecturers using the manual signing sheets is that when students miss classes, the lecturer is unable to gage their progress as well as build their skills. The student misses out on important information that is relayed in class as well as key pointers and guidelines that are given on how to tackle a particular topic or examination.

Lastly, when students do not attend class it affects their performance in examinations. A study by(Bai et al., 2018) showed that students who attended class regularly gained additional knowledge and other in-class support and resources. They were well organized, motivated and performed better in their examinations. In addition, they expected that students who missed classes would check the website more regularly to catch up on what they had missed. However, it was the opposite as the students ended up performing poorly in the examinations. This shows that there is a positive correlation between class attendance and student performance.

2.2.2 Correlation between Class Attendance and Academic Performance

In institutions of higher learning, attendance plays an important role as it is a mechanism which is able to reveal how much knowledge is imparted in students through the use of teaching materials that are offered such as carrying out discussions in class, course work, notes and case studies that are assigned to students. Kieszczynka (2010) A study was conducted by (Crede et al, 2010), where they investigated the relationship between class attendance and performance in the university. They used data from a course in the university that was not mandatory to attend classes. The methods that they used were cluster analysis and regression analysis. In addition, they used three distinct groups, students who drop out before final examination, those who attend classes as well as the examination and those who study on their own but miss classes due to compelling reasons. The results were that those students who attended classes passed their examinations and those who missed classes due to compelling reasons also passed their examinations. However, the students who missed classes without compelling reasons failed the examinations. This shows that there is a correlation between class attendance and student performance. Figure 2.1 below shows the correlation between class attendance and student performance.

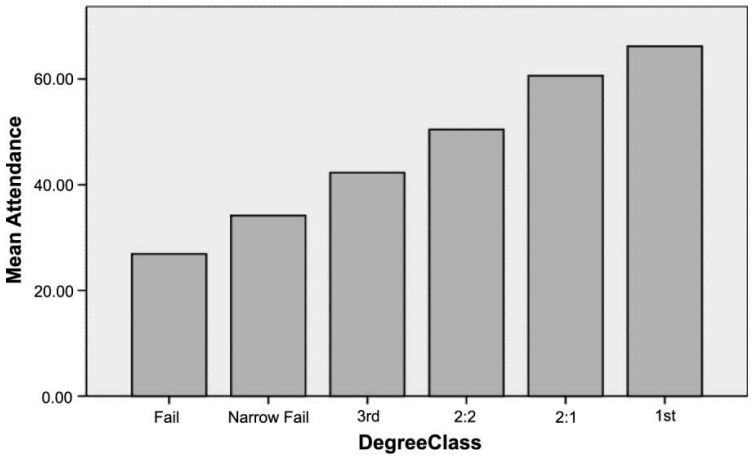


Figure 2.1: Sample figure caption (always below the figure)

2.3 Review of Automated Class Attendance Capturing Systems

2.3.1 Attendance Monitoring System Using Face Recognition and Face Detection

According to the article by (Kowsalya et al., 2019) attendance monitoring is very important in almost all organizations and institutions. They were able to come up with an automated process of capturing class attendance in school. The system could not only be used for class attendance but also monitoring employees. In the working of the system, the students marked their attendance in class using face recognition, the system would recognise the face of the students, which is then updated in MySQL database. A biometric method was used for eyeball detection where an eyeball sensor is used and the image of the eyeball is then stored in the database. Student faces were already pre-stored in the database. In addition, a student was required to carry a phone that had a GPS system. The advantage of this system was that it saved on time and effort needed to record the attendance manually. Figure 2.2 below shows the block diagram of the attendance system using face recognition and detection.

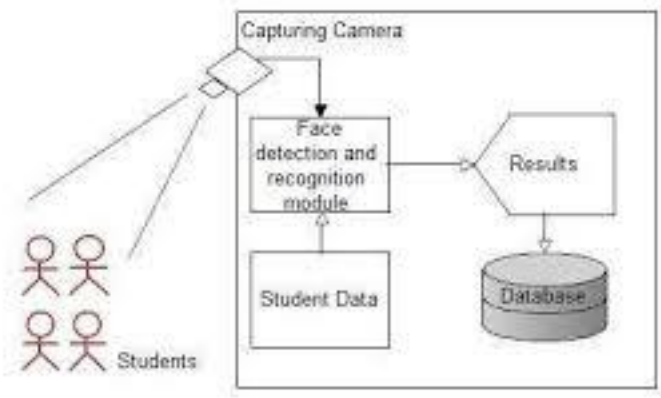


Figure 2.2: A Block Diagram Showing the Attendance System Using Face Detection And Recognition (Kowsalya et al., 2019)

2.3.2 Attendance System Using RFID Technology

Radio Frequency Identification Technology (RFID) is a technology that transmits data using radio waves from an RFID tag attached to an object by the reader for tracking and identifying objects which consists of the reader and the tags. (Olanipekun & Boyinbode, 2015)

Reviews from the article by (D. et al., 2018)show that RFID technology has grown rapidly in decades along with the demand from modern industry where data accuracy and consistency is required. The RFID technology has been applied in class attendance monitoring system according to this article the student has an RFID tag and puts it near an RFID reader. The ID results from the RFID reader would be sent to the microcontroller, which would then be compared to the student data stored in the memory. If the data ID is a lecture participant, then the students name would be displayed using LCD display and by use of a Wi-Fi module controller, the student's attendance data is sent to a cloud database. By use of this technology, data implementation took place faster than the manual way of using signing sheets. Figure 2.3 below shows the block diagram of how the attendance system using RFID worked.

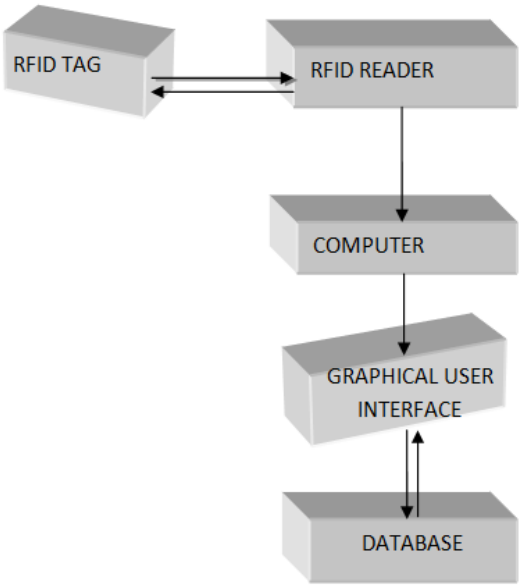


Figure 2.3: A Block Diagram of the Attendance System Using RFID Technology (D. et al., 2018)

2.3.3 Smart Attendance System Using QR Code

QR codes have a wide array of applications in this evolving technology world. One of the ways in which it can be used is in a student class attendance system. Reviews from the article by (Patel et al., 2019) showed how it was implemented in monitoring class attendance. They decided to use QR code because it is used to store massive information in a smaller space. In addition, they were also able to secure authentication by using data-hiding algorithms with embedded QR codes. Students were required to have smartphones so they can scan the QR code, which would be displayed by the teacher. Once the student scanned the QR code, automatically the attendance would be marked accordingly to the User ID. Figure 2.4 below shows the block diagram of how the smart attendance system using QR code worked.

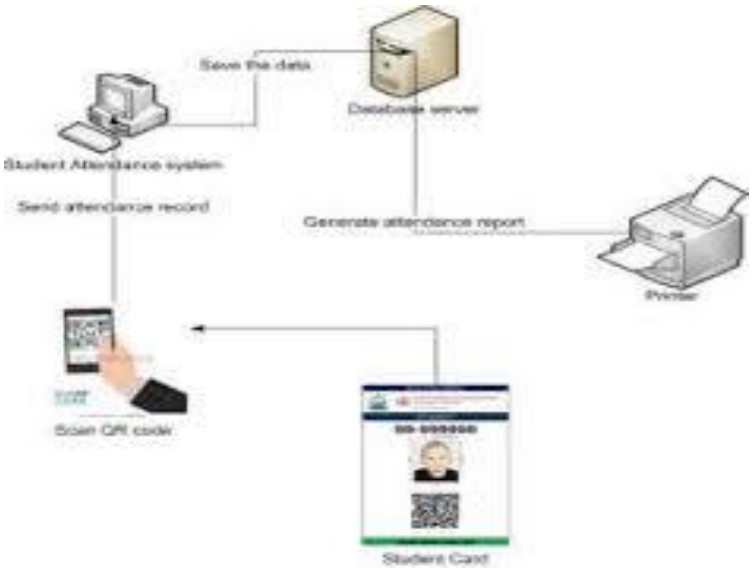


Figure 2.4: A Block Diagram of the Attendance System Using QR Code (Patel et al., 2019)

2.3.4 Attendance Management Using Biometrics with SMS Alert

This system was able to take students' attendance successfully by using fingerprints as well as sending a notification to parents. According to (Desai, 2018)attendance data is stored in a database along with the updated date and time. Additionally, an SMS notification is successfully sent to parent's mobile using GSM. Stored data of attendance was then used for calculating defaulters. Figure 2.5 below shows the block diagram of how the attendance system using biometrics and SMS alert worked.

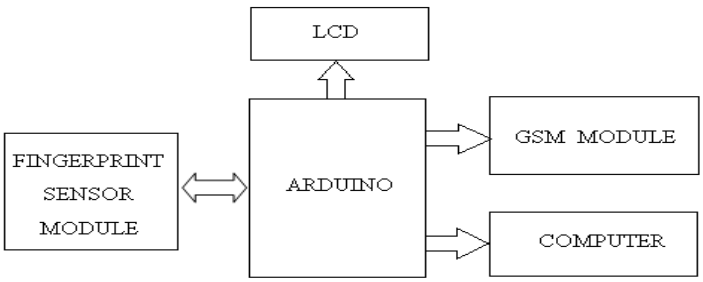


Figure 2.5: A Block Diagram of the Attendance System Using Biometrics with SMS Alert (Desai, 2018)

2.4 Gaps in Existing Technologies

2.4.1 RFID Technology

There are a number of challenges associated with using RFID technology. According to (Edusys, n.d.)The system is expensive because a lot of technology goes into making the system. Secondly, in case of a large number of students, purchasing tags for everyone becomes rather costly. Lastly, replacing the microchip, radio transceiver, antenna and battery in the system is tiresome and costly.

2.4.2 QR Codes Technology

QR Codes pose a number of challenges. Firstly, attackers can be able to encode malicious links. Furthermore, a study by expert Ravi Borgaonkar demonstrated how Man-Machine- Interface (MMI) codes was used to run different attacks against Samsung devices. Attackers were able to encode the MMI code into a QR code to trigger the execution of the MMI code, which erases all data from the mobile devices. (Krombholz et al., 2014)This study proves that QR codes are not as secure as attackers can use them.

2.5 How the Proposed System will solve the Gaps in Existing Technologies

The proposed system is to capture attendance using a fingerprint scanner. The proposed system has a number of advantages. According to an article by Alhothaily et al (2015), fingerprint attendance systems waste no time in capturing attendance, managing the attendance is automated meaning there is no chance for fake attendance marking and the system is also easy to use. In addition, according to the study by Lakshmanaswamy (2014), biometrics eliminates the problems when an ID card is lost which is an advantage over using RFID tags with the student IDs. In addition, the article further explains that by use of biometrics, security level is enhanced which is another advantage over QR codes as the codes can be cracked. With the proposed system, data accuracy and efficiency will be enhanced. In addition there will be no falsification of records which occurs when students sign for each other.

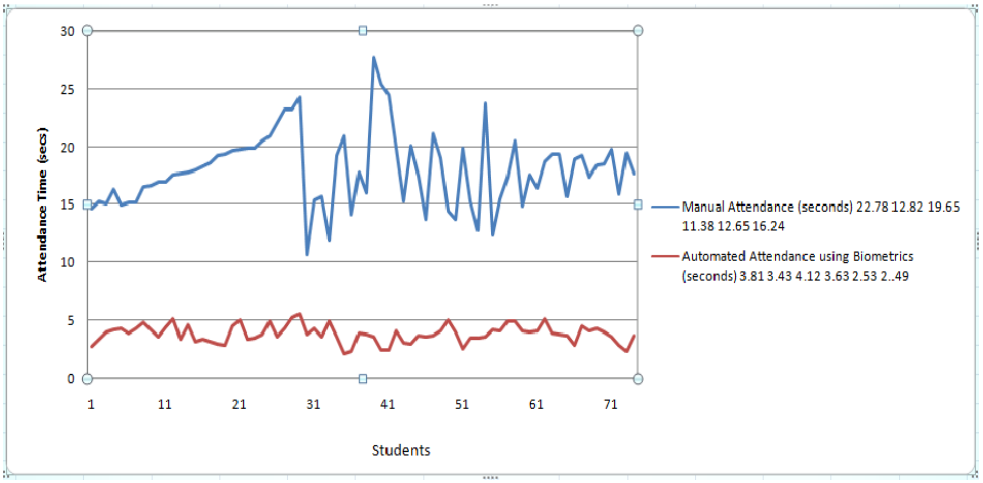
2.6 Comparison of Manual Attendance System with Attendance Systems Using Biometrics

A study was done by (Shoewu, 2012)where he compared the time it took to record class attendance using manual signing sheets against the time it took to take attendance using the biometric method of using a fingerprint scanner. In the study, it

showed that the manual attendance system's average execution for eighty students approximately was 17.83 seconds as against 3.79 seconds for the automatic attendance system, which used a fingerprint scanner. Reports generated also showed that the attendance system approximately takes 30 seconds. The system successfully took attendance. In addition, the prototype also captured new fingerprints to be stored in the database, scanned fingerprints placed on the device sensor and compared them against those stored in the database. The performance of the system was successful and would be considered for full implementation especially because of the short execution time. Everyone who tested the system was pleased. The table 2.1 below is a 25-student sample out of 80 tests that were conducted. It can thus be seen in the table that the automatic attendance system using a fingerprint scanner is way better and faster as compared to using manual signing sheets.

Table 2.1: Comparison of the Execution Time of Manual Attendance and Attendance System Using Biometrics (Shoewu, 2012)

STUDENT	MANUAL ATTENDANCE	ATTENDANCE SYSTEM
1	22.78	3.81
2	12.82	3.43
3	19.65	4.12
4	11.38	3.63
5	12.65	2.53
6	16.24	2..49
7	14.66	2.72
8	15.23	3.35
9	15.03	4.01
10	16.31	4.21
11	14.97	4.31
12	15.16	3.85
13	15.18	4.32
14	16.54	4.78
15	16.59	4.23
16	16.92	3.55
17	16.95	4.34
18	17.61	5.11
19	17.72	3.36
20	17.78	4.57
21	18.01	3.12
22	18.25	3.31
23	18.62	3.1
24	19.19	2.92
25	19.34	2.83



2.7 Conceptual Framework

This is a conceptual diagram that shows how the proposed system will function. In the proposed system, the administrator logs in to the system using their credentials. After that, the administrator is able to add a new user, view users that already exist, mark attendance, and check out their profile, which will consist of their name, their respective subject and other details. Lastly, the administrator will also be able to view the attendance report. The application will take information about the user such as the user's name, contact details, user's fingerprint then the user's finger print will be matched with a database on the server which will retrieve the date and time. The fingerprint module is used to scan fingerprint of students. When a student scans their fingerprint, their information is displayed on the screen of their phone. Later on, data gets updates on the server automatically and an attendance report is generated. With the proposed system, the use of a finger print scanner will be able to curb the problem of students signing for each other when they are not in class. Additionally, data accuracy will be improved as it takes the date and time of the attendance in real time.

