

**MOBILE LEARNING APPLICATION FOR  
ANDROID OPERATING SYSTEM BASED ON  
CLOUD COMPUTING**

**A THESIS SUBMITTED TO THE GRADUATE  
SCHOOL OF APPLIED SCIENCES  
OF  
NEAR EAST UNIVERSITY**

**By  
KHALIFA BATURE SHEHU**

**In Partial Fulfillment of the Requirements for  
the Degree of Master of Science  
in  
Software Engineering**

**NICOSIA, 2017**

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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**To my parents...**

## ABSTRACT

Education and learning should be a continuous process. At some point, learning may become inconvenient and may even lead to a halt or break, making gaps in the process due to some challenges that may arise for the student, natural like sickness or being unfit or otherwise like having a demanding job or financial constraint that restricts constant and regular mobility to the geographical location of learning or even other strong reasons that make it difficult to hold up with learning in the traditional classroom method. Learning is based on communication and exchange of information between the lecturer and the students. Looking into today's reality with the level of technological advancement where any type of communication – calls, messages, emails and even exchange of media files – can take place from two people to a number of people in a group remotely from anywhere and at any moment, learning should also be designed and incorporated to match up with this technological advancement. Mobile phones now can perform functions more than what they were originally intended for, paving way for other mobile devices like smart phones, PDAs, palmtops and tablets. These devices however, have become so common and populate every society in large number over the recent years. Because of this fact, smart phones have made great and huge impact on our lives that resulted in relying on them for our daily lives and routings even beyond normal communications like the phone call, text messaging and email to even becoming a necessary instrument of staying up to date with current events, news and information around the globe and other social lives. The use of mobile phones and other mobile devices incorporated into a method of learning is very crucial and has so many benefits for the students and the lecturers as it provides an alternative to the traditional method of classroom learning as a means of distance learning as well as an enhancement and reinforcement to the classroom learning to aid both the student and lecturer, giving more confidence and convenience in learning and filling in for the individual students with low learning rate as everybody have different learning rate and the flexibility in teaching schedule and style for the lecturer.

The aim of this thesis is to manifest the idea of mobile learning for higher education by developing a new mobile application on the android platform that will support learning for higher education based on cloud computing.

**Keywords:** Android; mobile learning; smart phones; mobile devices; cloud computing

## ÖZET

Eğitim ve öğrenme devam eden bir süreç değildir. Bazı noktalarda doğal olarak ortaya çıkabilecek hastalık, zorunlu bir iş veya maddi kısıtlama, coğrafi konum sebebiyle yaşanan sorunlar hatta geleneksel sınıf yönteminde öğrenmeyi zorlaştıran diğer nedenler gibi bazı güçlükler sebebiyle öğrencinin öğrenme sürecinde aralar oluşabilir ya da sonlanabilir. Öğrenme, eğitmen ve öğrenciler arasındaki iletişim ve bilgi değişimine dayanır. Günümüz teknolojinin sağladığı olanaklar (çağrı, mesaj, e-postalar ve hatta medya dosyalarının değişimi vb) sayesinde iletişim iki insandan bir gruptaki birkaç kişiye her yerde ve her an olabildiğinden öğrenme de bu teknolojik ilerleme ile eşleşecek şekilde tasarlanmalı ve birleştirilmelidir. Cep telefonları artık PDA'lar, avuçiçi bilgisayar, akıllı telefonlar ve tabletler gibi diğer mobil cihazların işlevlerini de yerine getirebilmektedir. Bu cihazlar son yıllarda çok sayıda yaygınlaşarak her kesimde kabul gördü. Akıllı telefonlar, kısa mesajlar, telefon görüşmesi ve e-postalar gibi normal iletişimin ötesinde güncel olaylar, haber ve dünya genelindeki bilgileri ve diğer sosyal yaşantıları takip etme aracı olarak günlük yaşantılarımız üzerinde büyük etkiler yaptı. Bir öğrenme yöntemine dahil edilmiş cep telefonlarının ve diğer mobil cihazların kullanımı herkesin farklı öğrenme hızına, öğrenme planına, öğretim görevlisinin farklı stile ve öğretme esnekliğine sahip olması nedeniyle, hem öğrenciye hem de öğretim görevlisine yardım etmek, öğrenen sınıfın geliştirilmesi ve takviyesi, daha düşük öğrenme oranı olan öğrencilere öğrenme konusunda daha fazla güven ve kolaylık sağlanması, uzaktan öğrenme aracı olarak sınıf öğreniminin geleneksel yöntemine bir alternatif sunması nedeniyle öğrenciler ve öğretim görevlileri için çok fazla fayda sağlamaktadır.

Bu tezin amacı, yüksek öğrenim için bulut bilişime dayalı öğrenmeyi destekleyecek android platformunda yeni bir mobil uygulama geliştirerek yüksek öğrenim için mobil öğrenme konusuna katkı koymaktır.

**Anahtar kelimeler:** Android; mobil öğrenme; akıllı telefonlar; mobil cihazlar; bulut bilişim

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## LIST OF ABBREVIATIONS

<b>3G:</b>	Third Generation Mobile Telephony
<b>API:</b>	Application Programming Interface
<b>CPU:</b>	Central Processing Unit
<b>EBOOK:</b>	Electronic Book
<b>EMAIL:</b>	Electronic Mail
<b>E-LEARNING:</b>	Electronic Learning
<b>GAE:</b>	Google App Engine
<b>GPRS:</b>	General Packet Radio Service
<b>HTML:</b>	Hyper Text Mark-up Language
<b>HTTPS:</b>	Hyper Text Transfer Protocol Secure
<b>IDE:</b>	Integrated Development Environment
<b>JSON:</b>	Java Script Object Notation
<b>MCC:</b>	Mobile Cloud Computing
<b>MLEARNING:</b>	Mobile Learning
<b>MOS</b>	Mobile Operating System
<b>MP3:</b>	Moving Picture Expert Group Audio Layer 3
<b>OS</b>	Operating System
<b>PC</b>	Personal Computer
<b>PDA:</b>	Personal Digital Assistant
<b>PDF:</b>	Portable Document Format
<b>SDK:</b>	Software Development Kit
<b>SSL:</b>	Secure Socket Layer
<b>SMS:</b>	Short Messaging Service
<b>UML:</b>	Unified Modeling Language
<b>Wi-Fi:</b>	Wireless Fidelity
<b>XML:</b>	Extensible Markup Language

## **CHAPTER 1**

### **INTRODUCTION**

Learning is a phenomenon that is expected to yield a gain in acquiring of knowledge or skills by study or experience irrespective of the method, formal or informal by means of communication and exchange of information. As it is generally perceived to be, that learning takes place formally within enclosed walls (classroom), so does learning takes place outside of the classroom effectively with even better impact (Bidin and Abu Zaiden, 2013). Learning outside of a classroom can be thought of to be informal depending on the manner and approach as well as being formal, organized over a long distance. The coming of electronic devices, the Internet and web technologies brought about e-learning, which provides educational activities and experience outside of a classroom and even over a long distance (Çavus and Al-Momani, 2011). Looking into e-learning and distant learning, with the recent growth and advancement in technology, we can think of a method of learning that can be remote as well as mobile, making it possible for learning activity to take place anywhere and at anytime even on the move with mobile devices (Taleb and Sohrabi, 2012). Mobile phones have grown very huge in population in every single society around the globe in the last few years and have features and functions beyond just phone call and text message to many other experiences that include learning (Bidin and Abu Zaiden, 2013).

This work focus on the emphasis and importance of learning and teaching with the aid of mobile phones or other mobile devices, which is referred to as (m-Learning) and the way it can reinforce formal learning done inside a classroom. A mobile application on the android mobile operating system will be developed based on cloud computing to aid the lecturer in the delivery of lecture and the student with a convenient and flexible learning experience, where they can communicate information and even exchange educational and study materials in various forms.

#### **1.1 Problem Statement**

Learning is more effective and productive when done without any gap or breaks in the process. It is inevitable that in the process of learning with the traditional classroom method, there might be a reason or the other at a moment in time where the student

might be faced with challenges and learning pinned to a particular geographical location and place might become inconvenient (Taleb and Sohrabi, 2012). With the traditional classroom method, learning is not flexible in the sense that when a particular learning session is missed by a student, it cannot be fully recovered back and after each classroom learning session, learning has stopped till the next session because learning is tied to a fixed timetable and it continues like that. The inflexibility of this learning method does not only affects the student but also affects the lecturer as well (Sarrab et. al., 2012). Even with the use of telecommunication technologies like the phone calls and SMS as a medium that helps to pass information that support learning, these are not sufficient because there is a limitation of learning experience and information that can be passed and this even comes at a cost from the service providers (Çavus and Ibrahim, 2009). Furthermore, social media platforms are being used to promote learning experiences and activities but are inevitable from distraction away from the full concentration on learning by mind taking activities of friends to even other unprofitable social and personal engagement with other friends.

Portability of study materials is another issue whereby students have to carry loads of books and laptop computers around that are not easy to carry about, thereby affecting the learning of a student that is always on the move or highly mobile. Sending announcements and educational information direct to individual students and contents via the email might be a little time-taking and stressful because the lecturer need to get the email address of each student and type it down to send an email and the higher the number of students, the more stressful it is. Due to human nature, every individual student has different learning rate, some students are fast learners and some are slow learners and for this fact, there is a need for a support tool to help both the lecturer and student to enhance the overall educational experience. A student might also be timid and not confident enough to ask questions expressing him/herself clearly in the classroom (Barati and Zolhavarieh, 2012).

## **1.2 Aim of the Thesis**

The aim of this thesis is to outline the benefits and importance of m-learning with its advantages when incorporated into formal learning environments in higher institutions and developing a new mobile learning application on the android platform based on cloud computing that will provide support for the best mobile learning experience. The application will provide support and reinforcements to the traditional learning method by

presenting the student with the courses he/she is offering, providing a medium where the student can have access to educational and other course study materials, information concerned with the learning activity, lectures in audio and video. The application will also provides a means of discussion of relevant topics and ideas by chat messaging with other course members as well as a medium of communication with the course lecturer. On the other hand, the application is aimed to offer the teacher an experience in relating to students by making available study materials and lectures in audio and video for playbacks and as well as a medium for passing additional materials and communication in other forms. The application will also provide a notification service for updates of activities.

### **1.3 The Importance of the Thesis**

This thesis stands to be of great importance because the topic of mobile learning (m-learning) is a relatively new area of research. The main importance is that the idea of m-learning cannot be over emphasized, this is because of the fact that learning itself in general cannot be over emphasized coupled together with the fact of the availability of mobile phones and other portable mobile devices with the roles they place in our daily routines and social activities. The gaining and acquisition of knowledge can be done at anywhere and at anytime and even with better impact when done at a moment when the mind is at large to its freedom and opened with passion to understand and gain new knowledge, providing both an alternative and a reinforcement at the same time to the traditional method of learning.

### **1.4 Limitations of the Study**

There are some challenges and constraints faced during the work of this thesis. These challenges pose as limitations to the smooth running, execution and implementation of the successful outcome of this study as desired. Having easy access to research materials that are relevant to the area of study as well as being recent and up-to-date was the primary limitation because of a huge amount of time was spent in looking for the relevant research materials almost making the study to be very tough and inconsistent. Another issue that posed as a limitation to this work was the issue of the resources for the execution and implementation. The resources here include computer hardware and software ranging from software applications that will help in producing a highly professional documentation that



will include diagrams, figures and other graphics to software applications that will help in designing and developing our target application for this study to hardware specification and configuration like the server and the cloud services, which require some financial spending and expenses. Also as part of the limitations faced, is the issue of technical skills like professional programming skills and the configuration of hardware together with other software for the implementation and deployment of the software application to the real world environment was something that was considered to hinder the successful accomplishment of the target for this thesis.

### **1.5 Overview of the Thesis**

This thesis document is a product of a research and study on the area of m-learning to aid and reinforce formal learning method as well as serve as an alternative at the same time. This document contains five (5) chapters excluding the introductory chapter. The chapters and their brief summary can be seen below:

- **Chapter 2 – Literature Review:** This chapter will deal with the review of scholarly papers on the concerned areas of the topic of this research, analyzing the related and existing research and systems that are relevant to the goal of this thesis.
- **Chapter 3 – Theoretical Framework:** This chapter will focus on the basic and essential supporting structure that guides the research and development of the system of this thesis.
- **Chapter 4 – System Analysis:** The analysis of the mobile learning system developed in this thesis will be presented in this chapter and these include the system architecture, description and technologies.
- **Chapter 5 – System Implementation:** The implementation chapter will depict how the final mobile learning application and system of this thesis will look like with the explanations of the interactions of the different stakeholders with the application in real environment.
- **Chapter 6 – Conclusion and Recommendations:** This is the final chapter of this thesis. The chapter presents the conclusion on the work and as well as gives recommendation on the system for the effective and efficient adaption.