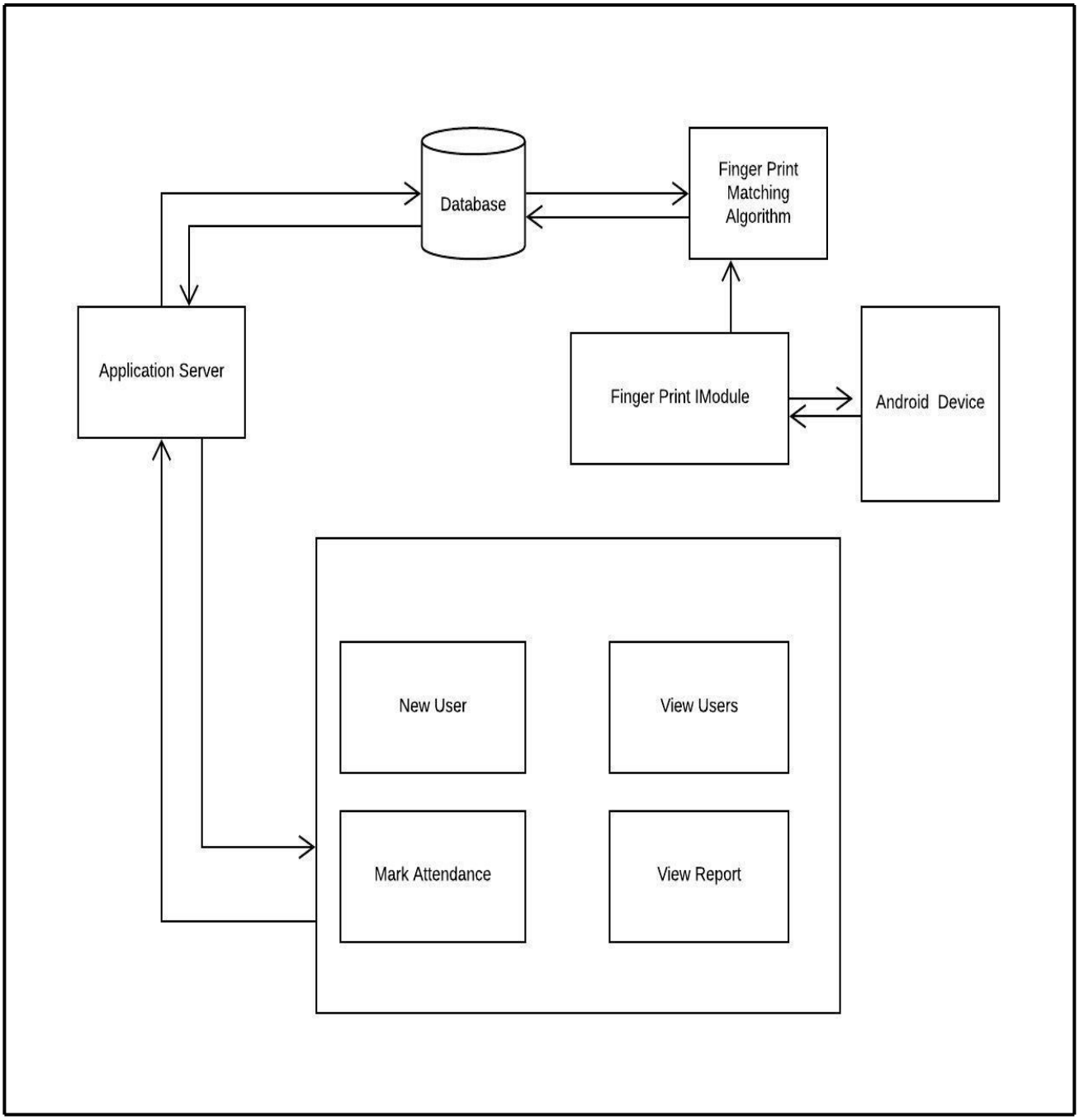


Figure 2.6: Conceptual Diagram of The Proposed System

2.8 Interpretive Summary of the Literature Review

This literature review provides insights into the area of class attendance monitoring systems. Previous studies have confirmed that indeed class attendance is positively correlated to academic performance in that the higher rate of class attendance, the higher academic performance of students. With this knowledge, academic institutions and researchers have been able to come up with different solutions of improving the attendance system

In addition, previous studies have also been carried out in regards to the development of class attendance systems, which put a lot of emphasis on using automated systems such as the use of biometrics. Biometric systems provide accurate identification and verification. However, in some of the systems such as us of QR codes, there is insecurity as hackers can crack the codes and in the case of using RFID technology, it is also costly to purchase the tags for a large number of students. The case is different when it comes to use of a fingerprint scanner to capture attendance, as it is cost-effective because small hand-held scanners are easy to set up and benefit from a high level of accuracy. In addition, it is also easy to use, as it just requires your fingerprints. Lastly, fingerprints are not transferrable which rules out sharing of passwords and improves data accuracy. This in turn makes it possible to use this technology to capture attendance of students

Chapter 3: Research Methodology

3.1 Introduction

This chapter describes the methodology that is used to carry out the research. As has been stated earlier, the sole purpose of this study is to improve the class attendance system in Strathmore University. This chapter covers areas on research design, matters pertaining the area of study, procedure of designing the research instruments, tools and techniques that will be used to develop the system and system development.

3.2 System Development Methodology

System development methodology refers to the structure that is followed in the creation of a new system. The structure follows consists of several methods and processes that will be implemented which will ensure that the system is created in the scheduled duration. Maheshwari (2002). The type of methodology that the proposed system will use is incremental development methodology. Incremental development methodology refers to a series of increments with each increment providing more functionality to customers. After the first increment, a core product is delivered which the customer can already use. Based on customer feedback, a plan is then generated for the next increments. The reason behind using incremental development methodology is because there is great interaction between end-users and the server. There is also high customer satisfaction and high product quality. Figure 3.1 below shows the steps of incremental development methodology.

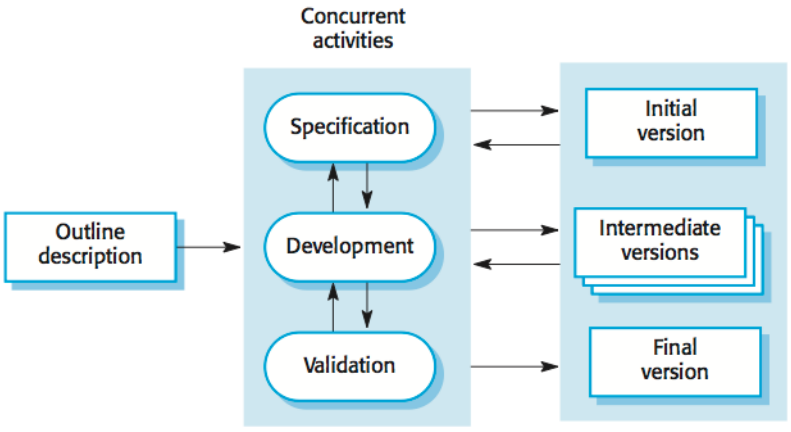


Figure 3.1: A Diagram Showing Incremental Development

3.2.1 Step 1: Requirement Phase

In this phase of incremental model, a product analysis expert identifies the basic requirements. In this stage, the project entailed understanding the system's functional requirements. After understanding the system's requirements, a document was prepared which contains the product requirement tools and categorized functionalities of the sys

3.2.2 Step 2: Design and Development Phase

In this stage, it involves designing the system functionality and development of the system.

3.2.3 Step 3: Testing Phase

In this stage, the behaviour of each existing function as well as its additional functionality is tested. Several testing methods are used. The reason behind using several testing methods is to be able to check the behaviour of the categorised function.

3.2.4 Step 4: Implementation Phase

In this stage, it involves coding the final system. After completion of this phase, the product working was enhanced and upgraded up to the system final product.

3.3 System Analysis

System analysis refers to the process of studying a procedure or a business in order to identify its goals so as to be able to create successful systems that will be achieved in an efficient way. The approach that the proposed system used is object-oriented analysis and design approach (OOAD). According to (*Object Oriented Analysis & Design - Lecture # 3*, n.d.), OOAD is the process of defining software objects and how they collaborate to fulfil the requirements. Concepts in the analysis model are mapped onto implementation classes and interfaces resulting in a model of the solution domain. The reason behind using OOAD was because one can be able to build large complex programs, there is increased code re-use and higher quality in the systems. Singh et al (2011).

3.3.1 Functional Requirements

According to Berg (2012), the functional requirements refer to the functionality and services that will be provided by the system in order for the system to function as needed. The functional requirements of the system are:

I. The system should be able to provide authenticity whereby only those students with registered accounts are able to access the automated biometric attendance system.

II. The system should be able to accommodate different users of the system. For example, it should be able to cater for the administrator and the users of the system who are students.

III. The system should be able to generate an attendance report of the students. When the students are enrolled in a class, he/she should be able to see their class attendance through a page that gives them the whole attendance status in the semester.

IV. The system should be able to capture students' attendance through the use of a biometric fingerprint scanner. When students attend class, they must scan their finger in the fingerprint device. If the scan matches, the attendance of the student is captured immediately and if not, the attendance of the student is not captured and the student will be marked absent.

V. The system should be able to send a warning message to a student if he/she has missed three or more classes. When a student misses three or more classes, they are in danger level and he/she should receive a warning message notifying them of their missed classes.

3.3.2 Non-Functional Requirements

According to Berg (2012), non-functional requirements are the requirements that specify the criteria that will be used to judge the system. The following are the non-functional requirements:

I. Performance- This refers to the action of doing a task or a function Satoa (2012). The system should be able to perform tasks at a certain speed to ensure tasks are completed efficiently.

II. Accuracy- the system should be reliable. It should be able to perform operations accurately.

III. Maintainability- the system should be maintainable. The administrator should be able to debug and fix any errors.

IV. Accessibility- the system should be easily accessible to users.

V. User-friendly- the system should have a user-friendly interface that should be easily accessible to the users.

VI. Storage of Information- The system should be able to store user information.

3.4 System Designs

System Design is the process of designing the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system *System Design - SEBoK*, n.d.)). The following are the designs that will be used:

3.4.1 Data Flow Diagram

Data flow diagrams define business processes by illustrating processes, data flow, data stores and external entities through the use of graphical symbols. Dennis et al (2012). This illustrated major processes, data stores and inter-related data flows which comprises of the system under construction. Each of the major processes are decomposed to give more details on the movement of data and how some processes interact with data stores.

3.4.2 Use Case Diagram

A use case is a specified functionality that shows activities that are performed to give a specific result. It follows that a use case diagram shows the relationship between actors of a system and different use cases. Kostoglou et al (2014). The use case diagram illustrates possible set of interactions between the system and it's actors.

3.4.3 System Sequence Diagram

A sequence diagram shows objects that compromise of a use case and the messages that pass between them for that particular use case. Dennis et al (2012). The system sequence diagram shows the major objects within the system and how information flows between them as well as the messages exchanged between them.

3.4.4 Class Diagram

Class diagrams present a set of classes, interfaces and associations which present an object-oriented view of the system under discussion. Kostoglou et al (2014). The class diagram provides an overview of the system by describing objects and classes within the system as well as relations between them. It also shows visibility of the different classes in relation to others in the model.

3.5 System Development Tools and Techniques

This refers to the tools that are used to ensure that the system will be created in an efficient manner. The following are the tools:

3.5.1 Android- This is the programming language that will be used to facilitate the design of the system. Android shall be used to create the interfaces of the system where the system can be able to mark attendance, add new users and also view the attendance report of the students.

3.5.2 MySQL Database- The database will consist of tables that stores records implemented using MySQL database. The reason behind using MySQL database is that it is fast and easy. In addition, it can store a very large record and requires little configuration.

3.5.3 Fingerprint Scanner- This will help to capture student's attendance accurately. This is because students will not be able to sign for each other, as one's fingerprint will be needed. Once a student places their finger on the fingerprint scanner, the scanner will scan to find a match, if there is a match, the student's attend is captured immediately and if not the student will be marked absent.

3.6 Domain of Execution

The domain of execution for this project is a mobile-based application. The reason behind choosing a mobile-based application is because there is a lot of interaction between the client and server.

3.7 Method to be used to Test the Developed System

System testing is an integral part of the software development life cycle (SDLC) as it is the procedure in which quality of the system is assessed. It is the activity of evaluating the system to determine whether it meets the requirements determination phase Hooda and Chhillar (2015). The technique that will be used to test the system is black box testing. According to (Nidhra, 2012) black box testing plays a significant role in software testing. It aids in overall functionality validation of the system. Black box testing is done based on customers requirements and so any incomplete or unpredictable requirements can be easily identified and it can be addressed later. The main advantage of using black box testing method to test the developed system is that testers do not need to have knowledge on a specific programming language. The testers also do not need to have knowledge on implementation. The other advantage for using this method for testing is that it helps to expose any ambiguities and inconsistencies in the requirements specification.

3.7.1 Tools to be used to Develop the System

According to the article by Kulkarni, automation test tools automates all the routine steps that are involved in a test. Each application has a different tool that need s to be used. Test automation tools simplify the testing process thus helping to make it easy and effective. The following are the test tools that will be used:

I. Robotium- This tester can record and play several that are required to perform testing. According to (Zadgaonkar, 2013), robotium is one of the world's leading Android test automation frameworks. The framework has benefits such as helping to automate test cases, business components can be extensively reused and complex test cases are executed.

II. Monkey Runner- This is a tool that can run tests on real devices connected to a PC or emulators. The tool has an API that allows controlling a smartphone, a tablet or an emulator from outside of Android code.

III. Calabash- This is an automated test tool that allows one to execute tests both on Android and iOS. It has advantages such as supporting native as well as hybrid mobile applications. In addition, robustness of processes are improved. (Zadgaonkar, 2013)

3.8 Proposed Modules and System Architecture

The following are the modules for the proposed system:

I. Administrator Module- The administrator has full control of the application and oversees registering all users of the system.

II. Attendance Marking- The mobile application is based on an Android platform and uses fingerprint biometrics. The fingerprint scanner ensures that students' attendance is captured.

III. User Module- This is a module that will allow students to mark their attendance.

Chapter 4: System Analysis and Design

4.1 Introduction

This chapter presents the overall design structure of the proposed system. The analysis part entails presenting the functional and non-functional requirements of the system. Thereafter, design diagrams are presented to illustrate the interactions between users of the system through the use of diagrams. Different components of the system are illustrated as well as how they contribute in solving the class attendance problem.

4.2 System Analysis

System analysis refers to the process of studying procedure or a business to identify its goals so as to be able to create successful systems in an efficient way.

4.3 System Design

System design is the process of designing elements of system architecture, modules and components, the different interfaces of the components and the data that goes through that system. The following are the design diagrams:

4.3.1 Use Case Diagram

The use case diagram shows possible interactions between the different actors. In our case, the different actors are the administrator, lecturer and student. Each actor plays a different role. The administrator will be responsible for registering users, registering units and generating attendance records. Lecturers on the other hand will be responsible for managing attendance information and students registered in the units they teach. Students will be able to mark their attendance and view a record of their attendance for the units they are registered in. Different users and their roles are detailed in Table 4.1 and it is summarised in the use case diagram in Figure 4.1 below

Table 4.1: Detailed Description of the User Roles

Actor	Use Case	Description
Administrator	Register users	The administrator creates accounts for the lecturers and students
	Register units	Create units, which will be assigned to lecturers.
	Update user list	The administrator adds new users into the system.
	Authentication	The administrator logs in and logs out of the system.
Lecturer	View attendance records	The lecturer is able to view attendance records of students who were present in class.
	Add students to a course	The lecturer adds students to a particular class they are teaching to make sure that students capture attendance for only the classes they are taking.
	Generate attendance records	The lecturer will generate attendance records of the students and the students will be able to view the report.
	Authentication	The lecturer logs in and logs out of the system
Student	Mark attendance	The student will capture their attendance using the biometric finger print scanner.
	View attendance report	Students are able to view the report on the classes that they have been attending.
	Receive messages/notifications	Students should be able to receive warning messages if

		he or she has missed three or more classes.
	Authentication	The student logs in and logs out of the system

4.3.2 Use Case Specifications

I. Use Case Name: User Authentication (Login and Logout)

LOGIN

Actors: Any student, lecturer or administrator who has an existing account

Basic Flow of Events:

1. The use case begins when an actor types his/her name and password on the login form.
2. Basic Flow-Login- The system validates the actor's password and logs him/her into the system.
3. The system displays the main form and the use case ends.

Alternative Flow of Events:

1. Invalid name/password- If the basic flow of the system cannot find the name or the password is invalid an error message will be displayed. The actor can type the new name or password or cancel the operation.

Preconditions:

1. The user already has an existing account

LOGOUT

Actors: Any student, lecturer or administrator who has an existing account.

Basic Event Flow:

1. The use case begins when the user logs into the system.
2. The user selects logout,
3. The system displays a prompt asking if the user wishes to logout. If the user confirms that they wish to logout, the system returns the user to the login page and their session is deleted.

II. Use Case Name: Registering Users

Actors: System Administrator

Basic Flow of Events:

1. The administrator selects the option to create a new user.
2. The administrator enters user details such as name, mobile number, email etc.
3. A user is then registered into the system.

Alternative Flow of Events: If an administrator has not been granted access to the system, they will not be able to create a new user account.

Pre-conditions-The administrator must have access to the automated attendance system so t hat they can be able to create a user account.

The administrator has received a request to open a new user account.

Post conditions- A new user account is created.

All the details of the user are stored in the database.

III. Use Case Name: Registering Units

Actors: Administrator

Basic Flow of Events:

1. The administrator selects the option to register a unit.
2. The administrator enters unit details such as unit code and unit name.
3. A unit is then registered into the system.

Alternative Flow of Events: If an administrator has not been granted access into the system, they will not be able to register a unit. Also, if the administrator does not have details regarding to the units such as the unit code and unit name, they will not be able to register the unit.

Pre-conditions: The administrator has access to the automated attendance system.

The administrator has unit details of the unit to be registered.

Post conditions: A unit is registered and details are stored in the system.

IV. Use Case Name: View Attendance Records

Actors: Lecturer and student

Basic Flow of Events:

1. The system retrieves the attendance information for each of the students after the students have already captured their attendance using the biometric fingerprint scanner.
2. The system prepares, formats and displays the attendance.
3. The student or lecturer select close after viewing the attendance records.

Alternative Flow of Events: If the system is not able to display any attendance records for a certain day, a message is relayed to the student and lecturer after which they terminate the process by pressing close.

Pre-conditions:

1. The lecturer or student has logged into the system.

Post Conditions- There are no post conditions associated with the use case.

V. Use Case Name: Generating Attendance Records

Actors: Administrator

Basic Flow of Events:

1. The use case starts when the administrator selects generate attendance records.
2. The system sends a request to the Automated biometric attendance system based on the attendance records that were captured by the students.
3. The system then generates the records of the students, which includes the date and time they were captured.
4. The use case ends.

Alternative Flow of Events: The system is unable to generate attendance records of the students in which a message is relayed to the administrator.

Pre-conditions:

1. The administrator has logged into the system.
2. The students have already captured their attendance in the system.

Post conditions:

The attendance records are generated.

VI. **Use Case Name**: Mark Attendance

Actors: Student

Basic Flow of Events:

1. The use case starts when a student has logged in to the system.
2. The student then selects mark attendance on the application system.
3. The student captures their attendance by placing their finger on the fingerprint scanner, which then captures the attendance of the student based on the date and time.
4. The use case ends.

Alternative Flow of Events:

1. Student attendance is not captured

Pre-conditions:

1. The student has registered their details in the system.
2. The student has registered their fingerprint into the system.
3. The student has logged into the system.

Post conditions:

1. The attendance of the student is captured

VII. **Use Case Name**: Receiving messages

Actors: Student

Basic Flow of Events:

1. The use case starts when the student has logged into the system.
2. The student selects view messages on the application menu.
3. The student reads warning messages of their attendance if they have missed two or more classes.
4. The student selects close.
5. The use case ends.

Alternative Flow of Events:

The student is unable to view their messages

Pre-conditions:

1. The student has logged into the system.

Post-conditions:

1. The student views messages.

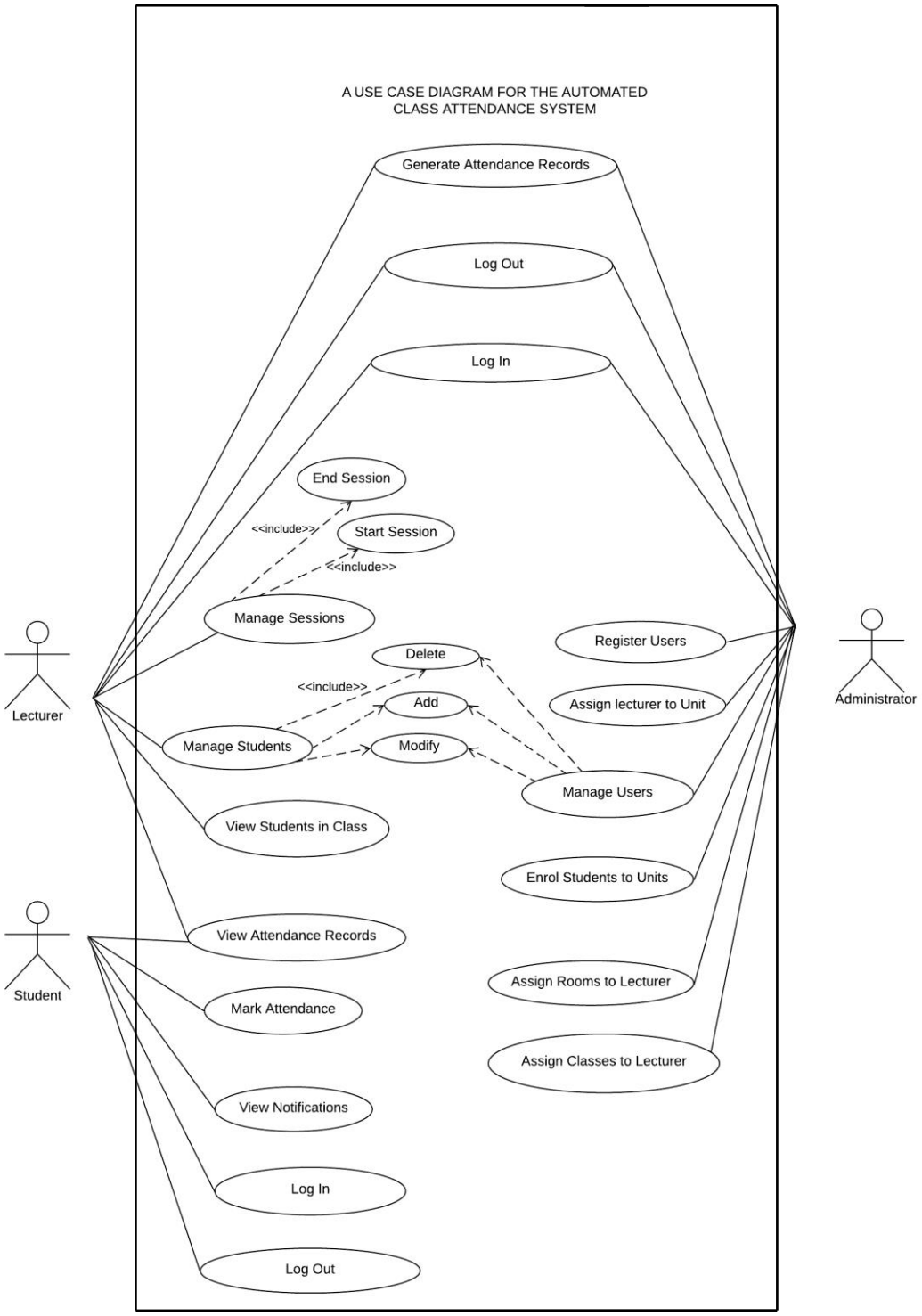


Figure 4.1: A Use Case Diagram for the Proposed System

4.3.3 Class Diagram

The class diagram provides an overview of the system by describing objects and classes within the system as well as the relationships between them. Figure 4.2 below illustrates the specifications for the software classes as well as related methods. In addition, the diagram also shows the visibility of the different classes in relation to others in the model.

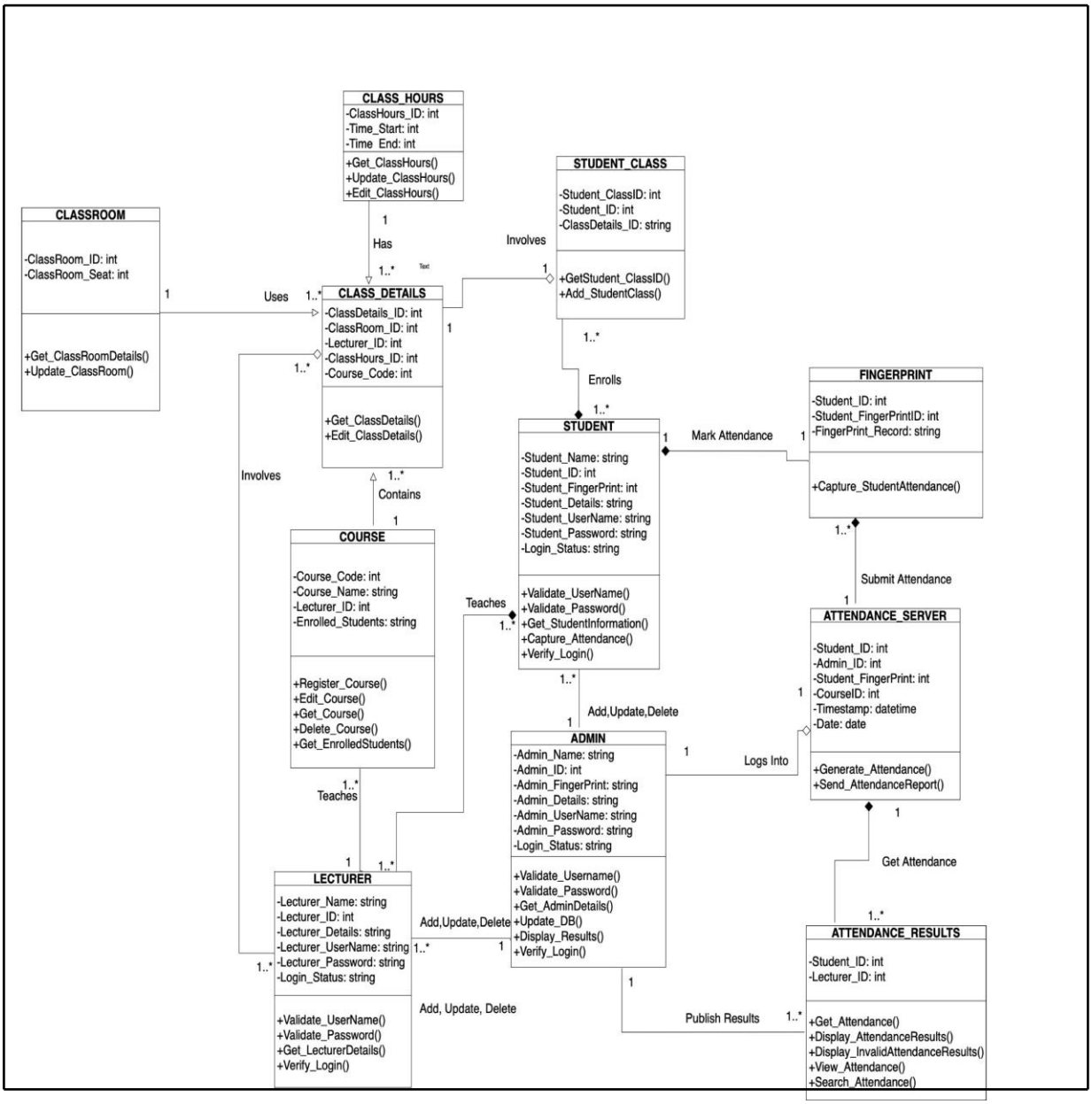


Figure 4.2: A Use Case Diagram for the Proposed System

4.3.4 Sequence Diagrams

A sequence diagram shows object interactions, which are usually arranged in time sequence. In our case, the sequence diagram in Figure 4.3 below depicts the scenario of a student marking their attendance. It shows how the process of a student capturing their attendance using the fingerprint scanner is done.

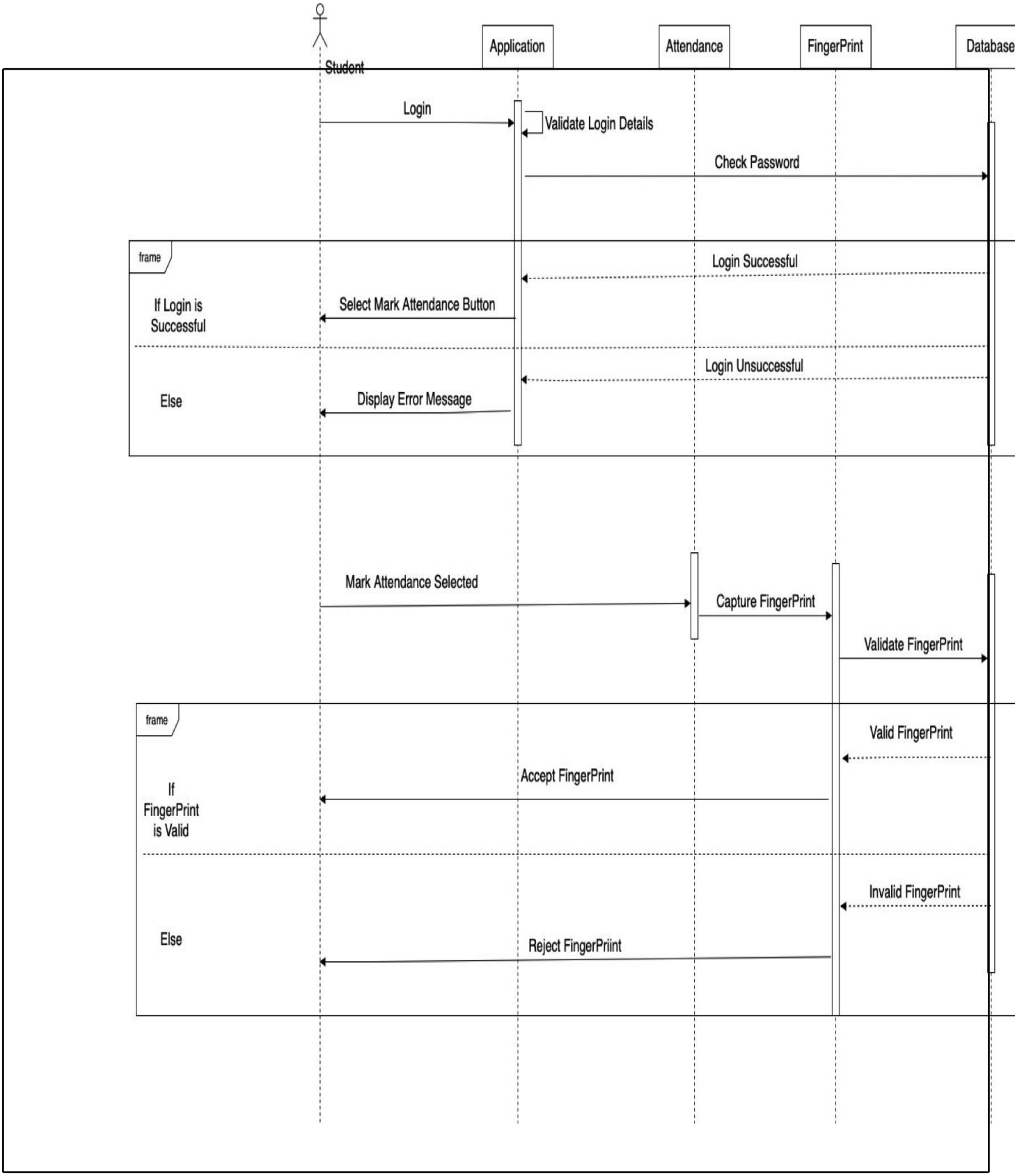


Figure 4.3: Sequence Diagram for Capturing Attendance in the Proposed System

4.3.5 Sequence Diagram for Viewing Attendance Records

Figure 4.4 below shows the sequence diagram of how a user of the system, which can either be a student, lecturer or an administrator are able to view attendance records after the student marks their attendance using the fingerprint scanner. It shows the interactions between the objects and the system application.

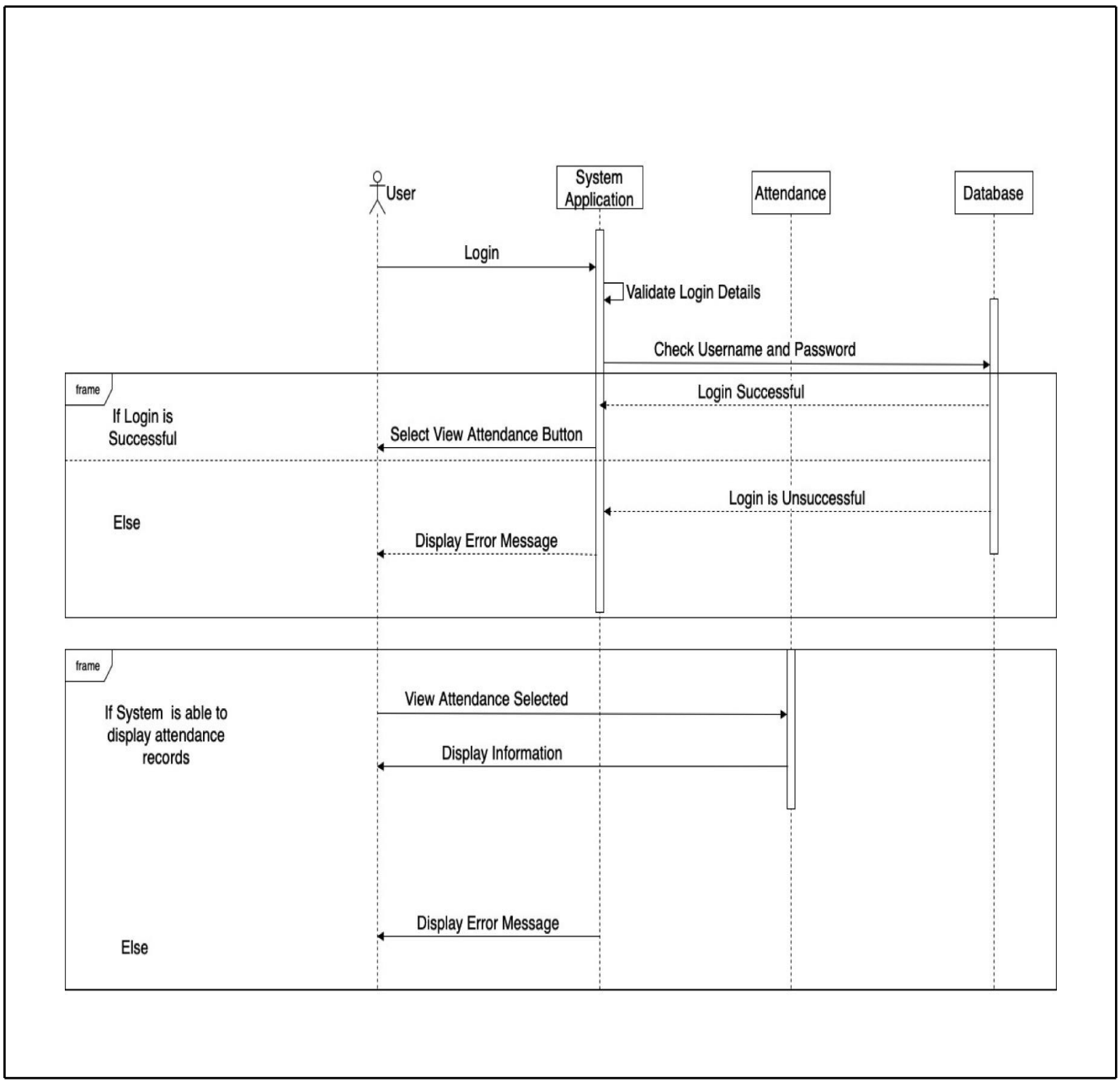


Figure 4.4: A Sequence Diagram for Viewing Attendance Records in the Proposed System

4.3.6 Sequence Diagram for User Login

Figure 4.5 below shows the sequence diagram for user login. The sequence diagram illustrates how a user logs into the class attendance system. In addition, it also shows what happens when a user is unable to login.