## **CHAPTER 2**

### **LITERATURE REVIEW**

The existing researches and study works on the area of mobile learning will be investigated and reviewed in this chapter. The proper understanding of the concept of m-Learning is going to be provided in this chapter, as well as the logic behind the whole idea and how far the study in the area has come by review of scholarly papers. The review of scholarly texts under this chapter will also cover the area of cloud computing.

#### **2.1 Mobile Learning**

From the terms ‘mobile’ and ‘learning’, the definition and some of the basic idea of mobile learning can be deduced but it cannot be possible to attribute a fixed or single meaning to the definition and idea of m-learning (El-Hussein and Cronje, 2010). mLearning holds different meanings, and perceived as subset or an upgrade to eLearning education method as well as distance educational method, which focuses on providing learning experiences with mobile devices. One acceptable definition that can be attributed to mobile learning is ‘any manner of gaining knowledge or skills that takes place when the student is not tied to a fixed or single location or any sort of learning activity or experience that takes place when the student takes advantage of the learning opportunities provided by mobile technologies, using mobile devices for support to teaching and acquiring new knowledge where the learner can gain knowledge and skills from anywhere and at anytime’ (Mehdipour and Zerehkafi, 2013). Mobile computing integrated into eLearning makes courses in the formal learning method more accessible and more portable. It can bring about enhancement of students knowledge, understanding and skills through interaction with other colleagues and their teacher online, reading their lectures and even listening to lectures through the use of handheld devices like smart phones, PDAs, tablets to even laptops connected to a network. Study materials like eBooks of any type and journals can be viewed online. With the arrival of mobile learning, universities need to be aware of learning tools like tablets, personal digital assistant (PDAs) and smart phones considering the role they play in learning on mobility (Majeed, 2015).

### **2.1.1 Concept of Mobile Learning**

Mobile learning has always been indirectly assumed to be eLearning with mobile devices and its origin and development has been understood as the upgrade and advancement of the conventional eLearning to bridge in the perceived inadequacies and limitations of the eLearning. The ‘mobility’ aspect of the eLearning compared to other forms of learning is what makes mLearning stand out from all other forms or method of acquiring knowledge, providing learning activities to enjoy the advantages offered by the mobility, applying mobile technologies and wireless network to extend access to educational resources to an online based system (Barati and Zolhavarieh, 2012). Learning with mobile devices places emphasis on the mobility of the student interacting with mobile and portable technologies to gain knowledge, skill and experience (Mehdipour and Zerehkafi, 2013). Learning using mobile device as an educational exercise is only considered when the technologies involved are completely mobile, as well as when the learner or user of this technologies is mobile or on the move while they learn. The significance of mLearning places emphasis on mobility and flexibility of learning and mobility of learner as well as the experience the learner gets by means of learning with portable and other mobile devices (El-Hussein and Cronje, 2010). Considering the relationship of each word in ‘mobile learning’ to understand the concept of the phenomenon of mLearning brings a great deal of challenges, for many terminologies and words are being used to define and explain this phenomenon, it means different things to different people. Some of these understandings and definitions of mlearning only put focus on the technology and hardware, be it PDAs smart phones, laptop computers and others. These definitions are thought of to undermine a proper understanding of the uses of portable technologies in the area learning. Some other definitions on the other hand place more emphasis on what students experience when they use mobile technologies in education. The domain of mobile learning can include mobile applications features to support new teaching techniques (Bidin and Abu Zaiden, 2013).

### **2.1.2 Benefits of Mobile Learning**

The idea of mobile learning is a very interesting one and stands very useful and strongly advised to be integrated as an add on to the formal learning method because of how important and effective learning with mobility has proven to be and also to bring mobile

technology to support classroom teaching. These mobile devices are less in weight compared to books and computer systems, making studying a continuous activity even immediately after the ending of the formal classroom learning as well as diversifying student participation in learning activities. Mobile learning can support learning, rather than just being independent to the process as an add-on to be more useful for students with special needs and can also serve as a hook to re-engaging interested students who have fallen out from the conventional method of learning in a classroom for one reason or the other. Mobile learning provides relatively less expensive opportunities because the cost of phones are significantly less compared to personal computers, providing continuous and situated learning with multimedia content delivery, decrease in total training cost, providing improvement in level of literacy and understanding and higher level of participation in education (Mehdipour and Zerehkafi, 2013). This is in addition to using the communication features of mobile phones like making calls, sending messages to even sending and importing media files from the server to your mobile device as part of a more broader learning engagement. With mobile devices used to deliver education in the higher institution, however, the constraints posed by the physical classroom, like size, will be reduced and even replaced with other virtual constraints. The contents of the education will still remain the same but only the delivery mode changes to using of technology that takes advantage of the convenience of the Internet's portability and mobility of devices for being able to engaged at anywhere and at anytime. Mobile computing and communication devices like the PDAs, smart phones and laptops with wireless network connection helps with learning on mobility enabling the educator or lecturer and students to extend beyond classrooms and lecture hall. These portable computing and communication devices provide the lecturer and the student with more interaction opportunities and increased flexibility that include:

- Support for Distance Learning
- Anytime and anywhere access to course content and materials
- Enhancing personal or student-centered learning
- Provides good avenue for review of contents
- Support differentiation of student learners needs and personalized learning

Can even enhance the interaction between and among the students and teachers (Sarraf et al., 2012).

### 2.1.3 Technologies for Mobile Learning

Mobile technologies used in the context of education are easy avenue to maintain knowledge and skills by gaining steady access to study resources. These mobile technologies facilitate distance learning as well as eLearning where there is difficulty of access to education in the formal method or even interrupted due to geographical location or because to some other kind of circumstances. M-Learning applications can be developed on various platforms using various technologies (Pocatilu, 2010). They can easily be distributed to reach isolated groups and provide them with access to advance and further learning. Some technologies that support mLearning include: PDF eBooks that can be accessed across devices, audio MP3 recordings of lectures and video files for watching lecture tutorials. Technologies that support the delivery of mobile learning services include:

- \* **3G:** mobile service for the delivery of compressed audio and visual contents
- \* **GPRS:** data service for providing connection and high speed data transfer rate
- \* **Wi-Fi:** provides access to high speed unlimited Internet service
- \* **Cloud computing:** for maintaining and sharing files like the eBooks, audios and videos lectures across different computing platform and mobile devices

Other technologies that support mobile learning are:

- \* **Portability:** The availability of devices and delivery technologies everywhere and at whatever moment the student needs to learn.
- \* **Personalization:** Individual students can make the technology to suit their personal need, learning style and generally support personal study rather than general learning.
- \* **Availability:** The technology can be used by student from anywhere and at any moment in time to enable communication with colleagues and lecturers or teachers.
- \* **Usability:** The technologies can be easily familiarized with and used even by students with no previous experience using it (Mehdipour and Zerehkafi, 2013).

## 2.2 Mobile Learning Systems

Mobile learning is a type of schooling related to electronic learning and distance learning whereby the learners can get access to the learning systems through mobile tools and

wireless networks, which create a more accessible, personalized and immediate learning environment with mobile technology. It allows learners to experience accessibility, cooperation and usability of learning resources, interaction and flexibility at suitable times and locations (Sajedi, 2015). Mobile learning is relatively new in education to help students and lecturers as an options available in the expansion of distance learning, accomplished with small portable devices, laptop computers, palm-tops and other similar handheld devices (McConatha et al., 2008). Devices that can support m-learning were extremely broad in earlier research. Recent research however, suggest that the most common form of using m-learning technologies is the smart phones (Pollara and Broussard, 2011). This is because fact points out that most learners or students own mobile phones that can be used with m-learning applications. Çavus and Ibrahim (2009) showed in their survey that mobile phones are relatively cheaper than other mobile devices and every student own a mobile phone at Near East University, which can be used to boost the motivation and engagement of students as well as help in delivery of lecture as the survey further shows that students prefer to receive notice and lots more on their phones and suggesting that lectures can as well use mobile phone based teaching as support to the classroom teaching. In the interest of the advancement of mobile technology and their increasing affordability and wide compatibility, mobile devices particularly on the Android platform have transformed from a means of communication to tools for socialization, entertainment and education (Cabanban, 2013).

During the course of research in the area of mobile learning, different researchers have come up with different ideas regarding the development of mLearning systems. An mLearning system comprise of at least these components: the m-Learning device, the mLearning software and the mLearning contents. The software may simply be a standalone application, a web browser or a client application (Pocatilu, 2010). A number of related mobile learning systems and applications are developed and implemented, some of which are reviewed as part of the research conducted on this work. Tamhane et al. (2015) on their mobile learning application that is based on the android mobile platform was basically designed to consist of two parts, the first part is the tutorial part where the learning contents are found, this part can be thought be standalone because it can be accessible even when the learner is offline. The second part of this system is a chat room where a messaging discussion can take place and questions or other queries can be sent and

received in real-time, this part is accessible only with a network connection. Zheng et al. (2015) proposed a learning system that contains two major functions as well, for teachers' teaching and students' learning. On the teachers course module, the teacher can easily manage a course by uploading audio, video and pictures as well as publish course announcement through the website. Interaction between course participants like questions and answers is also supported. On the other part, the system provides the students with learning experience by being able to view and read course contents, ask and respond questions. Other published course announcements to guide the student on learning can be viewed. The system is basically a responsive website developed using HTML 5 to be suitably accessible by cross-platform mobile devices through the mobile web browser. Han et al. (2012) also designed an mLearning system for the android mobile platform with support on the Google cloud computing. The system has different modules that include the resource data module, which contains the learning resources like the lectures of teachers to learners in video files, course notification to learners on relevant information such as seminar, curriculum changes, assignment and project submission etc; the reading and practice resources in the form of pictures with texts for students to read and exercise as a means of self-test environment to deepen understanding of contents; another module on the system is the collaborative interaction module, interaction between and among various students is achieved from this part. The intended interaction mainly includes the learners and teachers, learners and learners and the learners and the interface. This module is intended to encourage users to further enhance learning through mutual cooperation and collaboration. The system has a self-service module that provides ease of learning to the students by personalizing the support to the user based on their habit on the system. Every time the student signs into the system, the server will provide better service by calling the records and data on the student's history and search habit. The system uses a distributed structure using GAE platform to optimize and store data. Martono and Nurhayeti (2014) designed and implemented a related kind of mLearning system on android operating system. The system has a dashboard on the server where the teacher can manage course learning resources and on the mobile application, pages of course content can be accessible as well as being able to download the file of the lecture material in PDF form and the application provides support for delivering quiz/examination of the lecture. Kong, L (2012) in her paper describe the implementation of an android mLearning system divided into

three areas; the playback area where teaching scenario can be viewed, the directory area for previewing the chapter directories whereby students can navigate and select relevant chapters to read for independent study. The third area of this learning application is the presentation area for video playbacks for switching related pictures, texts, animations and even teaching videos. Further mentioned that on the Internet based learning system, the system supports streaming technology by which learners can see the live teaching as well as multimedia presentation.

### **2.3 Cloud Computing**

Cloud computing is a model of computing that enables ubiquitous access to shared resources that include storage, applications, computing power and even services over the internet. Cloud computing basically relies on sharing and delivery of on-demand computing resources over the Internet (IBM, 2017). Cloud computing is often simply referred to as just ‘cloud’, which is a metaphor for describing the web as a space where computing has been preinstalled and computing operations exists as a service, operating systems, storage, processing power down to application software. This promotes the delivery of Infor-Tech services whereby resources can be accessed from the Internet through web browser or web-based applications. Rather than storing files on a local disk or hard drive or any other local storage device, cloud computing makes it possible, flexible and more convenient to save the files on to a remote storage or database, which can be accessible from an electronic computing device from anywhere and at anytime provided there is a network connection and a software program or application that can run it. This is why it is referred to as cloud computing, for the resources being accessed from the cloud and the user need not to be at a particular place to have access (Investopedia, 2017). The idea is basically taking away the heavy load and heavy data processing away from the device and moving it to a huge and powerful computer far away on the cloud. This improves the availability of information technology resources and holds many advantages over other computing techniques (Kumar and Goudar, 2012).



## **CHAPTER 3**

### **THEORETICAL FRAMEWORK**

This chapter will describe the structure that guides lines related to the development of this study that include application development and mobile cloud.

#### **3.1 Mobile Application**

Mobile application is a software that runs on a mobile OS or mobile device such as the tablet computers, smart phones or smart watches. It runs on the mobile device unlike the web application, which runs in web browsers and the desktop application, which runs on the desktop computers. Mobile applications are developed to provide users or clients with a kind of similar services to that of the PC software. In general, mobile applications are small software units with limited functions. The uses of mobile applications is a relatively new and fast growing sector of Information and Communication technology (Islam et al., 2010). Mobile applications have vast area of uses and functions and can be placed into categories that include but not limited to the following areas:

- Business: eCommerce, Restaurant
- Communications: Call, Message, email, social networking, Internet Browsers
- Games: Cards, Puzzles, Racing, Adventure
- Educational: Dictionary, Encyclopedia, mLearning Applications
- Multimedia: Audio player, Video player, Image Viewer
- Productivity: Calculator, Calendar, Word processor, Spreadsheet
- Travel: Currency Converter, Translator, Map

##### **3.1.1 Mobile Application Development**

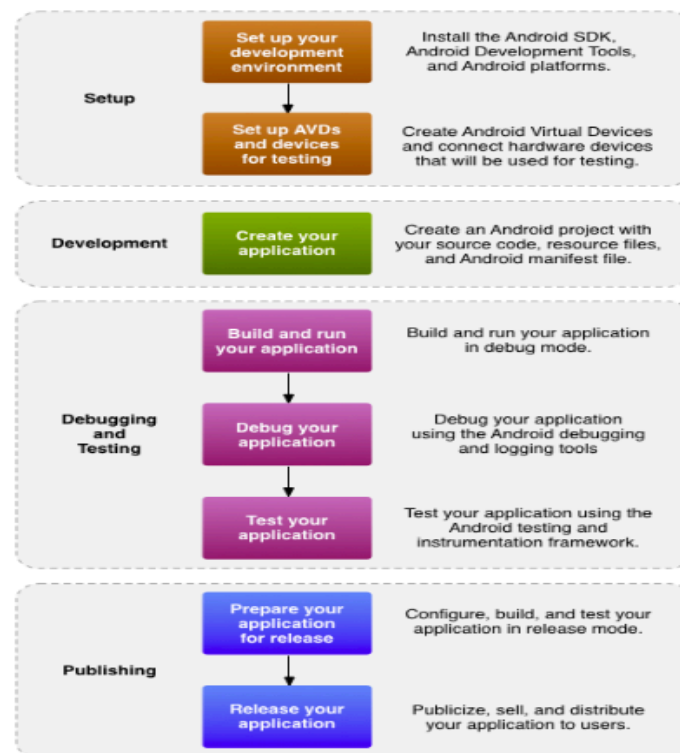
Mobile application development is the process involved in the designing and writing of codes for small and wireless computing devices. Like every other software application development, mobile application development follows the conventional software development methods. To ensure optimum performance of an application on a given type of device or platform, the application needs to be developed natively on the target device or platform.

## 3.2 Android Mobile Application

Android mobile applications are software applications built or developed to run on mobile devices be it smart watches, tablets, televisions and smart phones that are powered by the android operating system.

### 3.2.1 Android Application Development

Because the Android OS is an open-source mobile devices operating system that is developed based on the Linux kernel, so the android SDK is provided with a set of APIs for writing applications, together with tutorials and Android Studio IDE, which can be downloaded online and be used to create applications for smart watches, smart phones and other mobile devices that are powered by the android operating system (Singh et al., 2016). With no complexities, android developers can write applications that can make a mobile device user friendly and more useful. Google announced android studio in 2013 as the official IDE for android platform development. It is developed just for android application development and it is freely available for download on Linux, Macintosh and Windows. Developing an application for android follows a number a steps, which can be seen in the figure below (Pandey and Dani, 2014).



**Figure 3.1:** Steps for Android Application Development

As seen from figure 3.1, there are basically four steps involved in android application development, these four phases can be seen to contain processes as follows:

- **Setup:** This is the phase where the android SDK is downloaded, installed, set up the development environment and configure the android virtual devices (AVDs) or connect hardware devices, which are the target for installing the application.
- **Development:** This is the phase where an android project is created with all the source codes and resource files for the application are developed. Android applications are basically developed using java programming language but the user interface is designed in XML.
- **Debugging and Testing:** This is the phase where the project codes are build into a debug able .apk file that can be installed and run on an emulator or physical device.
- **Publishing:** Here the application is configured and build for release, deployment and distribution to the users.

### 3.3 Mobile Cloud Computing

Mobile cloud computing by definition can be said to be the combination of mobile computing, cloud computing and wireless network to bring rich computational resources to mobile users by enabling the computation of powerful mobile applications on a larger scale of mobile platforms with rich user experience. Mobile cloud computing technology do away with the constraints on functionalities, storage capacity and provides the mobility to serve multiple of mobile devices with resources anywhere and anytime over the Internet irrespective of heterogeneous platforms as it moves the computing power and storage away from the mobile hardware devices into the cloud (Shamim et al., 2015). Mobile Internet combined together with cloud computing is what is referred to *Mobile Cloud Computing*, which is basically cloud computing with the mobile experience. Cloud computing has enormously transformed the manner in which mobile applications are developed and also reduce the requirement of getting an advanced handset for running a mobile application (Han et al., 2012). When putting into consideration the need to development a powerful and reliable mobile learning tool, cloud computing should be adopted because of the limitation that mobile devices holds like storage capacity and computing power. The limitations of the mobile devices clearly appear with no doubt that great mobile internet experience will need more cloud computing but only if the cloud computing must fit the

various features of the device or application, meeting and addressing the shortcoming (Han et al., 2012). More on to that, mobile devices run on different mobile platform and even sometimes on the same platform but different versions which at times there might be disunity in some application features. However, mobile application powered from the cloud will make application update faster as the application interface will be the only challenge faced. Mobile applications that consume much power and network will be difficult to promote but MCC already provided the solution to that. This was done effectively by the reduction of frequency of exchange of data and data transfer between mobile devices and the cloud, which is achieved by optimizing the cloud. This is very important for mLearning applications as it provides more battery time for learning activities and makes access to study materials faster. The application of mobile cloud computing in the area of mobile learning is as a result of the facts on the limitations that mobile learning applications face that include high cost of acquiring a powerful mobile device, low network transmission rate and most importantly inflexibility on the availability and limited educational resources, hence cloud-based mobile learning applications are introduced to solves these limitations as well as utilizing a larger storage capacity, powerful processing ability and provide learners with much better services in terms of information size, faster processing speed and longer battery life (Gayathri and Srinivas, 2014).

### **3.3.1 Characteristics of Mobile Cloud Computing**

Mobile cloud computing have characteristics that will suitably fit mobile learning technology and these characteristics include (Shamim et al., 2015) :

- **Flexibility:** MCC offers flexibility in the sense that users can rapidly access resources dynamically anywhere they want without any need for human interaction with the service providers anytime they desire.
- **Scalability:** Mobile cloud computing can handle many connections to the system on the network and perform the desired operation like releasing resources to multiple users at a time with maximum efficiency and reliability.
- **Broad Network Access:** The mobile cloud computing services is available wherever there is internet access on heterogeneous platforms and devices like smart phones, tablets, laptops and personal digital assistance.

- **Location Independence:** Regardless of where or which geographical location a user might be, MCC can render the service of having access to resource efficiently.
- **Reliability:** Mobile cloud computing offers very high reliability by ensuring disaster recovery and offers continuity of service with backups servers.
- **Elasticity:** Users can have resources without any type of prior contact with the service providers. The user can use the resources to scale up whenever they want and release them when they are not in need of them to scale down.

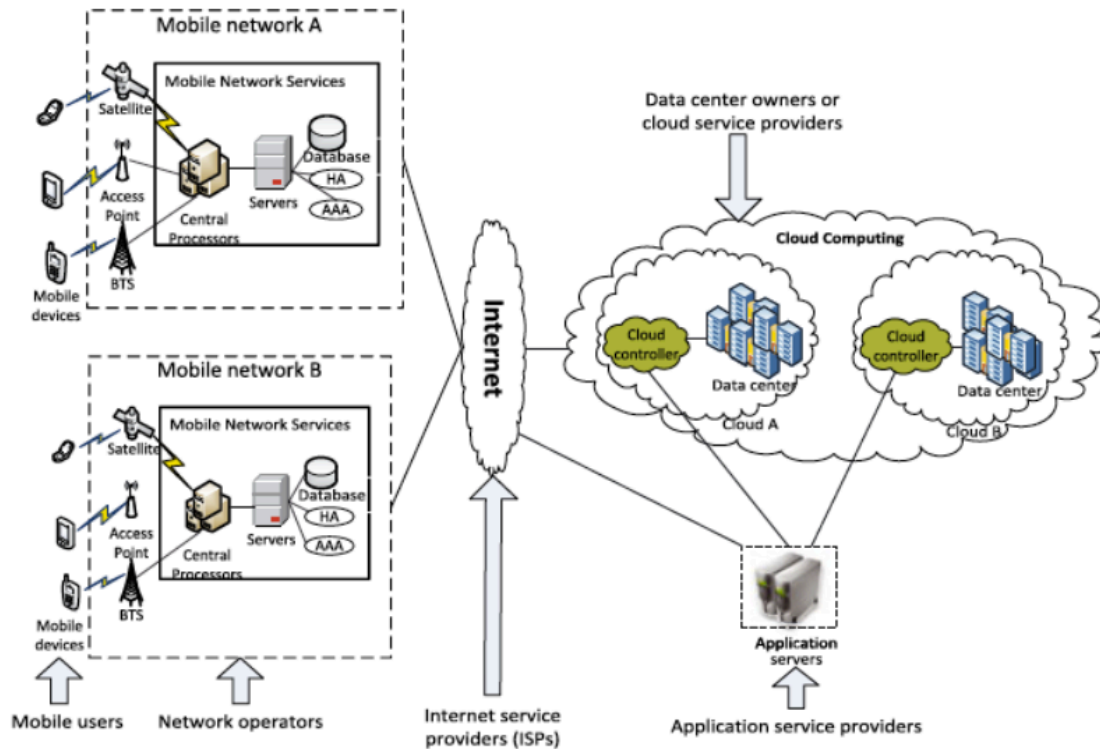
### 3.3.2 Advantages of Mobile Cloud Computing

Combining the individual advantages that mobile computing and cloud computing holds will yield a number of great advantages that delivers optimal services and a promising solution for mobile computing. The advantages of mobile cloud computing includes:

- **Long Battery Lifetime:** MCC offers enhanced battery life for mobile device. This is achieved with the fact that the CPU performance and disk organization is increased because large computation and complex processes doesn't take place in the resource limited mobile devices but on the very resourceful cloud-computing server. This avoids taking long time of computation that is being executed by an application on the device, which may result in large amount of power consumption.
- **Improved Reliability:** Storing of data and information on the clouds is an effective way of getting very high reliability because the data are stored and backed up in a number of servers and this absolutely eliminates the loss of data on the mobile devices as a standalone storage. Even more, MCC add reliability where data and other information contents can be accessed from more than one device.
- **Storage Capacity and Processing Power:** One of the constraints and limitations of mobile devices is storage capacity. MCC can be said to be mainly developed to enhance mobile device storage and access to large files through wireless network.
- **Scalability:** Access to data and computing resources on the cloud can easily be done without constraints on the resource usage even when there is access to the same resources at a time by multiple users.
- **Ease of Integration:** Different types of services from different providers can be easily integrated through the cloud computing to meet the user's requirements on to a mobile application.