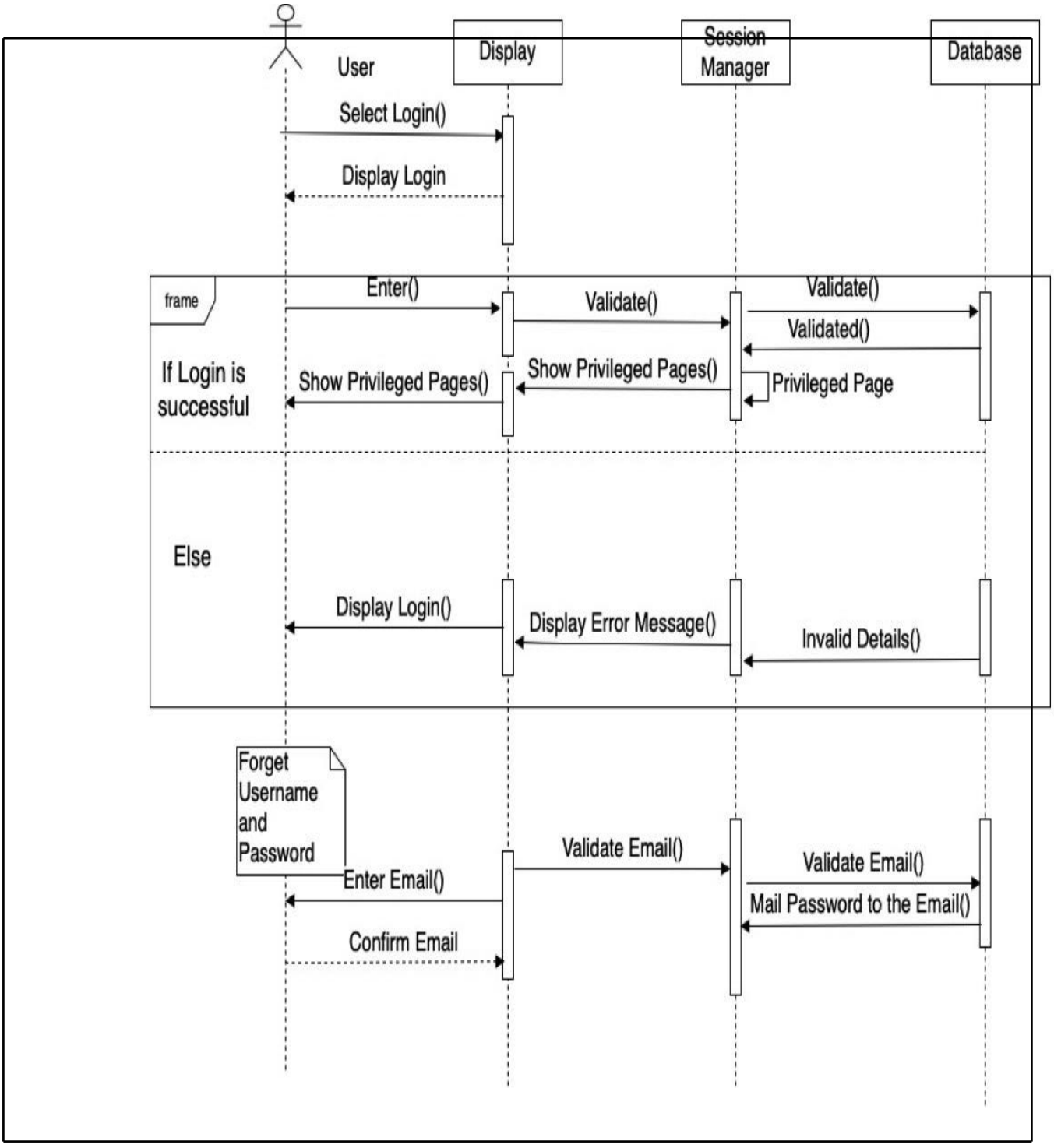


Figure 4.5: A Sequence Diagram for User Login in the Proposed System

4.3.7 Sequence Diagram for Registering A Course

Figure 4.6 below shows the sequence diagram for adding a course. For the administrator to add the course, they must be logged in the system. The administrator must also be granted access into the system otherwise they will not be able to register the course. If the system is unable to register the course, an error message will be displayed.

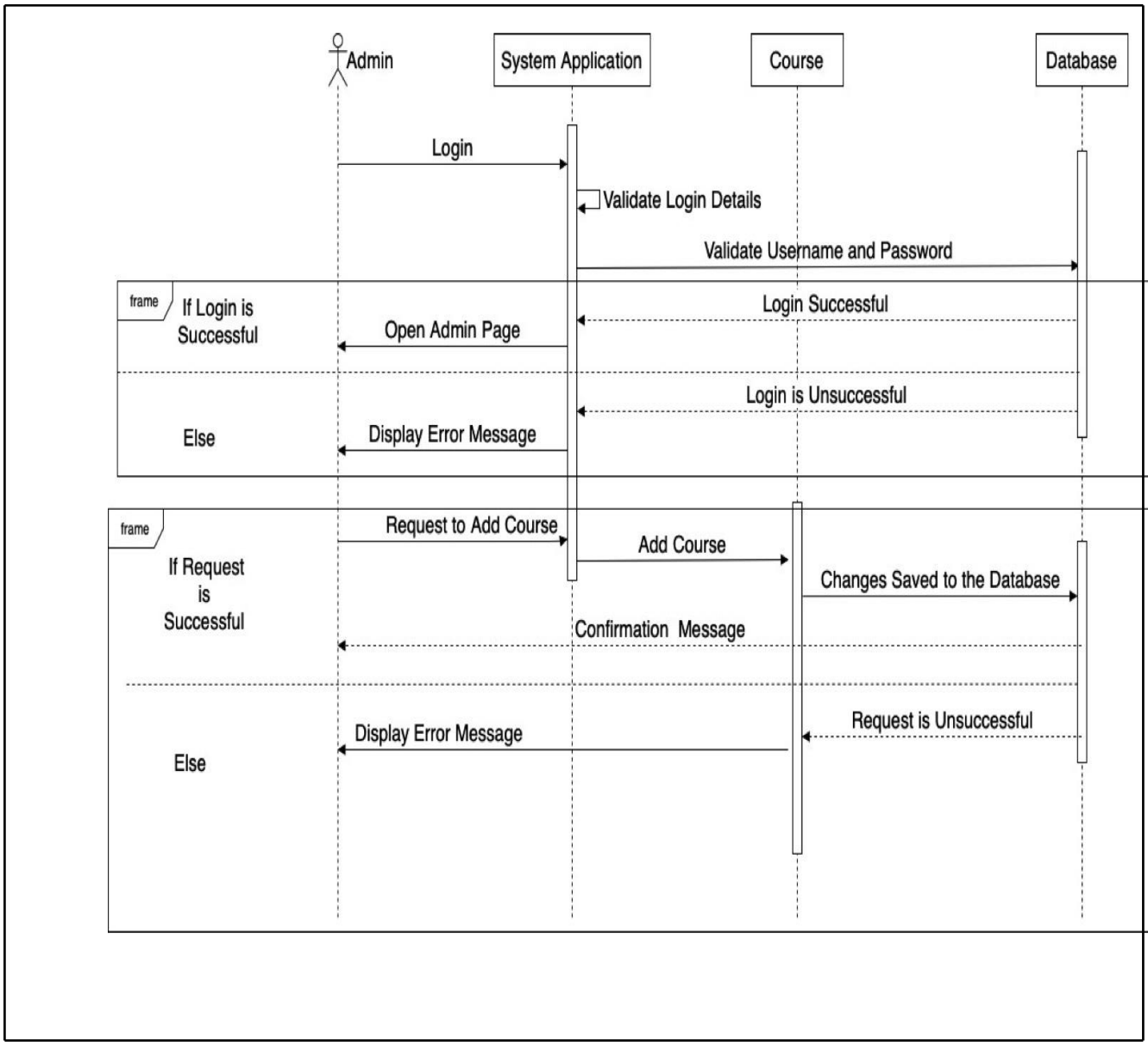


Figure 4.6: A Sequence Diagram for Registering a Course in the Proposed System

4.3.8 Sequence diagram for Registering Users

Figure 4.7 below shows a sequence diagram for registering new users into the system. For an administrator to register a new user, he or she must be logged into the system. They must also have access to the system and otherwise they shall not be able to register a new user. In addition, the administrator should have received a request to register a new user into the system.

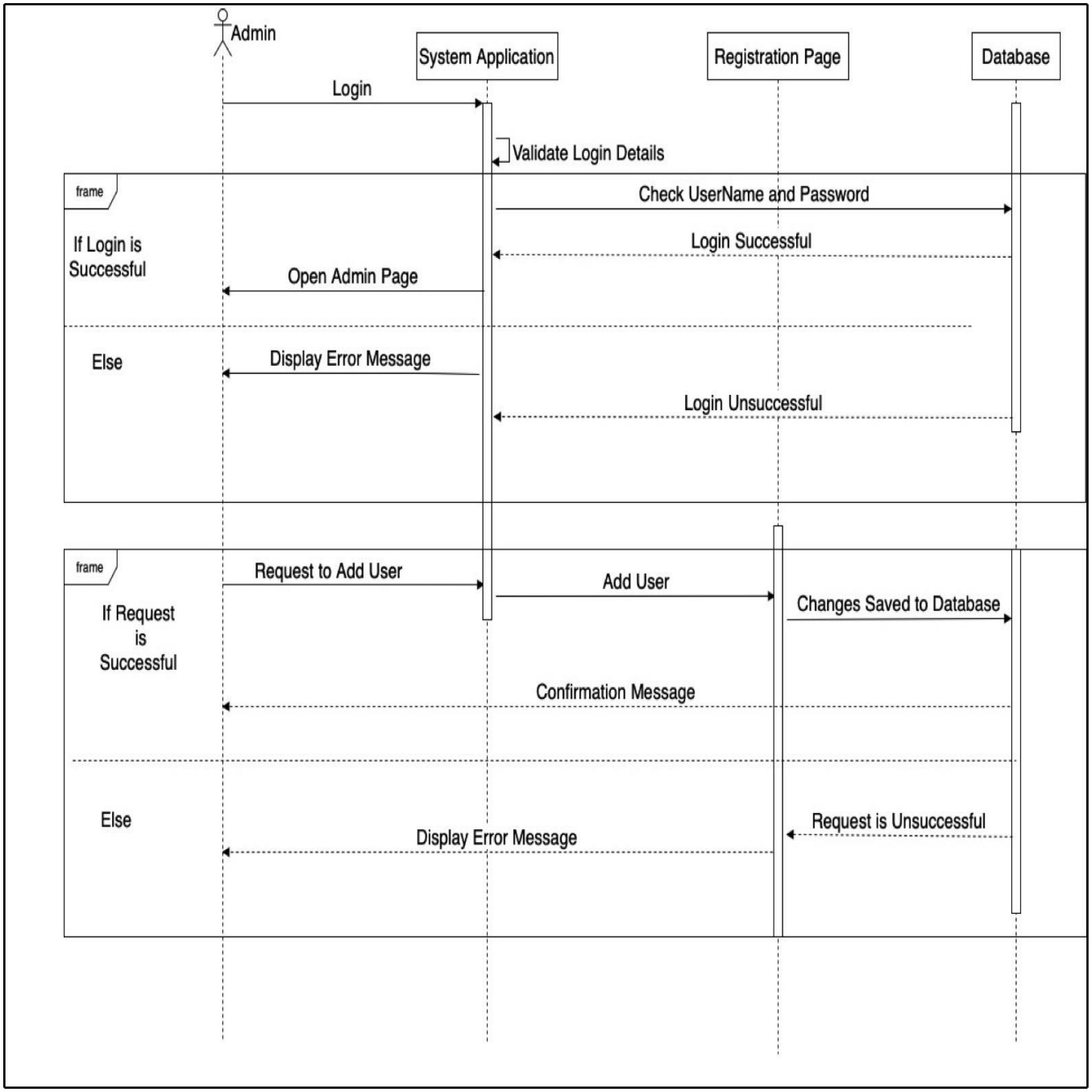


Figure 4.7: A Sequence Diagram for Registering Users in the Proposed System

4.3.9 Sequence Diagram for Deleting Users

Figure 4.8 below shows a sequence diagram for deleting users in the system. In order to delete a user, the administrator has to be logged into the system. If the administrator has not been granted access to the system, he or she will not be able to delete users.

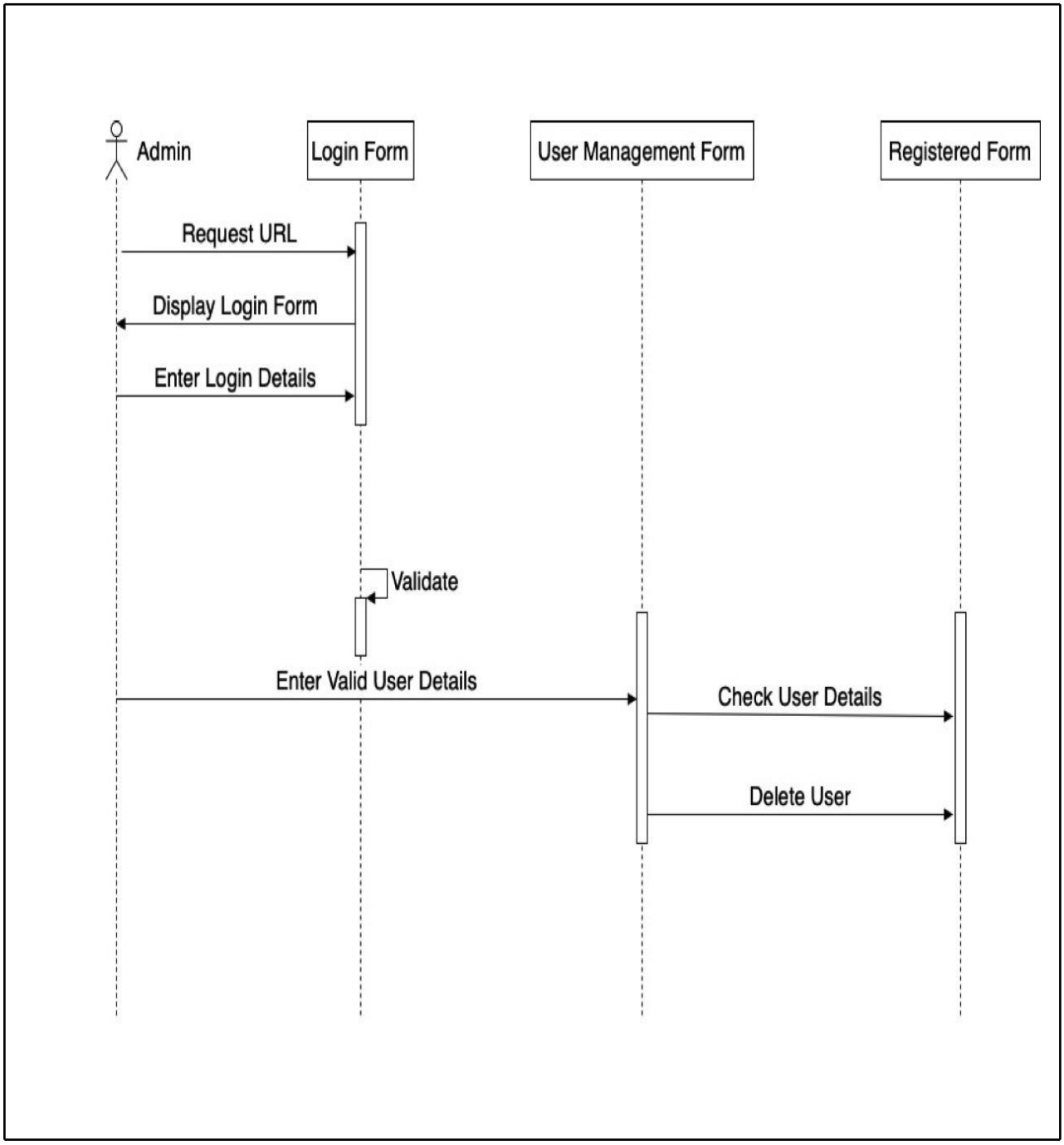


Figure 4.8: A Sequence Diagram for Deleting Users in the Proposed System

4.4 Sequence Diagram for Updating Users

Figure 4.9 below shows a sequence diagram for updating users. In order to update a user, the administrator has to be logged into the system. If the administrator has not been granted access to the system, he or she will not be able to update users.

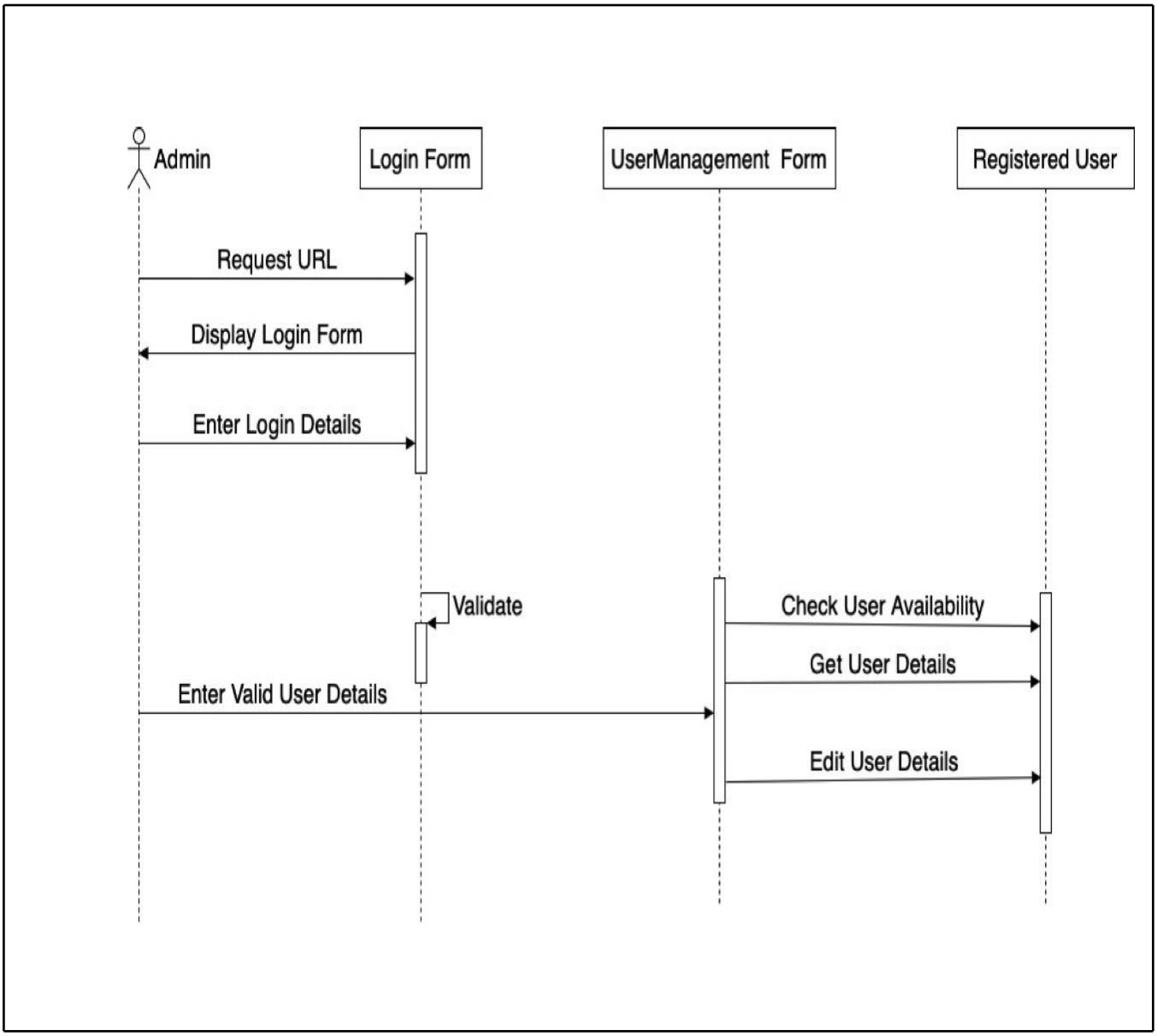


Figure 4.9: A Sequence Diagram for Updating Users in the Proposed

4.4.1 Sequence Diagram For the Application Interface

The sequence diagram showcases the different interactions between the different entities in the system. Figure 5.0 below shows the interactions between the automated class attendance system and the actors. The administrator logs into the system and is able to carry out activities such as adding students, lecturers, generating attendance records, adding classes and adding courses. In addition, the student is able to view their attendance records and capture their attendance using the fingerprint scanner. The lecturer on the other hand is able to view the attendance records of students.