### 3.3.3 Architecture of Mobile Cloud Computing

The mobile cloud computing architecture is composed of components that include the mobile user, the mobile operators, the Internet service providers and the cloud service providers. The architecture provides effectiveness using advantages of cloud computing. The mobile cloud computing general architecture can be seen from the figure below:



**Figure 3.2:** Architecture of Mobile Cloud Computing

The mobile devices are primarily mobile phones like smart phones and devices like personal digital assistants that communicate with the mobile network service providers with the help of access points, base stations and satellite. Information is transmitted from the mobile devices and is processed on the CPU, servers and databases of the mobile network service provider. The mobile network provider provides services to the mobile users as an authentication, authorization and accounting based on the subscriber data stored on their database, after which the subscriber request to the cloud through the internet and the cloud controllers which are present in the cloud, process the request to navigate the corresponding cloud service to deliver to the mobile subscriber.

### 3.3.4 Deployment Models of Mobile Cloud Computing

Mobile cloud computing can basically be identified with four deployment models for cloud architectures and they can be seen below as:

- **Private Cloud:** In this type of deployment model, the cloud is operated solely for a private organization and managed by the organization itself or a third party regardless it is located on the premise of the organization or off premise.
- **Community Cloud:** Various organizations establish and share the same cloud together as well as communal concern, policies to support a particular community. The cloud could be hosted by one of the organizations in the community or a third-party vendor and it may be on a physical server or a hosted server.
- **Public Cloud:** In this type of cloud deployment model, the cloud is made available to the general public. It is usually owned by the service provider together with its policies, charging model, value and profits. This deployment model is the most common form of cloud computing deployment model.
- **Hybrid Cloud:** The hybrid cloud computing deployment model is a combination of two or more clouds deployment models be it any of private, community or public, that remain as a single unique entity bounded together by standardized or proprietary technology that enables data and application portability.

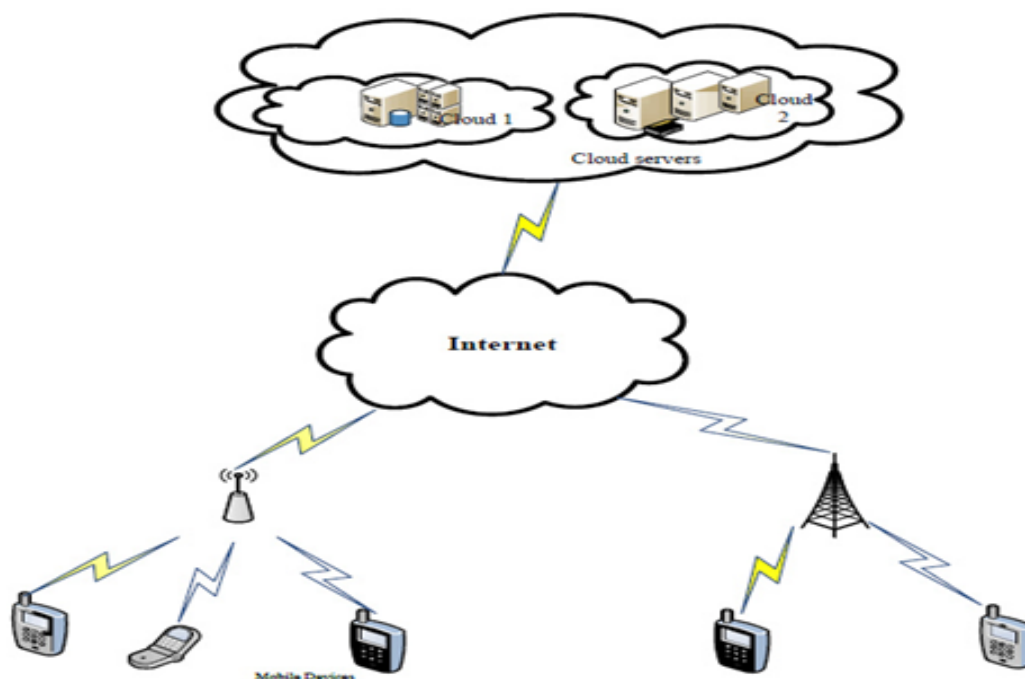
## CHAPTER 4

### SYSTEM ANALYSIS

Presented here in chapter four is the analysis on the proposed mobile learning system of this thesis. The system analysis covers areas that include the system description, system architecture and the user interactions with the system and even the database design.

#### 4.1 System Architecture

The mobile application is designed to communicate with a cloud-computing server on a remote location over a network. Access to resources as well as every single data and information viewed on the application is over a network as the resources are stored on the cloud and not on the device or the application built in database. To an extent, without network connectivity the application cannot be operated or navigated. The application support features that include multimedia, which are all handle by the cloud for storage and retrieval and other information that is required to be maintained in a database and chat messaging feature, which is also maintained in the cloud database. The figure below depicts the graphical architecture of the system.



**Figure 4.1:** Diagram of the Mobile Learning System Architecture



## **4.2 System Description**

Basically, the system as a whole is developed to support mobile learning. The mobile application is developed for the android mobile platform. To have access to the system, the intended or potential user of the system must first of all register to the system and afterwards can login to have access to the system at anytime and from anywhere with internet connection using the application. The mobile application displays the menu of the different learning activities that can be engaged with on the system. Whatever activity is selected, the mobile application will communicate with the backend cloud server over a network to make available the materials and resources on the mobile device.

As a single system, the mobile application has two distinct parts for the two different users, which are the student and the lecturer or the course administrator. For the reason that the system is intended for learning, the student side of the application is designed basically to provide access to study materials that include eBooks and other multimedia resources as well as communication channels to interact with the fellow students registered on the system and lecturer while both the student and the lecturer are on mobility. The other lecturer side of the application is meant for the lecturer to basically make available and manage the course learning materials on the system with ease and effectiveness at moments of comfort and mobility as well. The lecturer can also interact with the system directly through the backend and manage course materials and resources on the cloud storage and database. The lecturer can manage study resources both using the mobile application on his or her android device or directly on the backend cloud all from a remote location on mobility wherever there is a network connection.

## **4.3 System Requirements**

The system requirements are basically what is required of the system. These requirements can be perceived to be the needs and wants in terms of the system quality, the system functionalities and features. The system requirements are basically categorized into two groups, which can be seen below.

### **4.3.1 Functional Requirements**

This type of requirements are the needs and wants that are expected of the system in respect to the behaviors and the functionalities that the system can perform – what the

system is suppose to do or what is expected of the system. The functional requirements of our mobile learning application can be seen below:

1. The users (student and lecturer) shall be able to register to the system by providing his/her necessary information like the name, email and password before being able to access the system for the first time.
2. The users (student and lecturer) shall be able to login into the system from the android application using their registered email and password subsequently with different devices on which the application is installed.
3. The application shall be able to display the courses that a student is enrolled on for learning through the mobile learning platform.
4. The application shall be able to open an eBook in portable document format (PDF) so that the student can be able to preview and read from the eBooks.
5. The application shall be able to playback videos of lectures so that the student can play and watch them over and over at anytime and anywhere the student is comfortable and even download when there is the need.
6. The application shall be able to play back audio lectures from the storage so that the student can listen to audio information over and over from anywhere the student is comfortable and even download when there is the need.
7. The application shall be able to provide messaging service for communication between course members as well as between the different type of the system users (students and lecturers).
8. The application shall be able to allow the student to view notifications and on the other hand allow the lecturer to send notification to the students (push notification).
9. The application shall be able to allow the user to sign out or log out of the system to prevent an unauthorized access to the resources from an unauthorized user.
10. The application shall be able to allow the lecturer to upload and delete learning resources to the system on mobility.

#### **4.3.2 Non-Functional Requirements**

This type of requirements are the properties that is expected of a system to posses. These properties are used to define the quality of the system as well as used to judge the operation of the system rather than describing what the system should do and specifying

the behaviors. The non-functional requirements place constraints on the design. These requirements can be seen below:

**Table 4.1:** Non-Functional Requirements and their Descriptions

Requirements	Description
Security	Access to the system is granted to an authorized user by providing the correct matching email and password as login credentials.
Usability	The system shall be simple to understand and easy to navigate confidently by the users (student and lecturer) without any prior knowledge or training on the system.
Availability	The system shall be available for free to the interested potential users
Performance	The system shall be able to execute operations with high speed, very short response time and maximum efficiency.
Reliability	The system shall exhibit high reliability in performing its functions under the specified conditions over its life time and shall not cause any data loss when failed.
Maintainability	The system shall be able to be easily changed or modified to correct bugs and vulnerabilities as well as to meet new requirements

#### 4.4 System Technologies

The technologies used in the development and actualization of the mobile learning system of this thesis will be seen below from the front end to the back end.

##### 4.4.1 Mobile Application Technology

The mobile application is built for the android platform. It is developed with the popular programming language known as java, using Android Software Development Kit (SDK). The SDK comprises of Application Programming Interfaces (APIs) which are made up of development tools like the Android Studio IDE that is used to create android applications, sample codes, debugger libraries, documentation, tutorials and an android handset emulator. Some of the sourcecodes that are used in the development of the mobile application for this work can be seen at the appendices part of this document. The android studio is the official IDE specifically designed for android platform application development. It is freely available to developers under the Apache License 2.0 and also available for cross platforms computer operating system such as the Linux, Macintosh and Windows.

##### 4.4.2 Back-End Technology

The back-end technology used for the development of the system is known as Firebase. Firebase is a cloud services platform owned by Google that is designed to support web

application and mobile application development. It helps developers to develop an application that will sync seamless with ease as well as providing support and services to the mobile application. The Firebase application development platform offers a wide range of services that include cloud-messaging, real-time database, cloud storage, web hosting and lots more. The push notification service is a solution for messages and notifications across mobile platforms like the android, iOS and even web applications. The service of real-time database on this platform provides application developers with API that enable data from the application to be synchronized across client and saved on the cloud platform. The firebase real-time database is a JSON type database and client libraries are provided that enable integration with Android and iOS. The firebase cloud storage provides secure file uploads and downloads to applications developed to run on the firebase platform. Applications can be developed to use the cloud storage to store images, audios, videos and other generated contents. Client libraries are also provided that enable integration with Android and iOS. These services are integrated into our system to work as it is desired.

#### **4.4.3 Security Mechanisms**

Security concern in the mobile cloud computing model normally involves three areas, which are security on the mobile platform, security in the network or communication channel and security in the cloud. Security on the mobile platform involves securing the mobile device and/or application from threats that relates to the data/information (Popa et.al., 2013). At the level of this application, access to the application is based on a successful login using a registered email and a matching password. Input fields in the application are validated to ensure integrity as well as to prevent any threat that can be caused with input of malicious codes. During the registration on the application, an automatically generated User ID is sent to the user's email address. The user has to access his/her email to activate his/her account or else the functions offered by the application cannot be enjoyed. On the student side, access to a course requires a course enrollment code which the student can only get from the course instructor or lecturer.

Cloud service providers usually provides a secure channel of data transmission using security protocols such as SSL/HTTPS. These security protocols provide a link that is encrypted in an online communication between a client and a host. In the cloud, there are defined security rules for the types of users and for every action that requires the cloud

resources, user authentication with the automatically generated User ID and user email is checked against the user account to ascertain the user authenticity.

#### **4.5 Mobile Operating System**

This is a type of software system that is designed to allow tablet PCs, smart watches, smartphones and other mobile hardware to run mobile applications. It is basically a software platform on top of which other application programs can run on mobile devices. This type of operating system holds features of a PC operating system with some more features that are useful for mobile use like support for touchscreen, cellular, Bluetooth, music player, voice recorder, camera and network features (Farkade and Kaware, 2015).