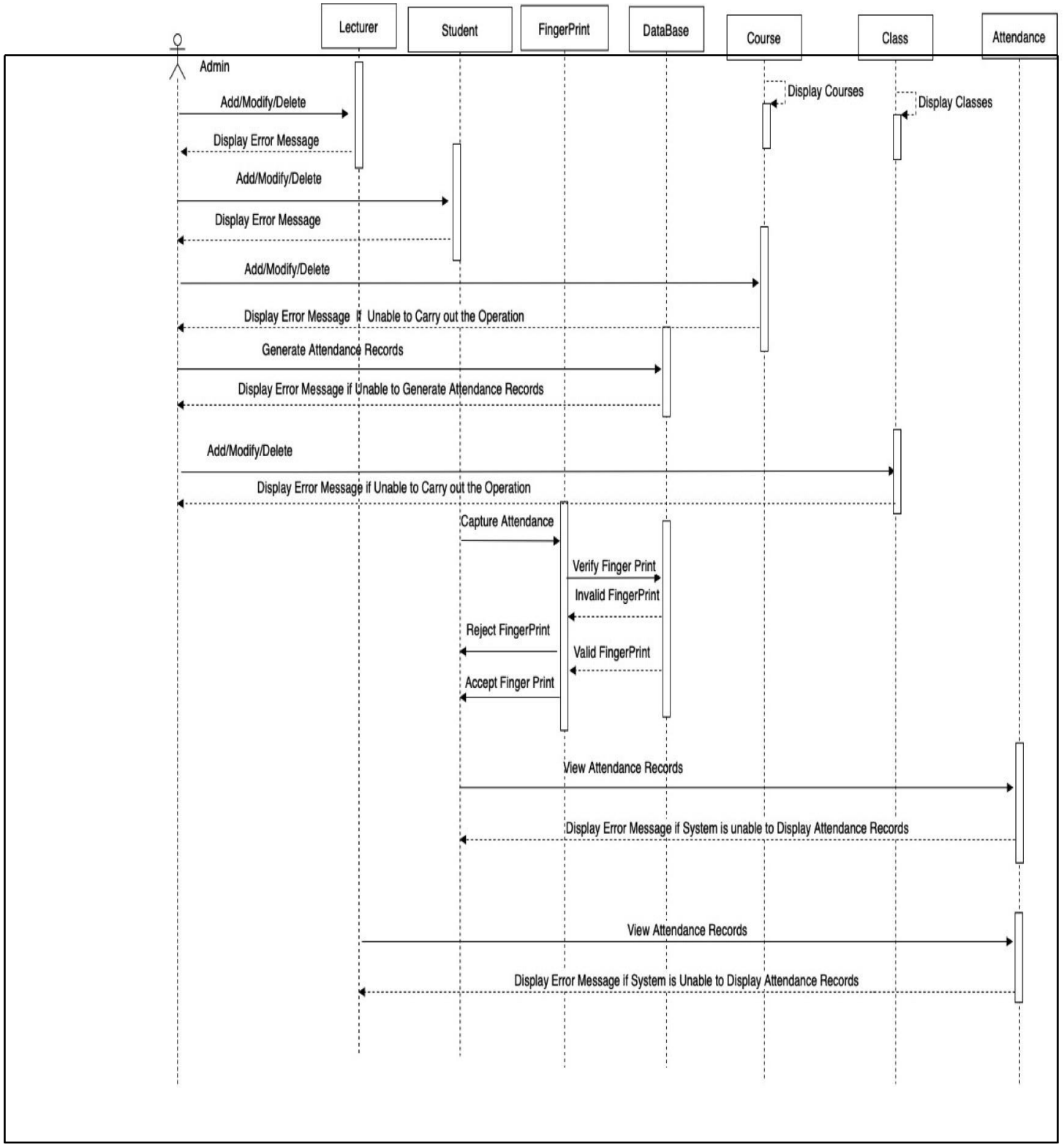


Figure 4.10: A Sequence Diagram for the Interface of the Proposed System

4.4.2 Entity Relationship Diagram

The entity relationship model describes the interrelation of the different entities in the model and also specifies the different relationships that can exist between the entities. In our case, we have different entities such as student, student class, admin, class details, lecturer, course, classroom, classroom details, class hours, fingerprint, attendance server and attendance results. Figure 5.1 below captures the different entities stated and also shows the relationship between the existing entities.

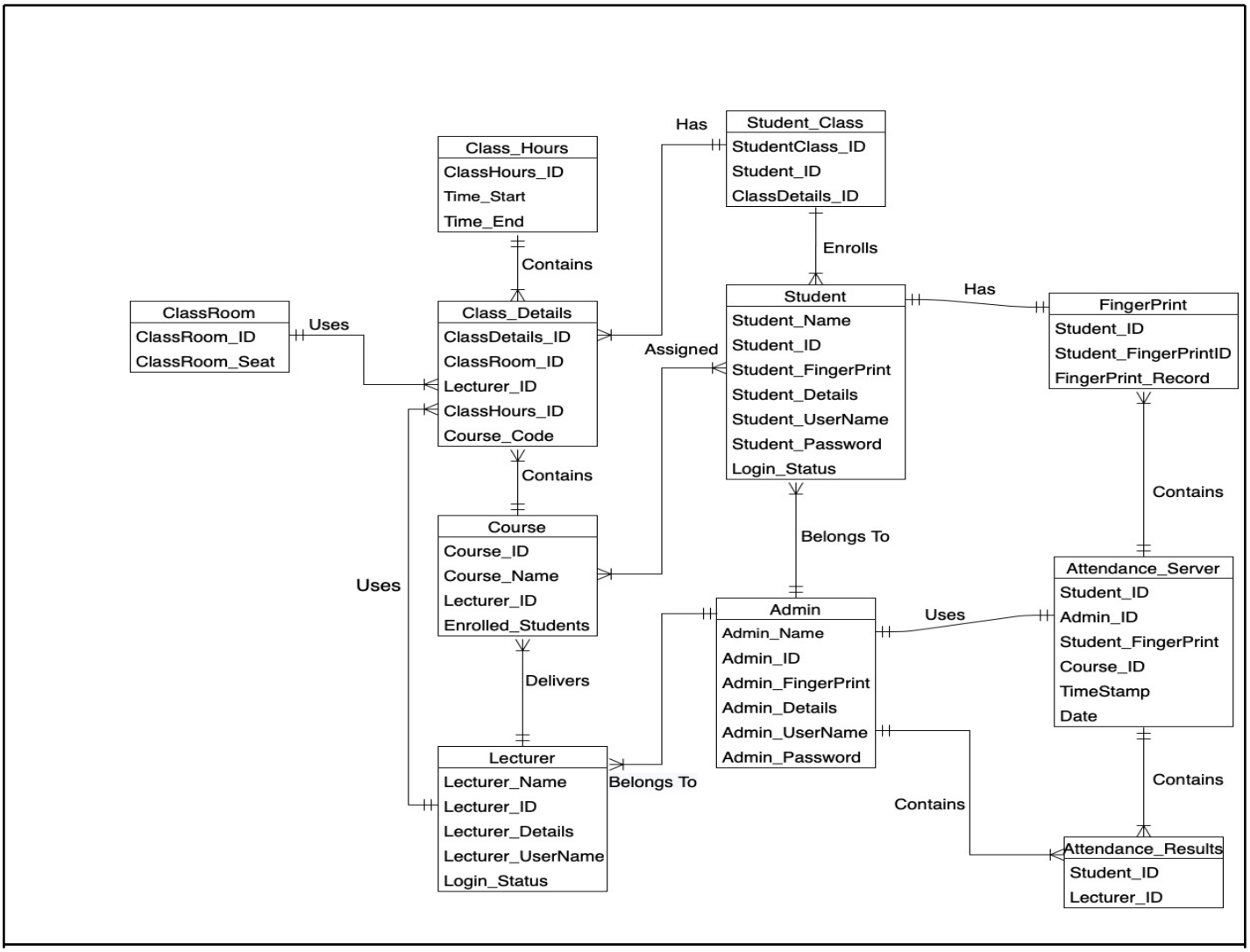


Figure 4.11: An Entity Relationship Diagram for the Proposed System

4.4.3 Database Schema

Figure 5.2 below shows the database schema of the proposed system. It shows the organization of data as a blueprint of how the database is constructed. In addition, it also shows the relations in the database.

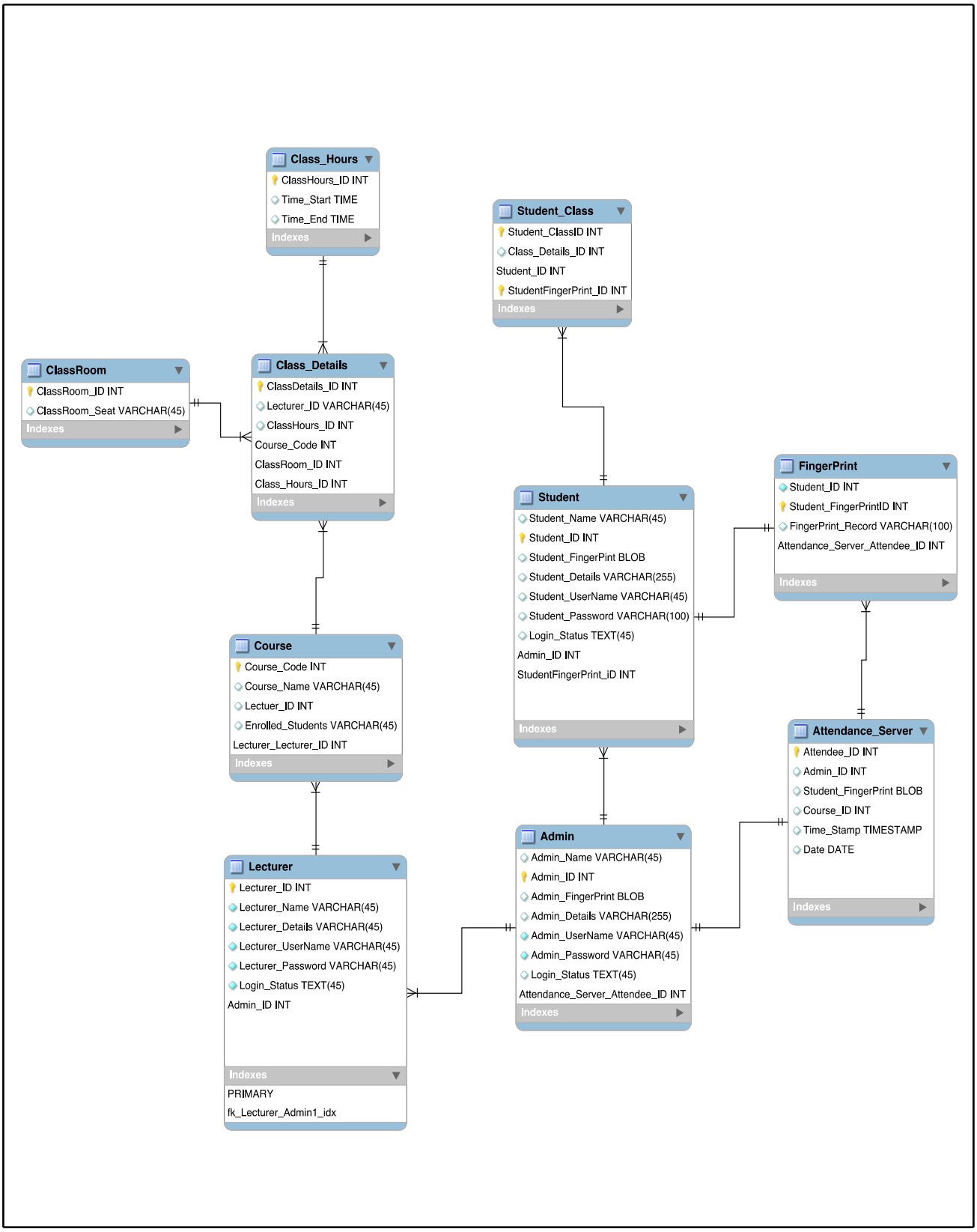


Figure 4.12: Database Schema of the Proposed System

Chapter 5: System Testing

5.1 Introduction

This chapter purposed to focus on how the system was implemented and the system algorithm that was used to build the biometric fingerprint attendance system. In addition, this chapter aimed to provide a description of how the system was implemented and tested so as to ensure that it fulfilled the specified requirements of the system. Finally, the chapter aimed at detecting system failures in order for the defects to be discovered before fully implementing the system.

5.2 System Implementation

At the beginning of the system development, actors of the system were identified. The main actors of the system are the lecturer, administrator and student. After that, the next stage of system development was to identify the different modules and how to use the modules. The three main actors would then interact with the modules. The most important activity for the student will be marking their attendance using the fingerprint scanner after which the administrator and lecturer will be able to view the attendance records.

System was developed using Android because the application is a mobile application and Android makes it easy to develop a mobile application. In addition, there is also presence of design diagrams, which eases the process of identifying process of flow of information throughout the system. Functional and non-functional requirements were earlier identified and were structured into the system. Using the proposed system methodology, it proved easy and more applicable to develop the system using incremental development and developing each module at a time. On completion of the different module development, they were later linked to come up with the system as a whole. In the process of linking the different modules is was important to maintain the logic of the system in that it was of essence to make sure that modules link together in a manner that is understandable and consistent. This means that on the click of a button the button should redirect to the next stated page and not a page that previously came before it.

5.3 System Installation Procedure and User Manual

The developed system uses Android Studio, which is an integrated development environment that is easy to use. Since the system uses firebase database, the first step is to download Android Studio.

The first step is to install the Java Development Kit. On your computer, open terminal window and type java-version. If you see Java SE version is below 7, or Java is not installed, you need to install the development kit before installing Android Studio.

To download the Java Standard Edition Development Kit:

1. Go to the Oracle Java SE downloads page,

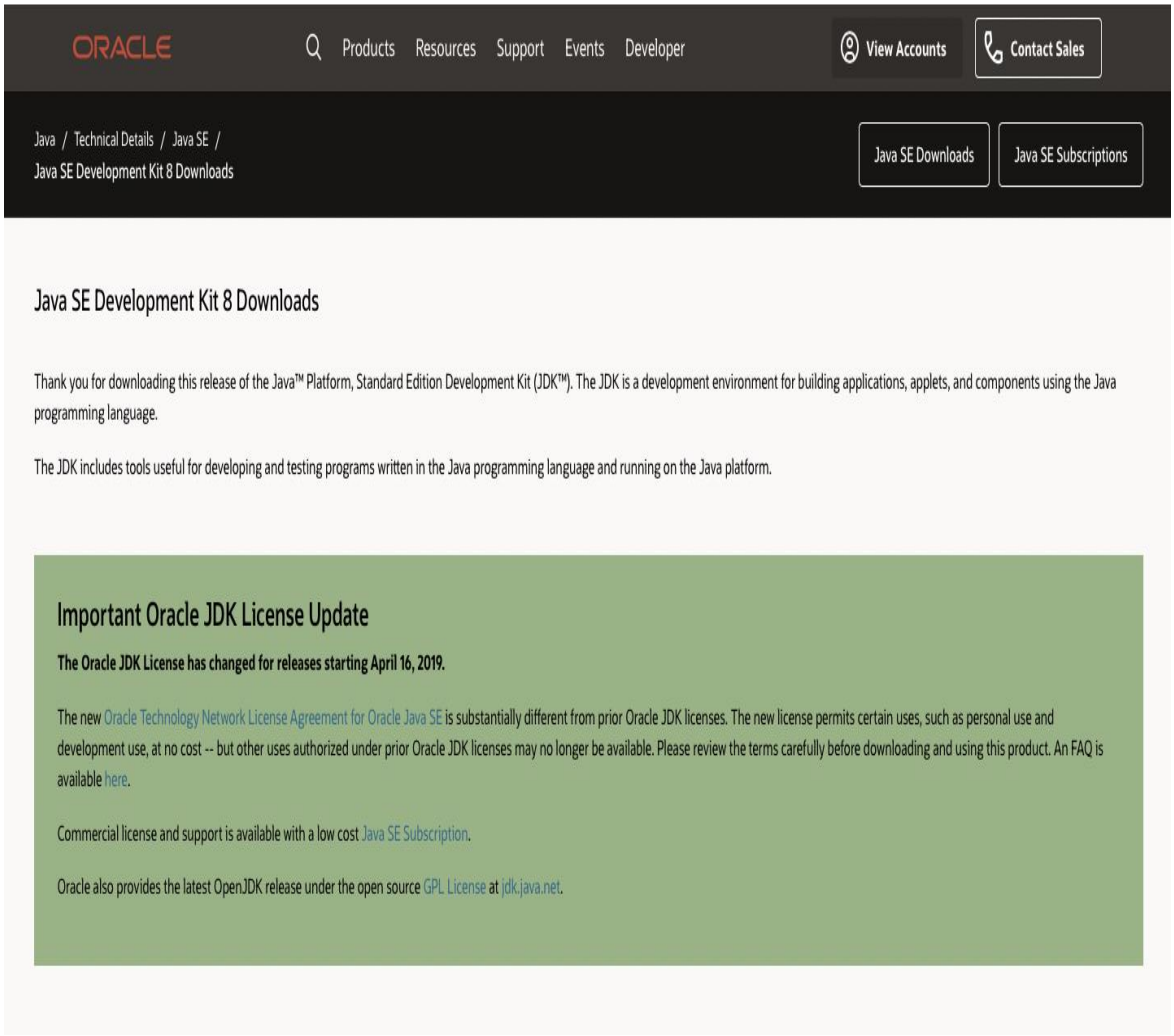
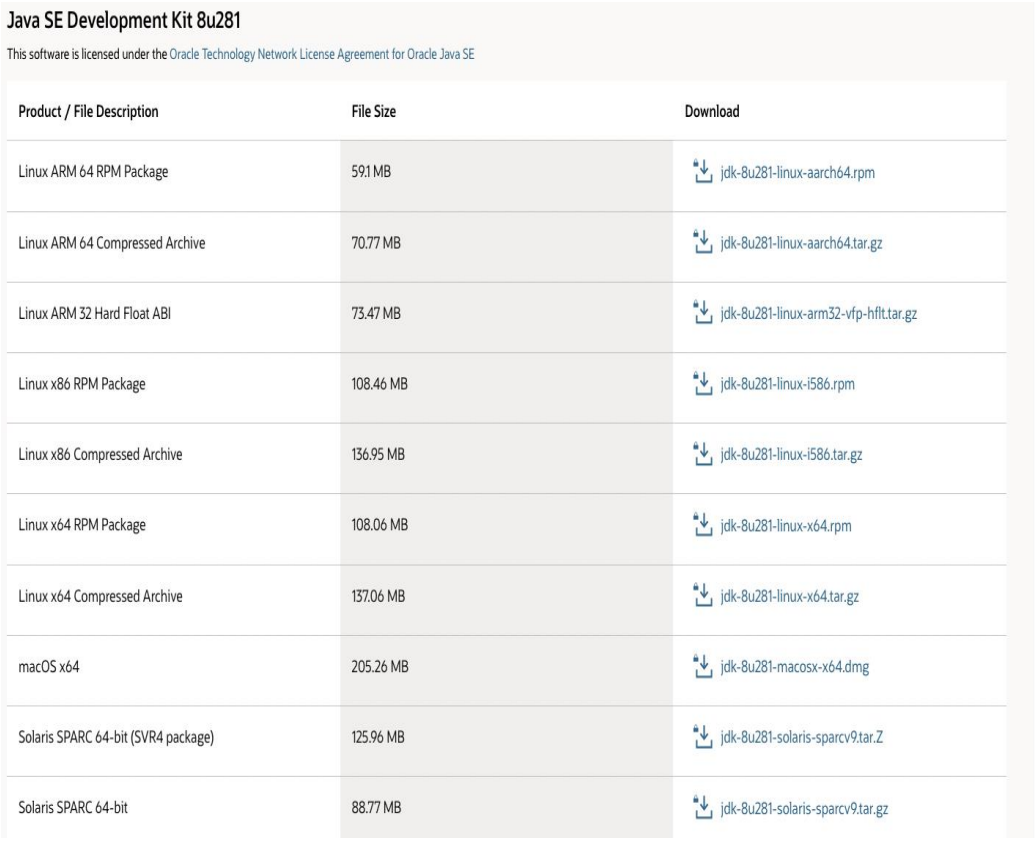


Figure 5.1: Oracle Java SE Downloads Page

2. Click the Java SE Development kit, you need to accept the License Agreement then download the appropriate version for the computer you are developing on.



Java SE Development Kit 8u281

This software is licensed under the Oracle Technology Network License Agreement for Oracle Java SE

Product / File Description	File Size	Download
Linux ARM 64 RPM Package	59.1 MB	jdk-8u281-linux-aarch64.rpm
Linux ARM 64 Compressed Archive	70.77 MB	jdk-8u281-linux-aarch64.tar.gz
Linux ARM 32 Hard Float ABI	73.47 MB	jdk-8u281-linux-arm32-vfp-hflt.tar.gz
Linux x86 RPM Package	108.46 MB	jdk-8u281-linux-i586.rpm
Linux x86 Compressed Archive	136.95 MB	jdk-8u281-linux-i586.tar.gz
Linux x64 RPM Package	108.06 MB	jdk-8u281-linux-x64.rpm
Linux x64 Compressed Archive	137.06 MB	jdk-8u281-linux-x64.tar.gz
macOS x64	205.26 MB	jdk-8u281-macosx-x64.dmg
Solaris SPARC 64-bit (SVR4 package)	125.96 MB	jdk-8u281-solaris-sparcv9.tar.Z
Solaris SPARC 64-bit	88.77 MB	jdk-8u281-solaris-sparcv9.tar.gz

Figure 5.2: Available Java SE Development Kits

3. Install the development kit and once it is done you can confirm by typing java-version in the terminal.

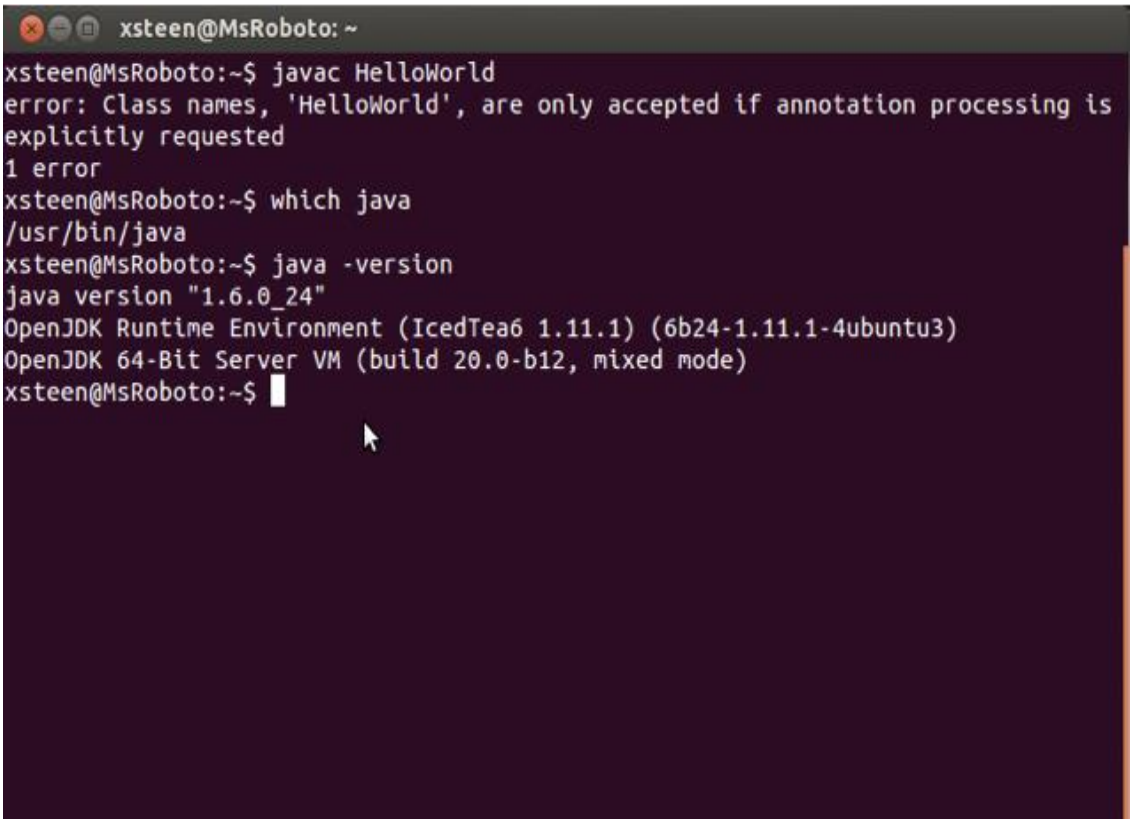


Figure 5.3: Confirming Java Version in the Terminal

4. Set the JAVA_HOME environment variable to the installation directory of the JDK.

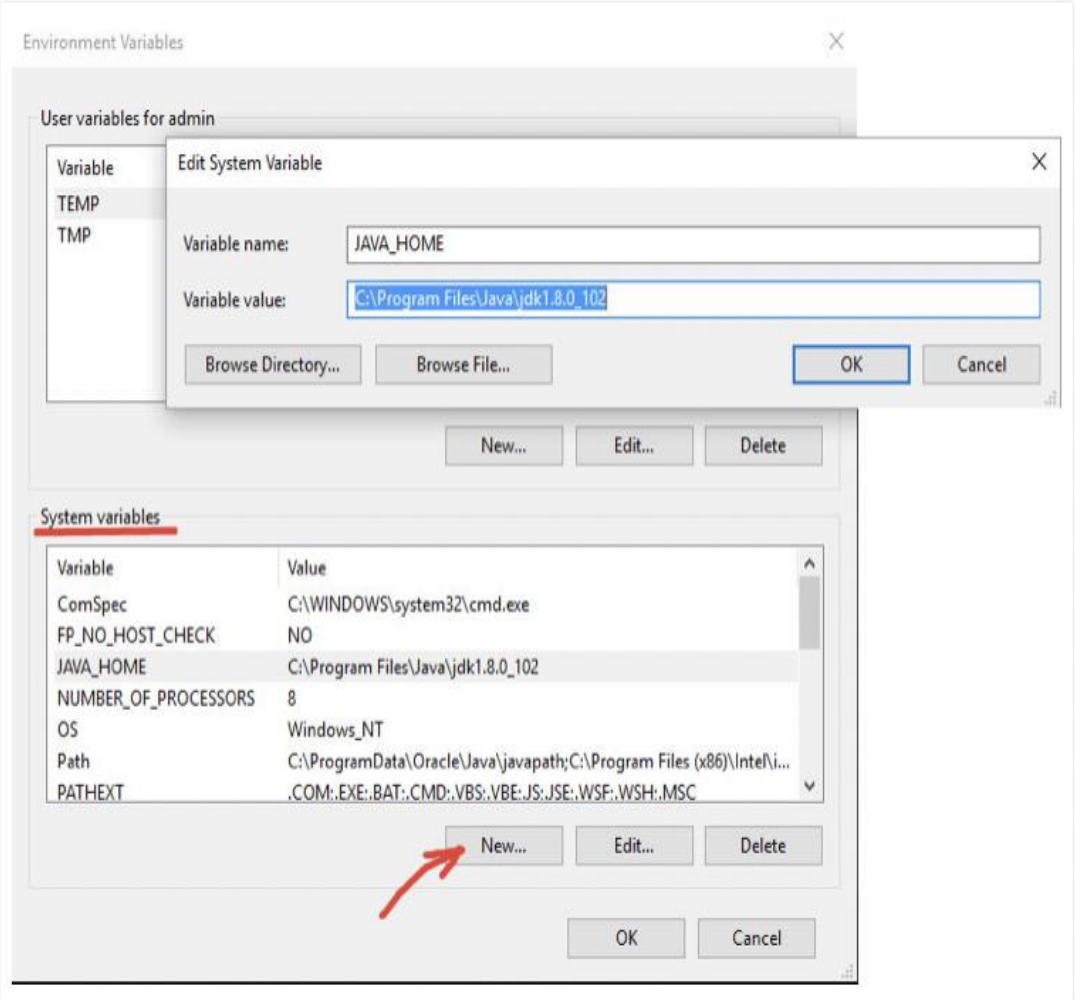


Figure 5.4: Setting the JAVA_HOME environment

5. After setting the JAVA_HOME environment, navigate to the Android developers site and click on the “Download Android Studio” option.

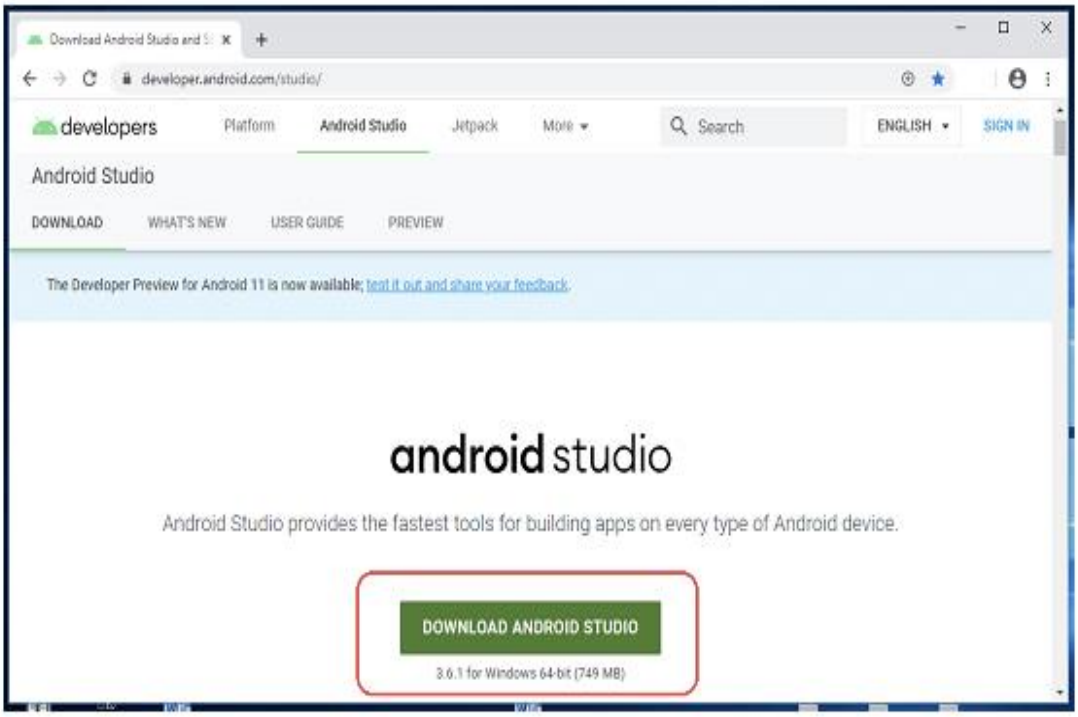


Figure 5.5: Downloading Android Studio

6. Double click on the downloaded “Android Studio ide.exe” file.

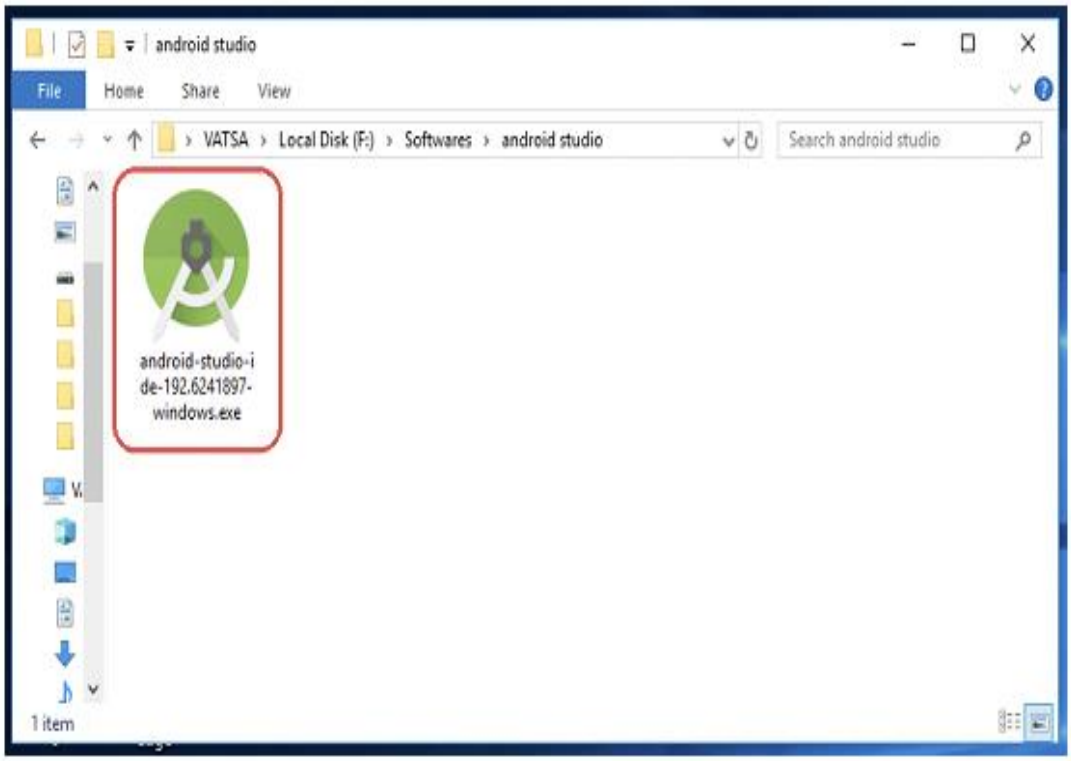


Figure 5.6: Android Studio ide.exe File

7. “Android Studio Setup” will appear on the screen and click “Next” to proceed.