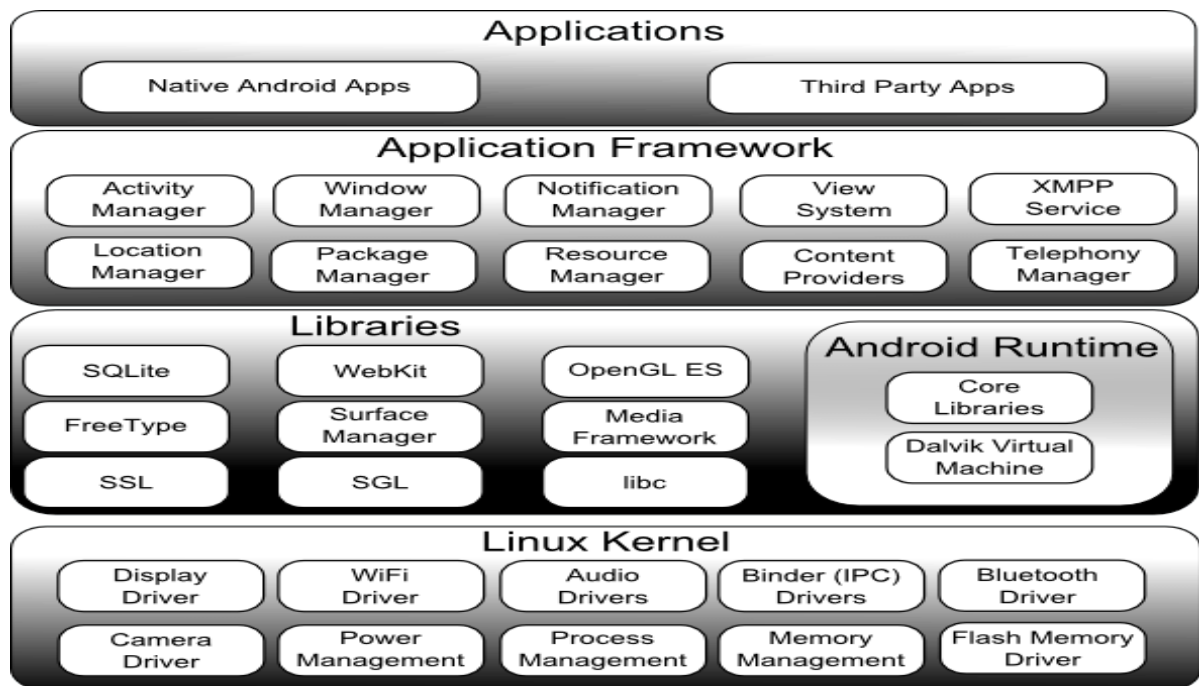
The mobile learning system for this thesis requires developing a new application to provide the learning experience using mobile devices. Numerous and various mobile hardware devices that run the target operating system can be used to enjoy the learning experience. The target operating system for the mobile application is the android mobile platform or operating system.

##### **4.5.1 Android Operating System**

The android operating system is a modern MOS that is based on the open-source Linux OS (Singh et al., 2016). Android is designed purposely for mobile devices or terminals. Google revealed android in 2007 along with a consortium of hardware, software and telecommunications companies, which are dedicated to advancing open standards for mobile devices. Android has the biggest market share among all smartphones operating systems. The android architecture is designed to make ease of development ability for developers because it has very few restrictions for developers (Mohini et al., 2013).

##### **4.5.2 Android Architecture**

The android as a mobile operating system is divided into four main layers. The architecture of the android operating system can be seen in the figure shown below:



**Figure 4.2:** The Android Mobile Operating System Architecture

**Applications Layer:** The application layer is the topmost layer of the android, where all the applications are housed. Just like the mobile learning application developed for this thesis and any other applications like games, web browsers and others types of application, this is the layer that the applications will be installed.

**Application Framework:** After the application layer, next is the application framework layer. The application framework layer provides ease of access to developers to modify the API framework to suit their needs. This layer provides abstraction for hardware access, managing the user interfaces and application resources.

**Libraries and Runtime:** The next layer after the application framework layer in descending order is the libraries. The library is divided into two elements, the android library and the android runtime. The android library is the reinforcement of the application framework and a connection linking the application framework layer with the kernel. This layer runs on the kernel layer and the libraries are written in C/C++. The android runtime is made up of core java libraries and delvic virtual machine, which optimize files for minimal memory footprints.

**Linux Kernel:** This layer is the last layer in the android architecture. This layer holds all the required hardware drivers like the camera, keyboard and the display drivers and more. The Linux operating system being a very powerful and great computer operating system in networking and easy interfacing with peripheral devices and operations like memory management, process management, storage management and other core services. This is the same core operations that this layer provide based on Linux to the android operating system.

#### **4.5.3 Advantages of Android**

Android operating has more advantages over all the mobile operating system that exists in the technology world, these advantages ranges from technological down to economical aspect. These advantages that the android mobile operating system hold can be seen below:

- The android operating system is built based on the kernel of the powerful Linux computer operating system and it is completely open-source and free for anyone to build or develop applications.
- The android operating system is a trending mobile operating system now because it powers billions of mobile hardware devices mostly tablets and smartphones.
- The android OS is the most widely used mobile operating system because android hardware devices are the highest selling because they are relatively cheap and inexpensive to acquire with wide variety of phones to suit your budget.
- The android operating system is built to be an open standard operating system for smartphones and mobile devices promoted by the open handset alliance (OHA), a consortium that brings about the collaboration of different mobile hardware device manufacturers like the Huawei, Samsung, HTC, Gionee and others to be powered on the android platform.
- The android operating system make easy access to thousands of applications that are ready to be downloaded for free via the Google Play Store.

#### **4.6 Application Features**

The mobile learning application has some distinctive characteristics that is designed to make learning more effective and very efficient. It provides an experience to the student that makes learning more interesting and collaborative. The features of our mobile learning

application can be seen below to include:

- The application offers security feature to both the teacher and student respectively. A correct username and a matching password must be provided to gain access to the learning environment.
- The application offers easy registration for both teachers and students to be able to experience teaching and learning on the mobile application platform.
- The application is easy to use with no prior knowledge or training on using it.
- The learner or student can have access to reading materials on a course in the PDF form that is uploaded onto the cloud by the teacher.
- Lectures and other recorded educational contents can be accessed in the form of podcast to be listened to if uploaded onto the cloud by the course teacher.
- Lectures in the form of classroom recording and other educational videos can be accessed and viewed and even downloaded by the student if the teacher uploads the videos to the system cloud storage.
- The system provides a chat room where there can be collaborative discussions on a course between the students and the teacher to broaden understanding.
- The system provides easy notification service to send information like project submission date, exam date and others to an unlimited number of multiple devices at a single time.
- The application has a provision where students can update their profile with the necessary and relevant information like name, student number and course.
- Students need to be enrolled on a course with the correct enrollment code before they can have access to the course resources to enjoy the learning experience.

On the other hand, the application posses some unique features to help the course teacher deliver course teaching and resources with ease. These features include:

- The lecturer or course teacher can create a course on the mobile application that he can use to manage the delivery of teaching on the move and in real-time.
- The lecturer or course teacher can upload course learning materials in the form of videos files, audio files, eBooks documents to the system cloud storage directly from remote location and on the move from the mobile learning application to be



accessed real-time by students on the application remotely and on the move as well.

- The lecturer or course teacher can record lectures with the mobile learning application and directly upload it to be accessed by students.
- The lecturer can view registered students enrolled on a course using the mobile learning platform and see the necessary and relevant information like their email address, name, student number and department.
- The lecturer can create chat rooms and discuss with students to enhance understanding by exchanging messages instantly and real-time.
- The lecturer can post announcements related to a course, which can be viewed by students enrolled on the course.

#### **4.7 UML Use Case**

The UML use case is a modeling language in software engineering that depicts the interactions between the external entities and the system. The external entities can be the users (usually referred to as actors) of the system or another system that is not part of the main system of our focus.

##### **4.7.1 Use Case Diagram**

Based on the design of our mobile learning system, there are two actors that interact with the system, which are the learner (student) and the lecturer (teacher). The use case diagram of the mobile learning application with the actions that can be performed can be seen below:



**Figure 4.3:** The Mobile Learning System UML Use Case Diagram

#### 4.7.2 Description of Use Case Diagram

Every use case stands for an action or the interaction that the system can be able to perform. From the above use case diagram of our mobile learning system, the description of each use case can be seen with the respective actor that can perform the interaction.

**Table 4.2:** Descriptions of the Actors that interact with the system

Actor Element	Description
<b>Student</b>	The student is the primary and main beneficiary of the system. The student interacts with the system to access the learning resources and materials and interacting with the secondary actor.
<b>Lecturer</b>	The lecturer is the secondary user of the system. The lecturer interacts with the system by uploading the learning materials and resources as well as interact with the primary actor.

**Table 4.3:** Descriptions of the system use case interactions

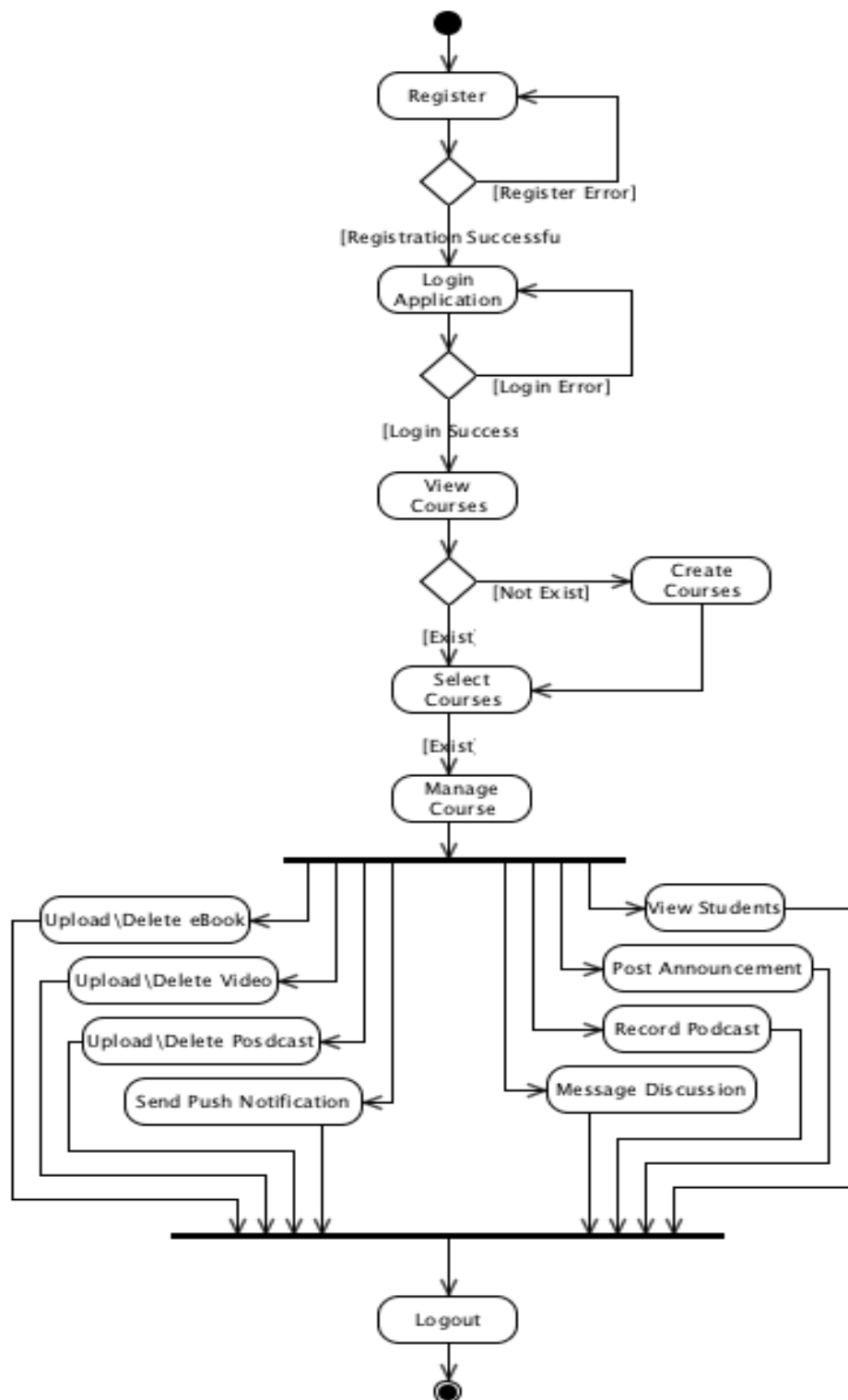
Use Case Element	Actor	Description
<b>Register</b>	student /Lecturer	Both the actors, the student and the lecturer has to register to the system first of all to be able to have access to the system.
<b>Login</b>	student /Lecturer	Subsequent access to the system on a different device will require a login using email & password from the both actors.
<b>View Courses</b>	Student	The learner (student) can view how many courses and their names on the system that he or she is learning.
<b>View Course Contents</b>	Student	The purpose of our system is learning and so the learner can interact with the system to view course resources in types that include eBooks and videos.
<b>View Notifications</b>	Student	The student will be able to view notifications of activities that the lecturer send to improve information on the learning.
<b>Playback Podcast</b>	Student	As part of the learning activity, the student should be able to playback audio lectures from the system storage.
<b>Chat Messages</b>	student /Lecturer	The student should be able to communicate with other student as well as the lecturer on the system via messaging.
<b>View Students</b>	Lecturer	The lecturer should be able to view the students or learners that are registered and learning through the system.
<b>Upload Video</b>	Lecturer	The lecturer should be able to interact with the system to upload video materials either via the mobile application.
<b>Record Audio</b>	Lecturer	As an alternative to the video material, the lecturer can record an audio lecture on the application and upload to the system for students.
<b>Upload eBooks</b>	Lecturer	The app can allow the lecturer to upload eBooks on the system so that the students can have access to it for reading and researching.
<b>Send Notification</b>	Lecturer	The lecturer can send notification to inform the students about important news, event and the like.