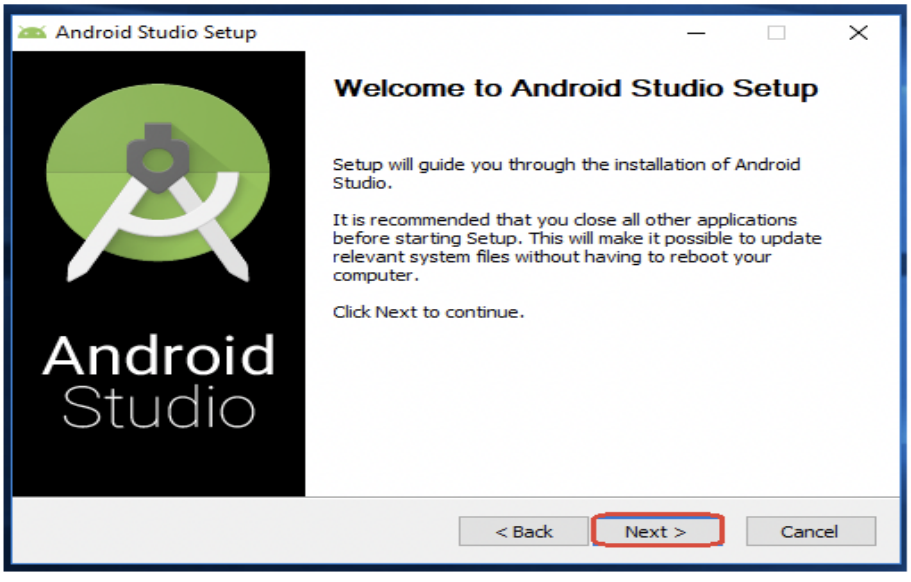


Figure 5.7: Android Studio Setup

8. Select the components that you want to install and click “Next” button.

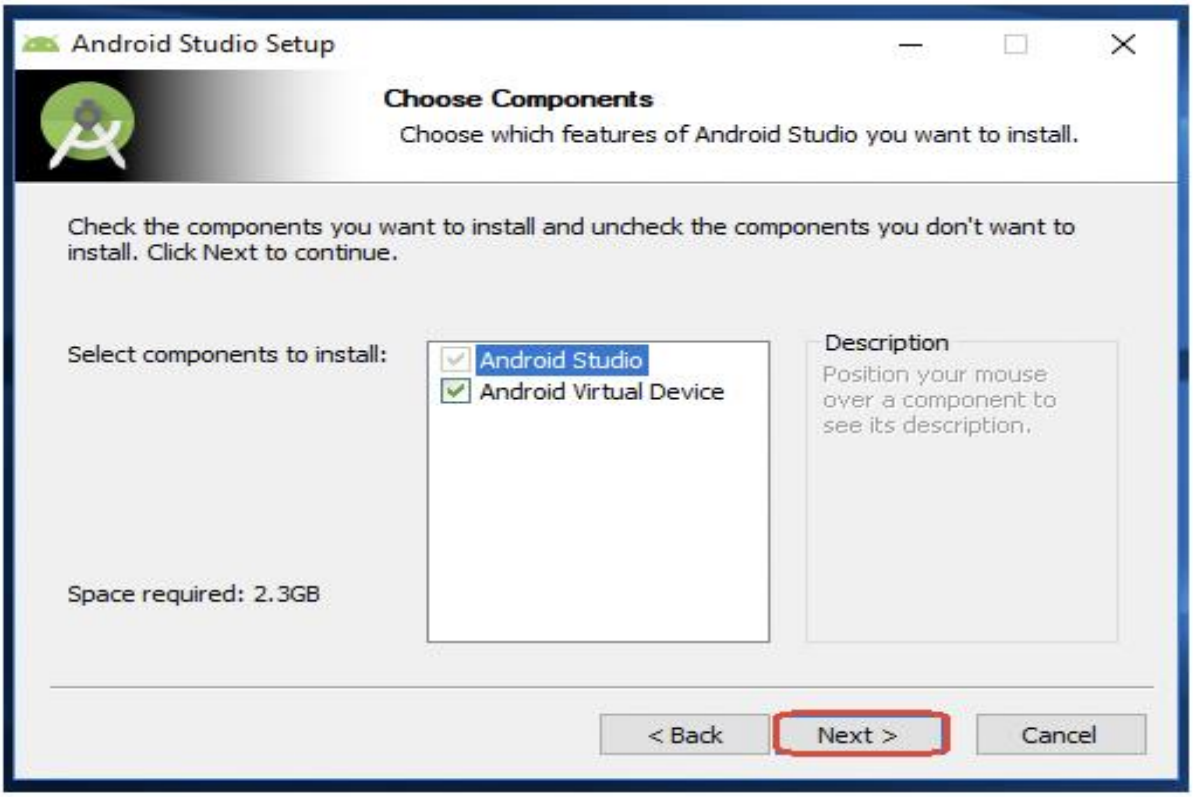


Figure 5.8: Android Studio Component

9. Browse location where you want to install android studio and click next.

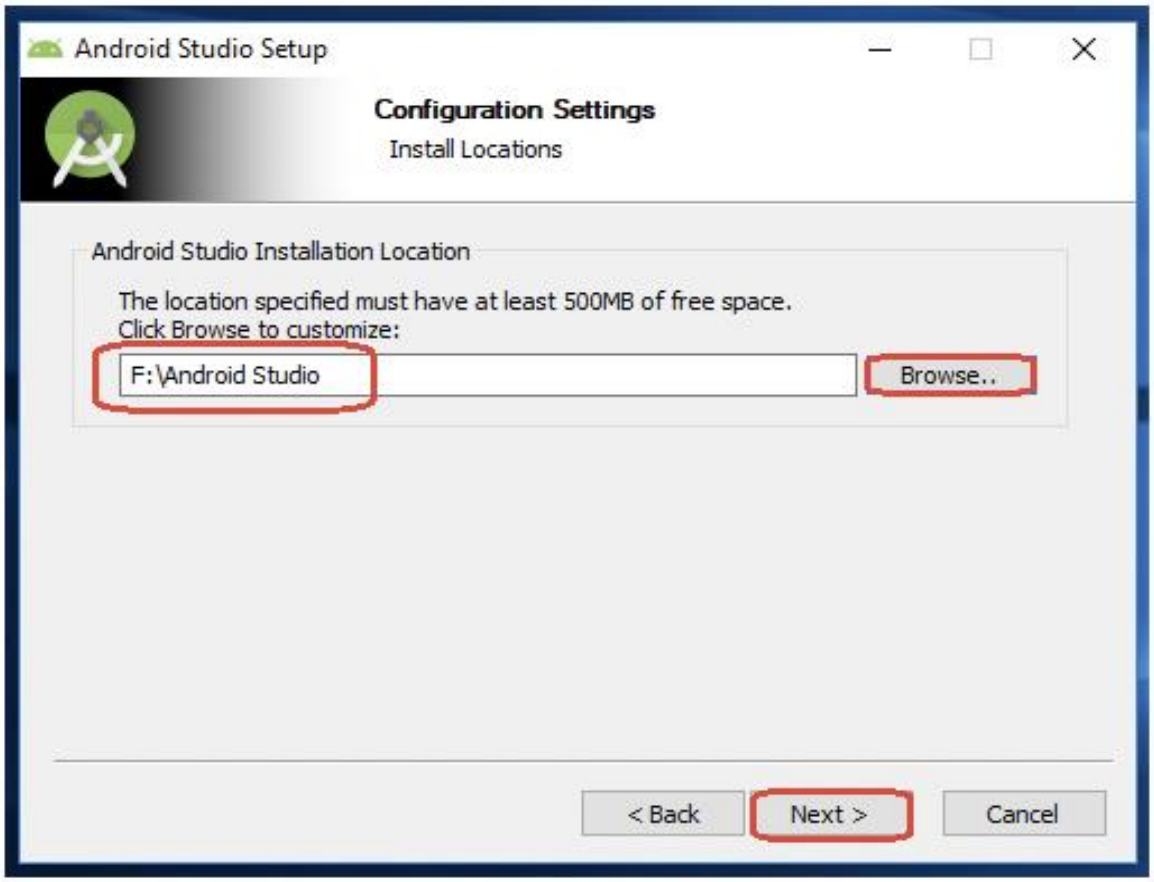


Figure 5.9: Browse Location for Android

10. Click on the "finish" button to finish installation.

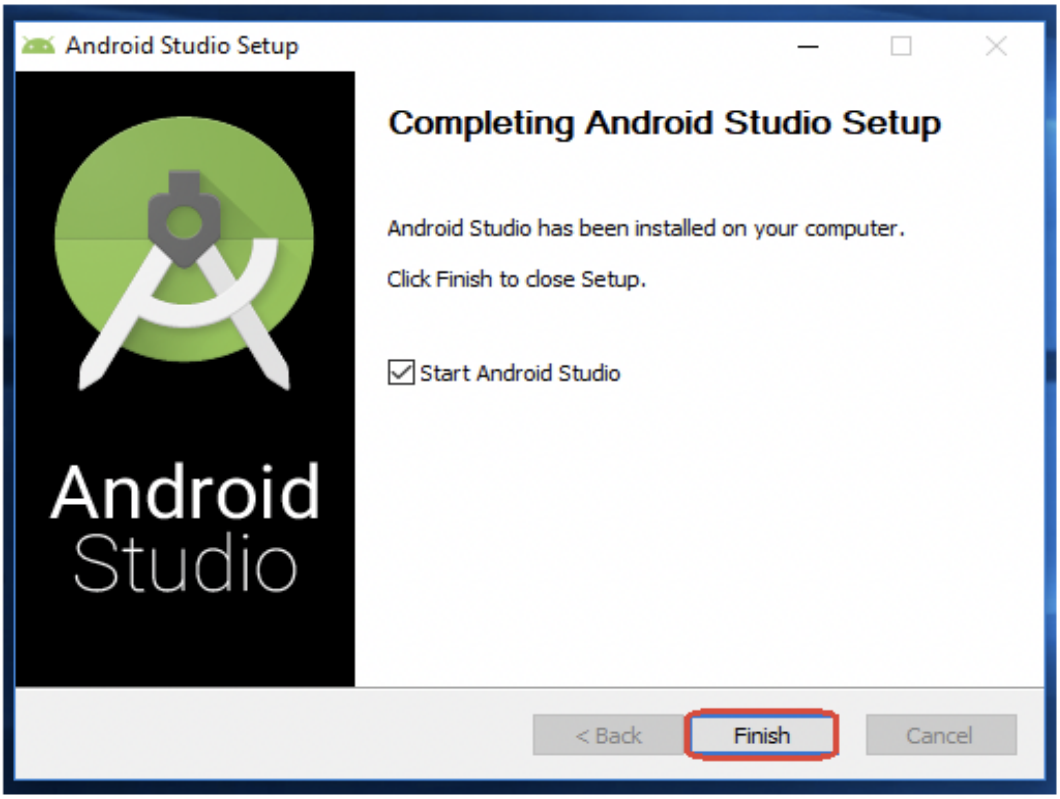


Figure 5.10: Completing the Android Studio Setup

Adding Firebase to your Project Using Android Studio

1. Go to the Firebase console and create a new project.

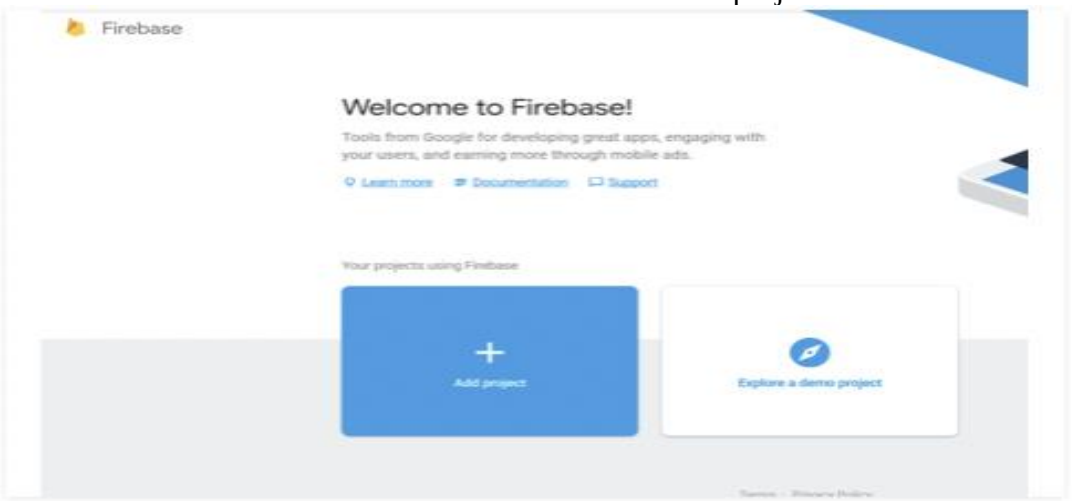


Figure 5.11: Firebase Console

2. Open Android Studio and click on **Tools** in the upper left corner.

3. Click on the Firebase option in the drop down menu.

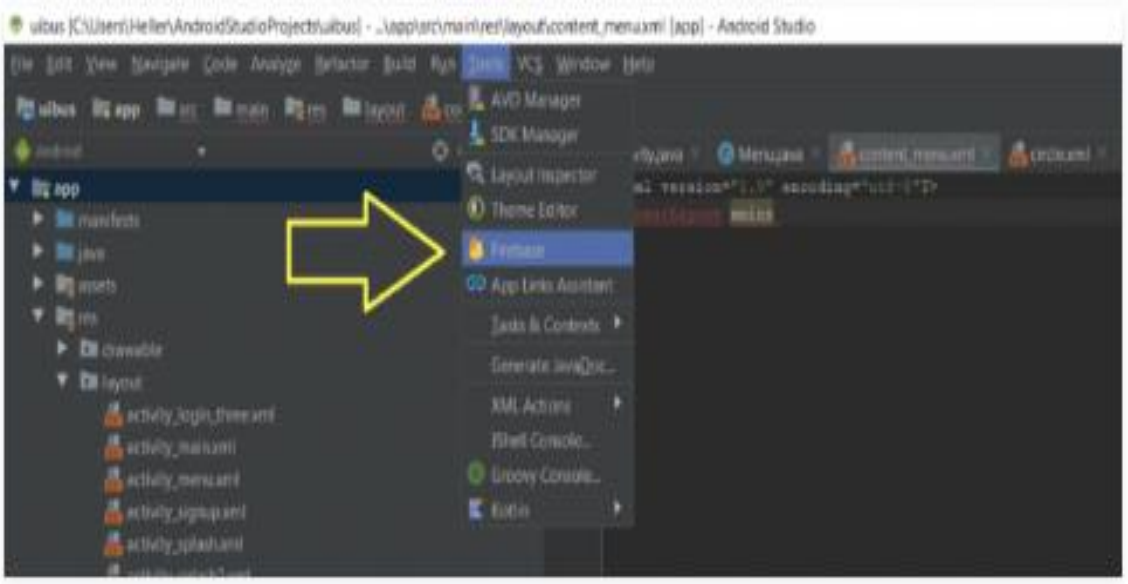


Figure 5.12: Drop Down Menu of Tools Option in Android Studio

4. Menu of services will appear. Click on the desired service.
5. Click on connect to Firebase.

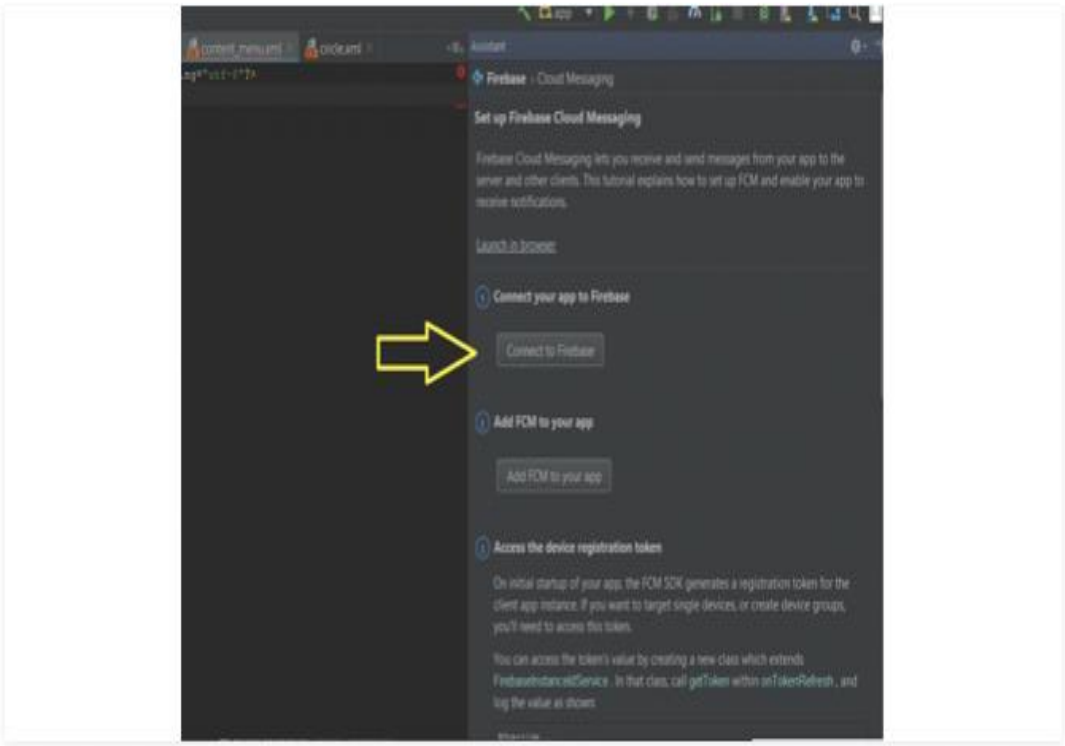


Figure 5.13: Connecting to Firebase

6. Add the dependencies of your service by clicking on the **Add.**

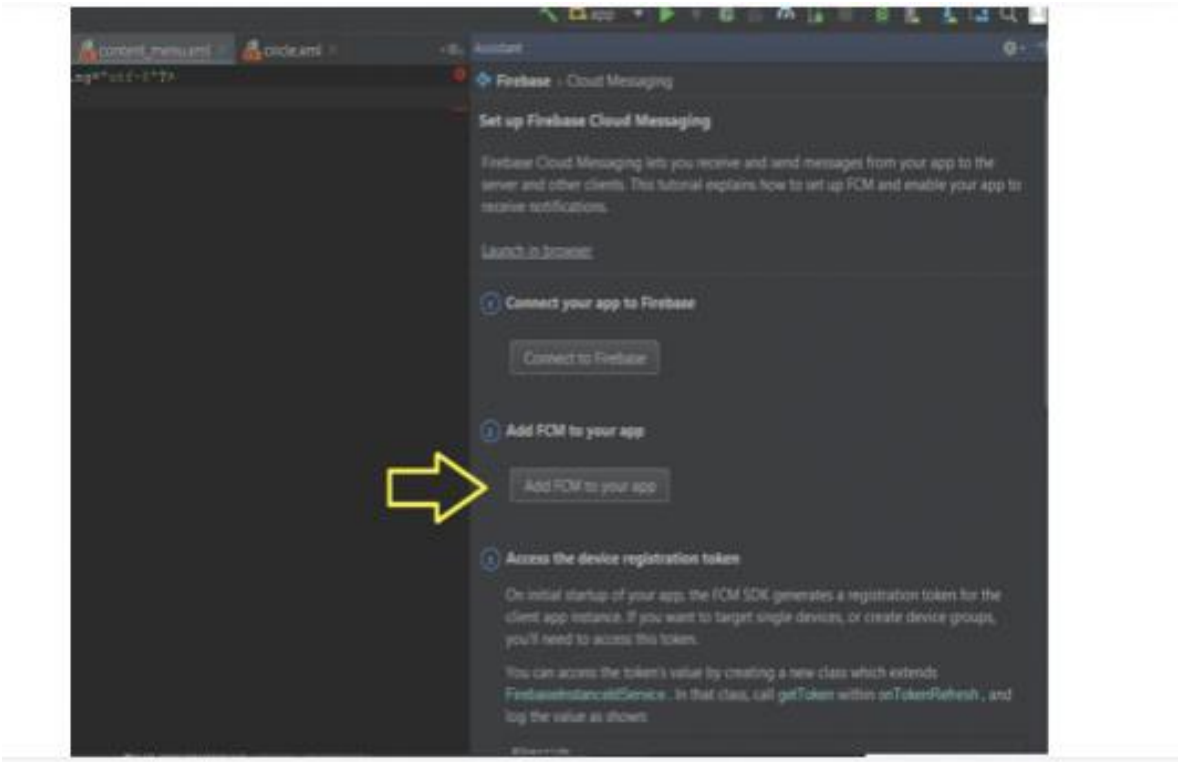


Figure 5.14: Adding Dependencies to your Service

Usage of System Modules

The Android biometric finger print attendance system has three main users that interact on a normal basis with the system that is the student, administrator and lecturer. Each of them has different modules of the system that they interact with. When a user first visits the mobile application, he/she first sees the welcome page, which represents the home page of the system. The welcome page contains the three different actors: student, lecturer and administrator.

Figure 5.15: Welcome Page of the System

Student Module

In the students' module, the students have to first sign up wand fill in different fields required by the system. If the sign up fails, the system will notify the student to make sure that they have keyed in their details correctly.

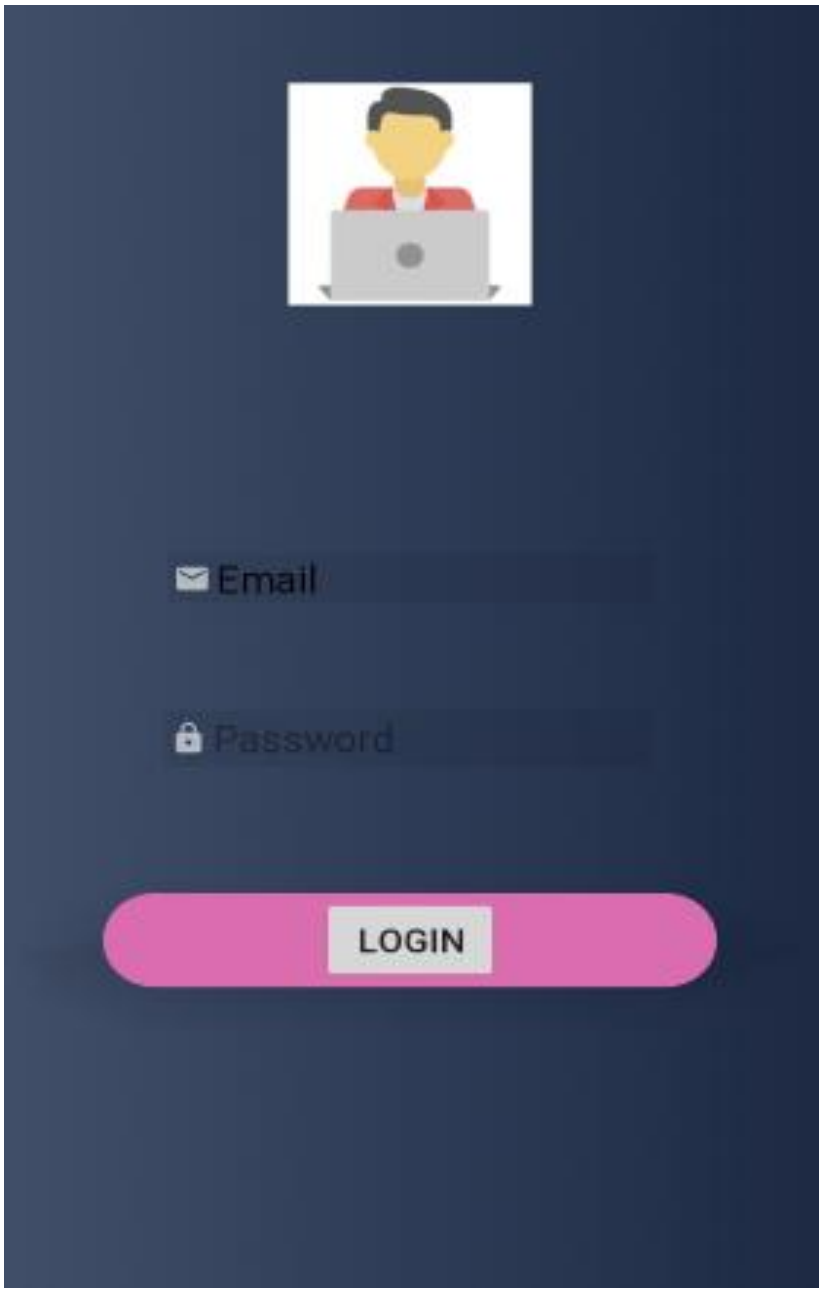


Figure 5.16: Student Login Form

After the login, the student is taken to the student menu page where they are able to mark their attendance, view attendance records and also sign out of the system.

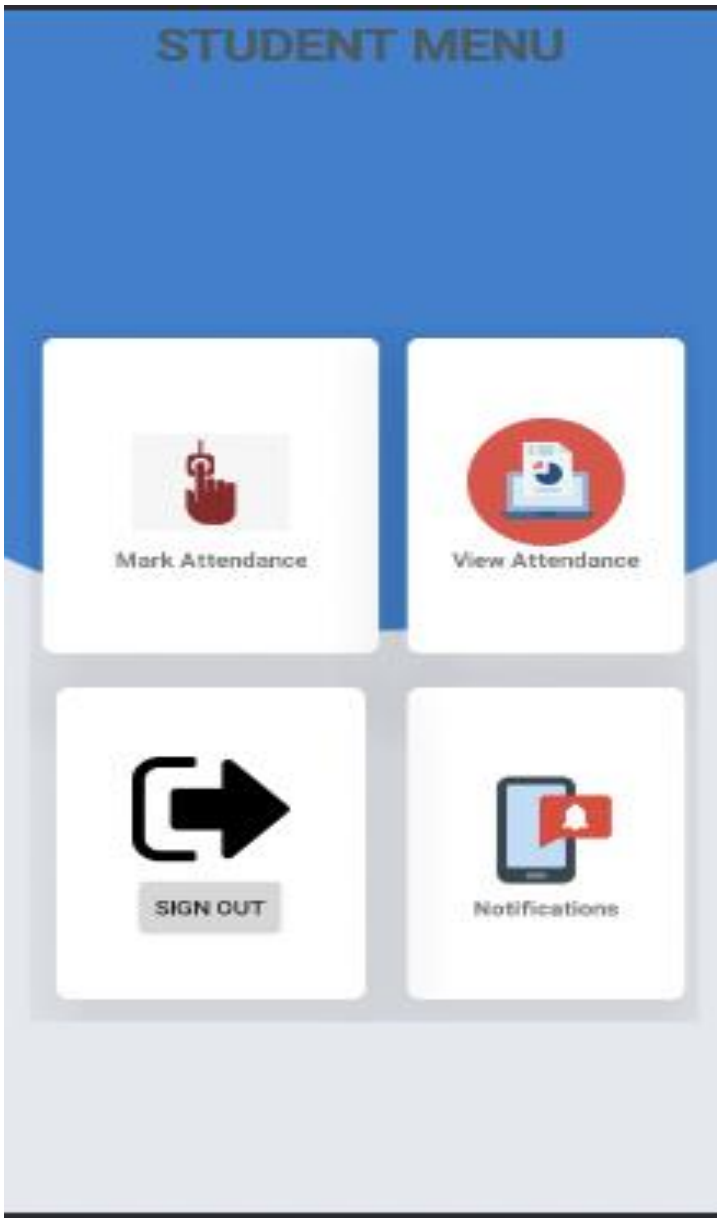


Figure 5.17: Student Menu

Administrator Module

In the administrator module, the administrator first logs into the system using their username and password.

Figure 5.18: Administrator Login Form

After logging in, the administrator is taken to the menu where he/she can be able to add a new user, view attendance records, view users, add a class and also sign out of the system.

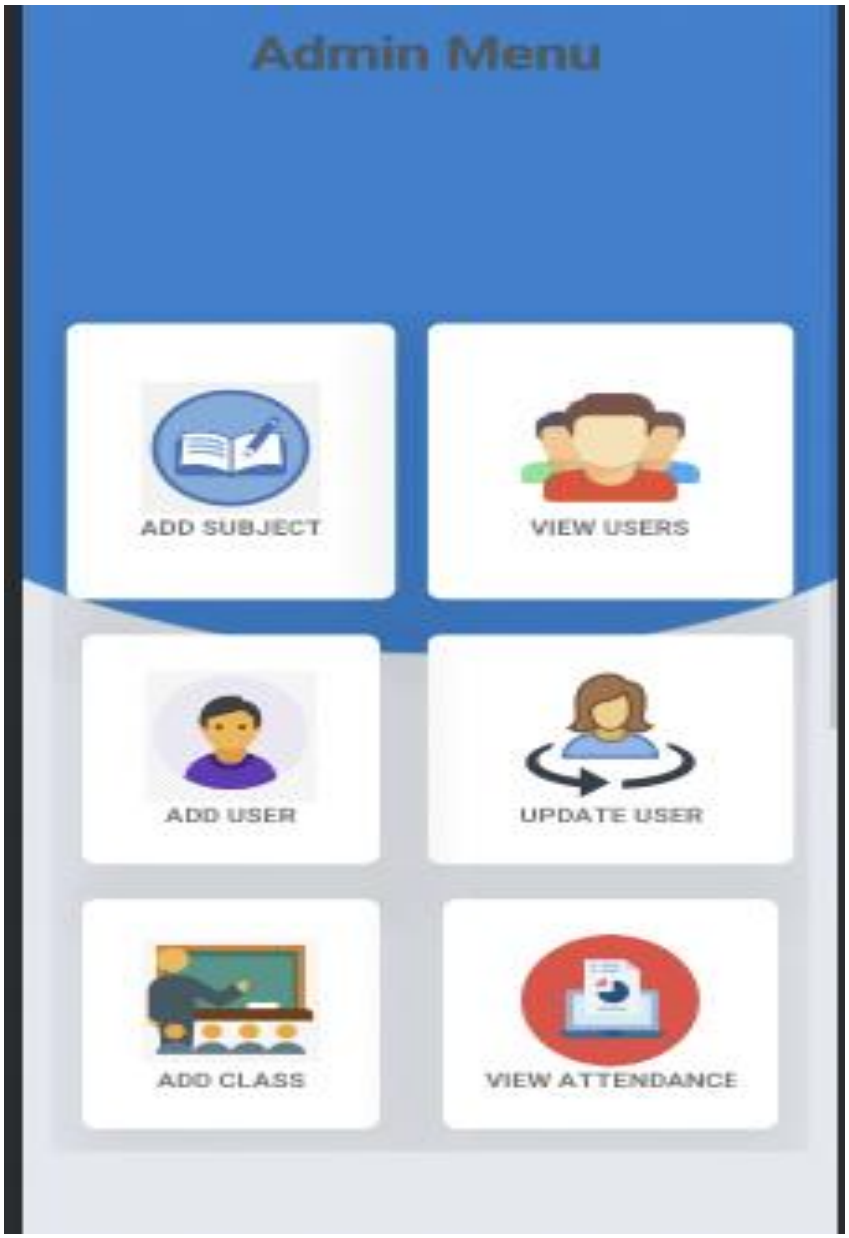


Figure 5.19: Administrator Menu

Lecturer Module

In the lecturer module, the lecturer first logs into the system using their username and password. In order for the lecturer to login, the administrator must register them as a user.

Figure 5.20: Lecturer Login Form

After logging in, the lecturer is taken to the lecturer menu where he/she is able to generate attendance records, add a student to a course and also sign out of the system.

5.4 System Testing

This section aims to focus on the system and what it does. It will majorly focus on the system testing and whether the system has succeeded or not. In addition, the section also aims to detect system failures and defects that can be discovered before the system is fully implemented into its intended environment.

Table 5.1:Test Cases

Test ID	**Related Requirement**	**Inspection Check**	**Pre-Condition**	**Test Data**	**Priority Level**
T1	FRQ1	Does the system provide authenticity whereby only registered users are able to access the system?	All details should be provided during registration of a new user.	**Sign up** Full Name: Peter Kamau Gender: Male Date Of Birth:02/05/1998 Phone:0700024562 Password: ******* Email: pkamau@gmail.com **Login** Email: pkamau@gmail.com Password: ******	Very High
T2	FRQ2	Does the system accommodate different users of the system?	None	None	Very High
T3	FRQ3	Does the system generate attendance report of the student?	Attendance of students should be captured. The lecturer should have logged into the system.	Data stored from the attendance table in the database	Medium
T4	FRQ4	Does the system send a warning	Student should have missed three	Data stored from the attendance table in the database	Medium

		message to the student if they have missed more than three classes?	or more classes		
T5	FRQ5	Does the system capture the attendance of the system through the use of a biometric fingerprint scanner?	Student should have already registered their fingerprint in the system. The student should have logged into the system.	None	Very High
T6	FRQ6	Does the system allow an administrator and student to view attendance records?	The student or administrator should have logged into the system.	Data stored from the attendance table in the database	

Table 5.2: Test Results

Test ID	**Related Requirement**	**Expected Result**	**Actual Result**	**Status**	**Remarks**
T1	FRQ1	The system should account for authenticity	The user can register and log in	Pass	No remarks
T2	FRQ2	The system should accommodate different users	The system accommodates student, lecturer and administrator	Pass	No remarks
T3	FRQ3	The system should generate attendance reports	A lecture can to generate attendance records	Pass	No remarks
T4	FRQ4	The system should send warning messages to a	The system can send warning messages to	Pass	No remarks

		student if a student has missed three or more classes	students who have missed three or more classes		
T5	FRQ5	The system should capture the attendance of students through the use of a biometric fingerprint scanner	The system can capture the attendance records of the students through the use of biometric fingerprint scanner	Pass	No remarks
T6	FRQ6	The system should allow the administrator and the student to view attendance records	An administrator and student can view attendance records	Pass	No remarks

Chapter 6: Conclusions and Recommendations for Future Work

6.1 Introduction

This chapter focuses on the system and what the system is able to achieve at the end of its completion. There is also the coverage on what the system is not able to achieve and make recommendations on future works that can be achieved by similar systems that aim to solving the same problem as the biometric student attendance system for Strathmore University. The discussion mainly involves the formation of the system as whole and cover in summary of all aspects and activities that are undertaken in the formation of the system. Discussion is on the system modules and what the different modules are able to do so far in the completion of the project. We are also be able to analyse the system developed and summarise on the data collected. On the recommendation, this will entail future suggestions on other tasks that can be achieved by the system in future or that can also be achieved by similar systems that aim to solve the same problem as the current system. This will help the current and future developers know of what areas to cover in future. Conclusion is on conversing and stating what the system is able to accomplish as per its completion and will also cover on the termination of the system development as a whole. This also marks the final stage of the system completion by confirming and clarifying that the system development came to the end of it construction as per the developers knowledge.

6.2 Conclusion

The recent method used by Strathmore University to capture student attendance has proved to be quite inefficient due to factors such as students signing for each other, students missing classes which results in dismal performance and also lecturers are unable to gage progress of students when they miss classes. Therefore, the need for an efficient information system is vital so that student attendance can be captured accurately and efficiently.

The mobile-based student attendance system with a biometric fingerprint scanner will therefore be of great significance, as student attendance will be captured accurately. From the analysis taken in regards to the project variables, which include time, cost, and scope, the methodology used in developing the system is incremental methodology. The methodology involves minimal planning unlike other methodologies which takes planning as a phase and also incremental methodology

allows incorporation of changes within the development process which in turn makes iteration process possible in all phases. With all this factors combined, the developed system will be able to address the challenges that Strathmore University faces when capturing student attendance.

6.3 Recommendations

For the system to fully function as expected, there should be interaction between the lecturer module, student module, administrator module and the database that is used for the purpose of storing data for the student attendance system, This interaction makes it easier to monitor data in this case being the student records. The student, administrator and lecturer modules are connected though not directly, through the database that has the same data being viewed by the modules of the system. By connecting the system with the database, we are able to work with data that in this case proves to be the most important entity of the system. The student is able to capture their attendance through the use of the biometric fingerprint and the administrator is able to view the attendance records. The lecturer is also able to generate attendance records of the students.

6.4 Future Work

The adoption of the mobile-based student attendance system using fingerprint scanner would be highly applicable in recording attendance of students in the University. However, the system can be improved by modifying the fingerprint scanner to capture the attendance of the student based on time. The biometric fingerprint scanner captures the attendance system based on the class of the student and the student name. By modifying the fingerprint scanner to capture the attendance based on time, it will provide more accuracy on the attendance results thus improving the efficiency of the system.

To make the system more secure, there could be the use of sessions that time out a user after a long inactivity period and prompts them to login again and get back to their task that they had earlier started. This will greatly facilitate the authentication process for the system and avoid future attacks by hackers into the system.

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Appendix A: Timeline of Activities