## 4.8 UML Activity Diagram

This UML diagram shows the dynamic behavior of a system. It is basically a flowchart that depicts flow from one activity of the system to another activity where an activity can otherwise be referred as an operation that can be performed by the system. The activity diagram for the mobile learning application of this thesis can be seen below.

### 4.8.1 Lecturer Activity Diagram

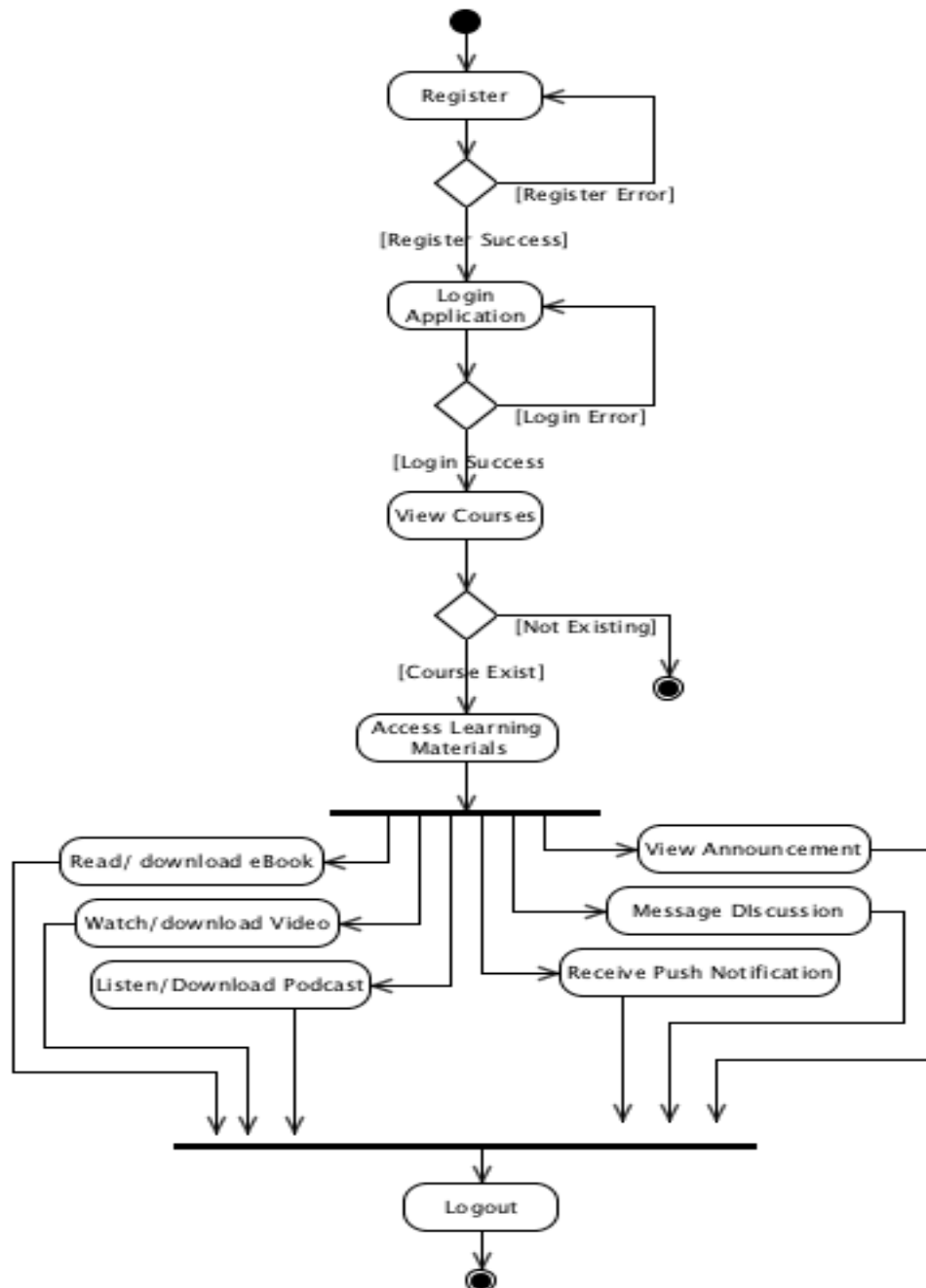
The lecturer activity diagram depicts the flow of activities that the lecturer can execute using the application. The diagram can be seen below:



**Figure 4.4:** The Application Lecturer Activity Diagram

#### 4.8.2 Student Activity Diagram

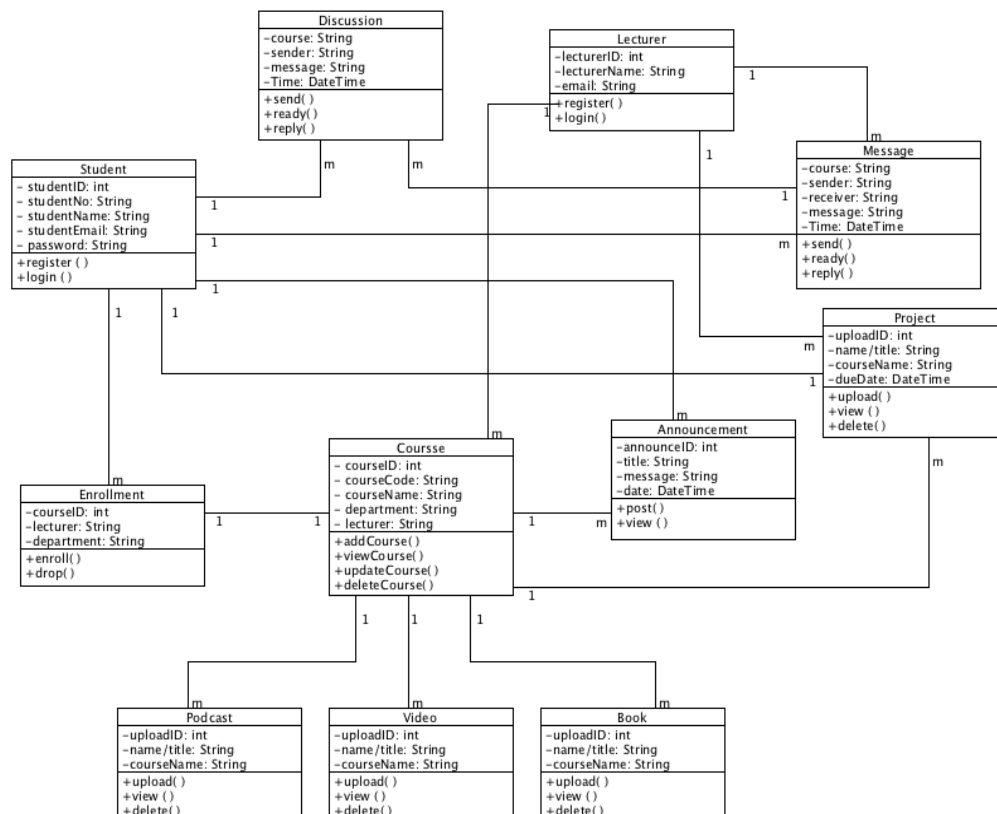
The student activity diagram depicts the flows of activities that a student can execute when running the application. These activities can be seen from the diagram below:



**Figure 4.5:** The Application Student Activity Diagram

## 4.9 UML Class Diagram

A class diagram is a type of UML diagram that depicts the static structure of a software application by showing the classes, attributes and operations together with the relationship and them. Class diagram is mostly used for object-oriented modelling because it is the only UML diagram that can be mapped directly with object-oriented programming languages. The figure below shows the class diagram for our application.



**Figure 4.6:** The UML Class Diagram

As seen from the diagram above, a class diagram is represented by a rectangular shape divided into three compartments, the top showing the name of the class, the second compartment showing the attributes of the class and the last compartment showing the methods or operations with a line from one class to another which is used to show the relationship between the classes. The lines that connect one class to the other is known as association. At both ends of each association, a character notation can be seen which shows the multiplicity. The multiplicity can be one to many ( $1:m$ ), many to one ( $m:1$ ), many to many ( $m:m$ ) or even one to one ( $1:1$ ).

## 4.10 UML Sequence Diagram

This is a type of UML diagram that is used for modelling the dynamics or interaction occurring within a software system or application. A sequence diagram shows how objects interact with one another and in what order

### 4.10.1 Lecturer Sequence Diagram

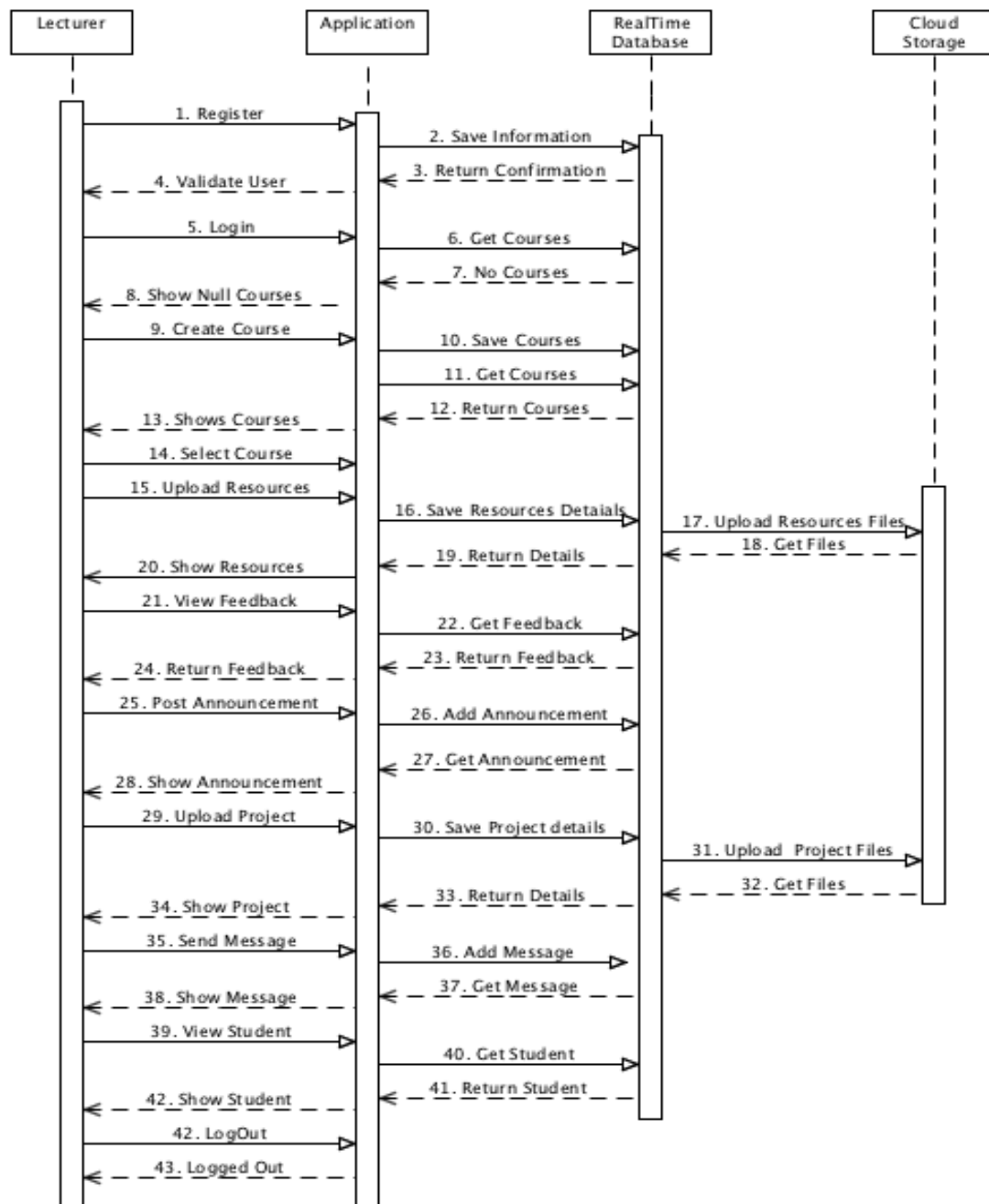
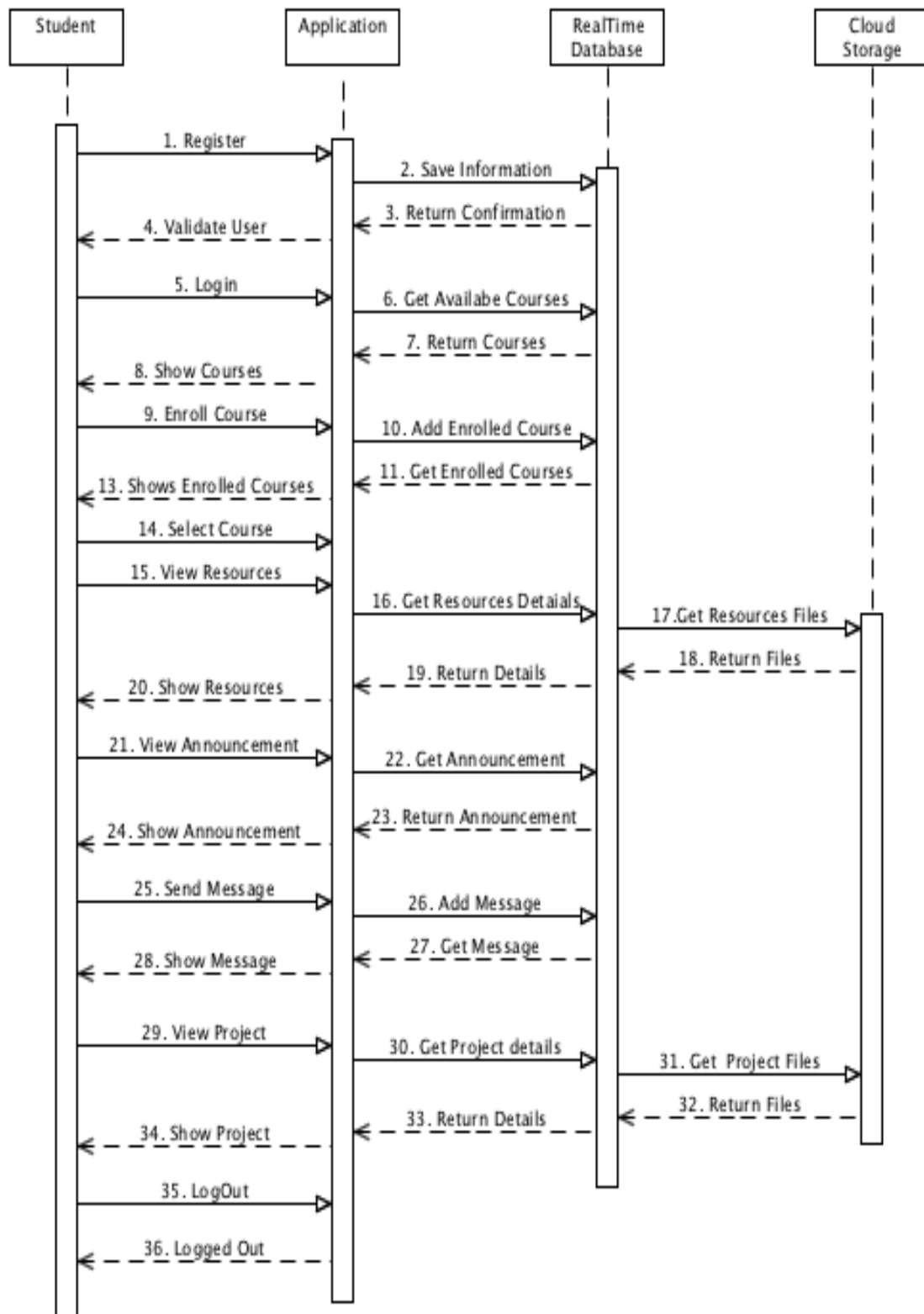


Figure 4.7: Lecturer Sequence Diagram

#### 4.10.2 Student Sequence Diagram

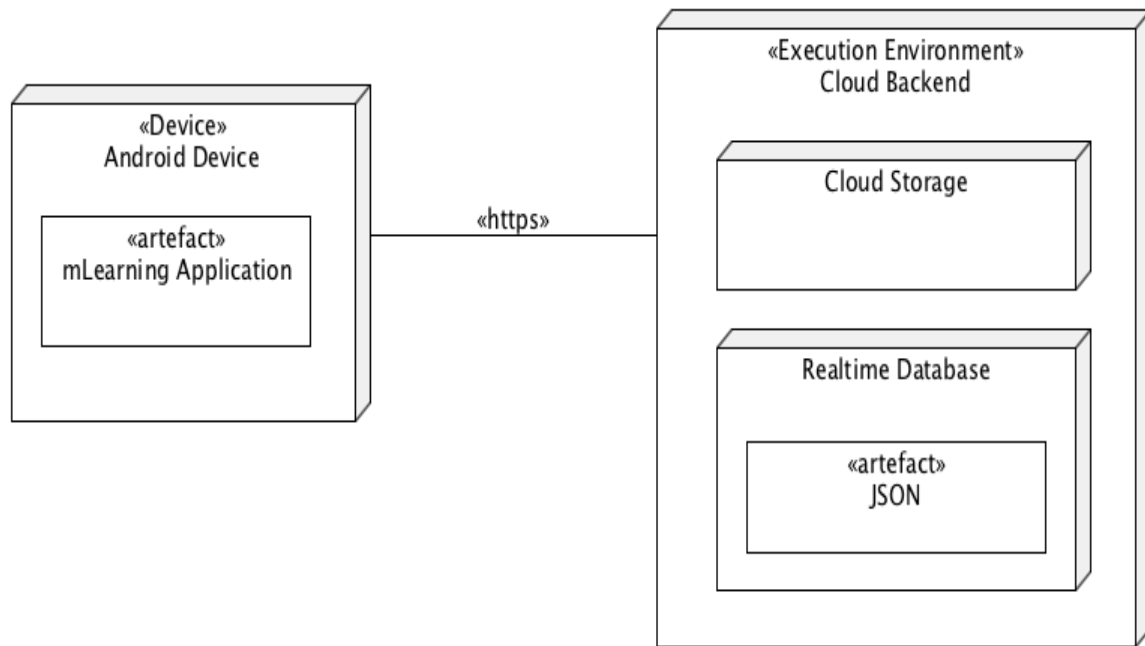


**Figure 4.8:** Student Sequence Diagram



#### 4.11 UML Deployment Diagram

A deployment diagram is a type of UML diagram that is used to model the static deployment view of a system by visualizing the topology of the system components. Below, the deployment diagram for our application can be seen.



**Figure 4.9:** The Application Deployment Diagram

As seen from the above diagram, the deployment of the application is represented. The diagram on the left shows the notation of a device, particularly an android mobile device, which contains our developed application. The second part of the diagram represents the cloud computing environment, where the storage space and database of the system resides. The device communication with the cloud environment is represented with the horizontal line connecting them and the communication is done using the '*https*' protocol.

## **CHAPTER 5**

### **SYSTEM IMPLEMENTATION**

This chapter will present and depict how the mobile learning application developed for this thesis will look like and also how it will be applicable in real environment after the deployment and installation on to a real android device, showing the application user interface, description of the expected behavior during interactions when executed by the users or respective stakeholders. Here in this chapter, we will see that the developed application has satisfied its intended purpose.

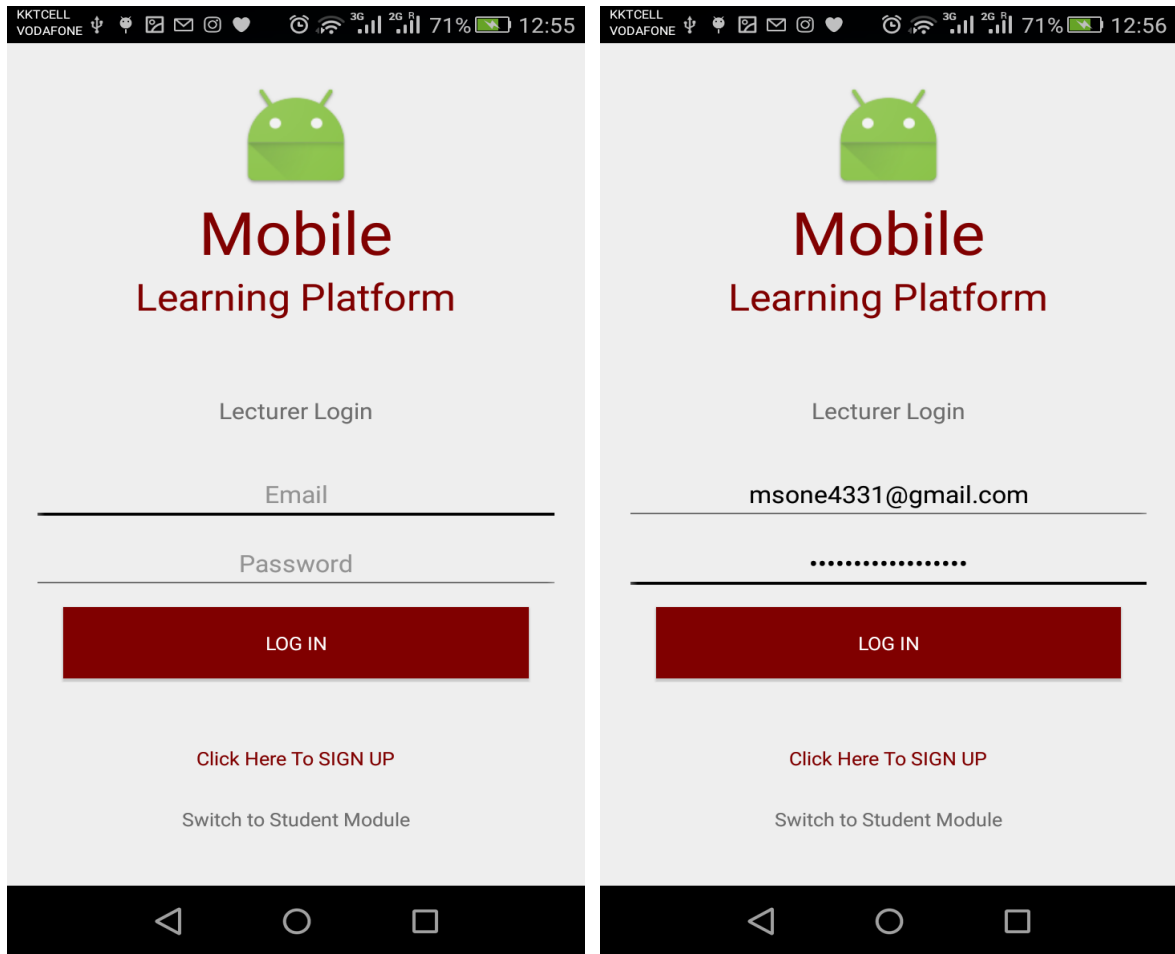
#### **5.1 Stakeholders**

The stakeholders of this mobile learning application are basically the parties that are concerned with the mobile application. Because this mobile application is designed and developed to support teaching and learning, the target stakeholders for this application are the lecturers, who can use it to support teaching and the students, who can also use the application to support learning respectively. Below we will see the interface as well as interaction flow when in use by each type of the respective types of user.

#### **5.2 Lecturer**

The lecturer can be perceived to be more like the system administrator in the sense that the lecturer manages the resources to be available on the system by creating, uploading and deleting learning contents. The lecturer can also view the learners or students that are registered on the mobile learning application as well as even interact with the students in a topic discussion directly and real-time via chat messaging. The lecturer can also interact with the mobile learning system from the backend to send special messages and notifications to the mobile application in multiple of thousands to students.

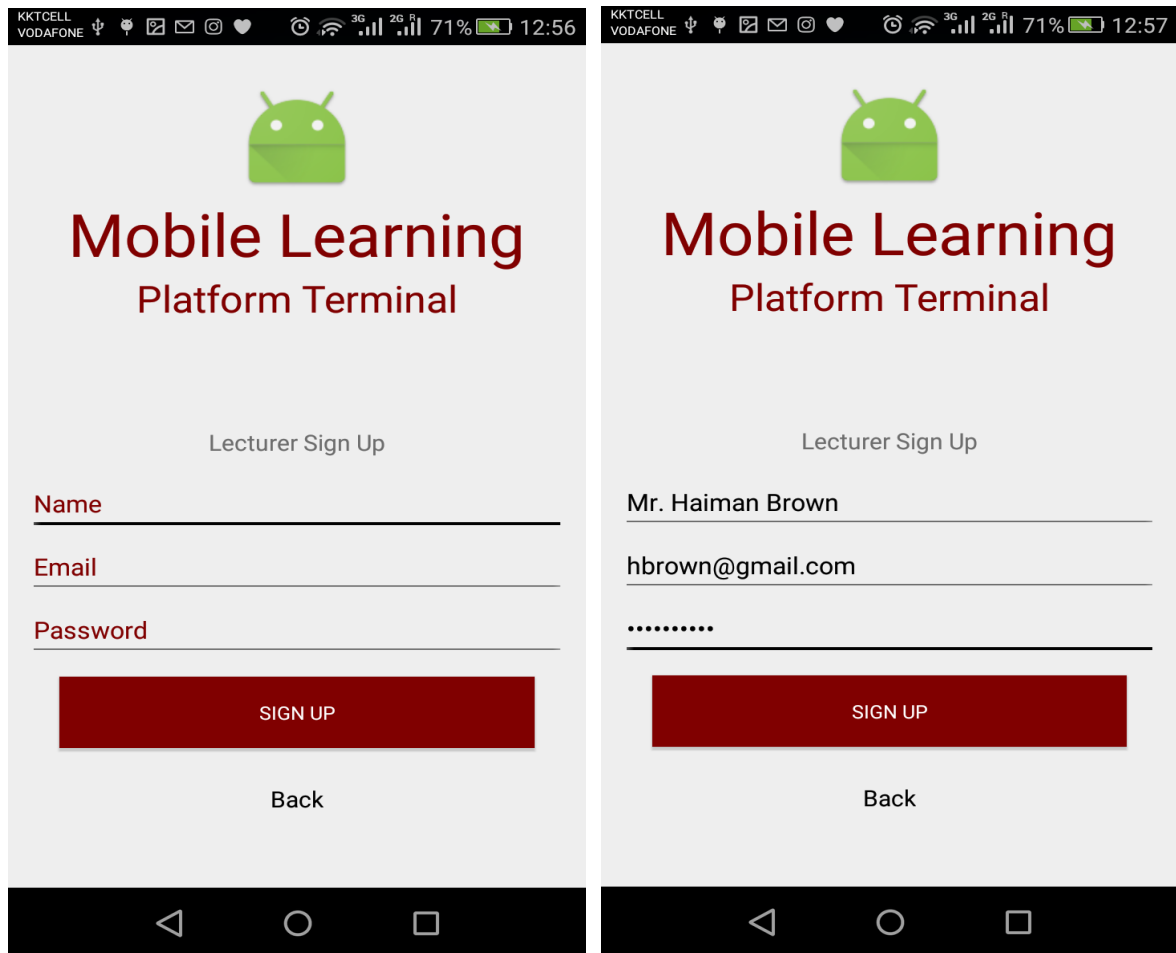
### 5.2.1 Lecturer Login Screen



**Figure 5.1:** Lecturer Login Activity of the Application

The above figure depicts the lecturer login screen. This login screen is the initial application interface that displays when the application is executed and switched from the student module to the lecturer module. This login interface as seen from the image above contains two text input field as identified for inputting the email address and password respectively. When a registered email and a matching password is entered into the respective fields and the button labeled as 'Login' is pressed, the lecturer is granted access to the application and whereas a wrong detail is provided, access to the application will be denied. To register on to the system, the text below the 'Login' button that says '*Click Here To Sign Up*' should be pressed to proceed to the activity where the lecturer can register. To quit from the lecturer side of the application, the text that says '*Switch to Student Module*' should be clicked.

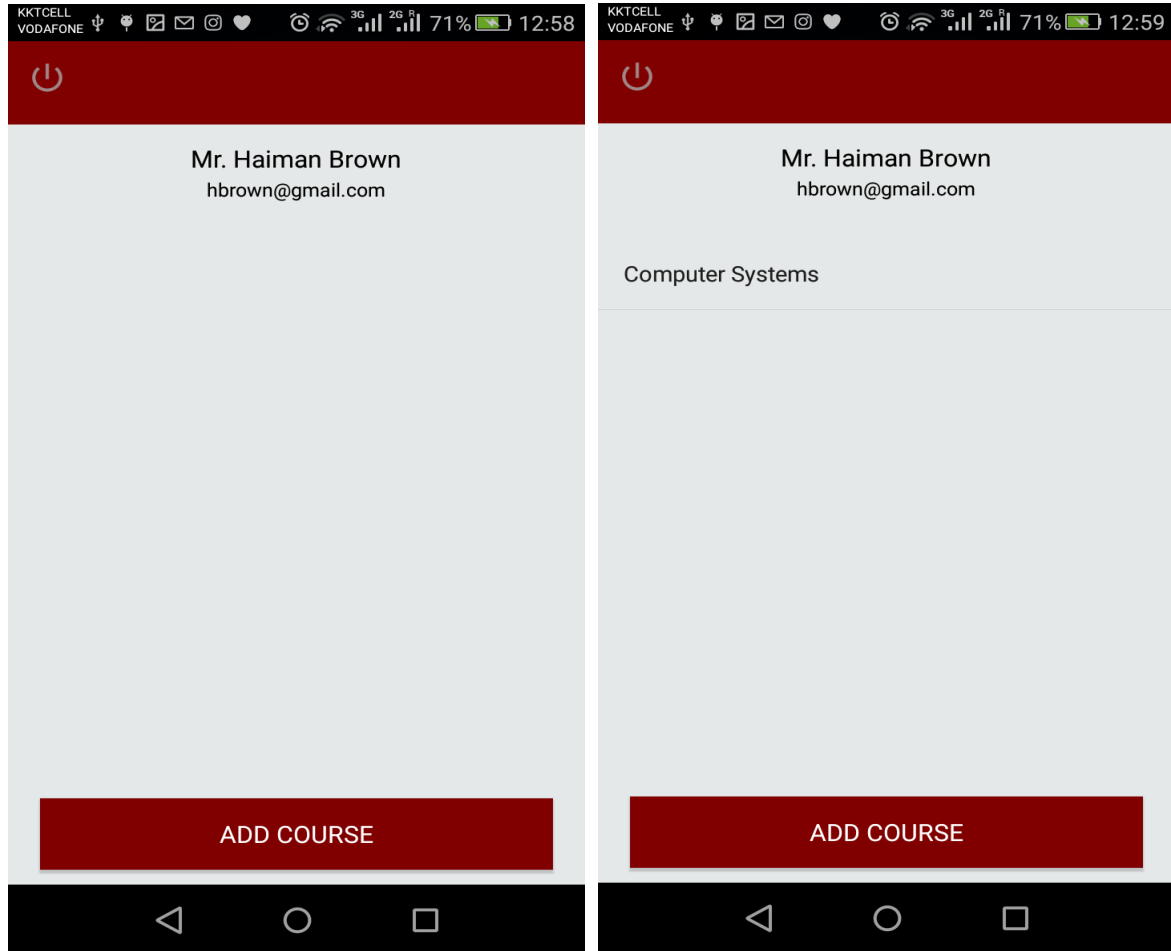
### 5.2.2 Lecturer Register Screen



**Figure 5.2:** Lecturer Register Activity of the Application

The figure seen above depicts the lecturer register activity of the application. As seen from the activity, there are three text input fields that are labeled respectively for entering the name, email address and password. After entering these details and pressing the ‘Sign up’ button, the lecturer will be registered on the system and can get access to the system. If any field is left blank or an incorrect email address format is entered, an error message will be displayed. Below the ‘Sign Up’ button is a text that says ‘Back’, when this text is clicked, it returns the application to the lecturer login activity.

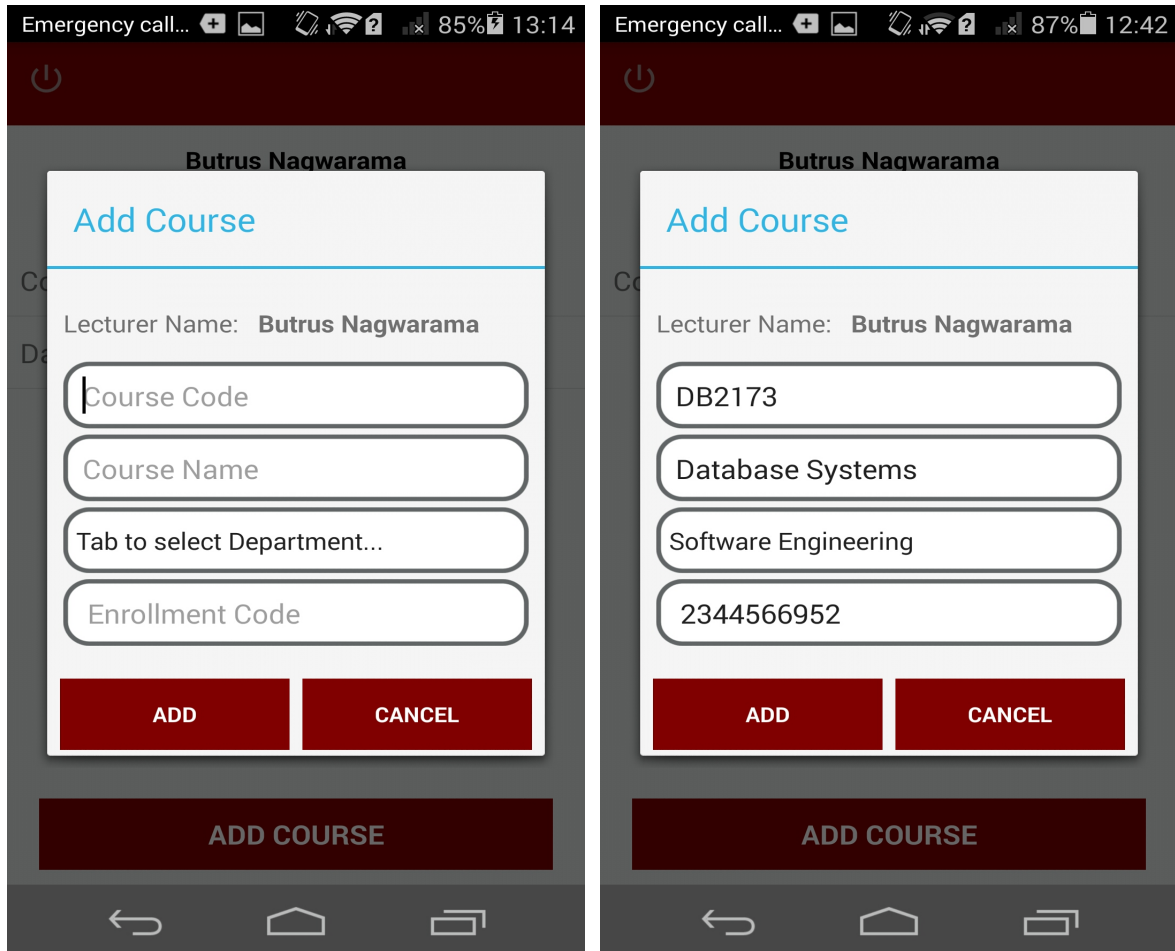
### 5.2.3 Lecturer View Course



**Figure 5.3:** Lecturer View Added Courses

The above figure depicts the application interface after a successful lecturer login. In the top center below the title bar, the name and email of the logged in lecturer is displayed. Below the lecturer details is the list of course the lecturer has already added and where there is no single course is already added, the next thing that will only be seen is the add course button at the bottom of the interface. When the add course button is clicked, a popped up dialog appears to add the course. Upon clicking on any course on the list, it proceeds to the course menu interface where the lecturer can navigate and manage the course.

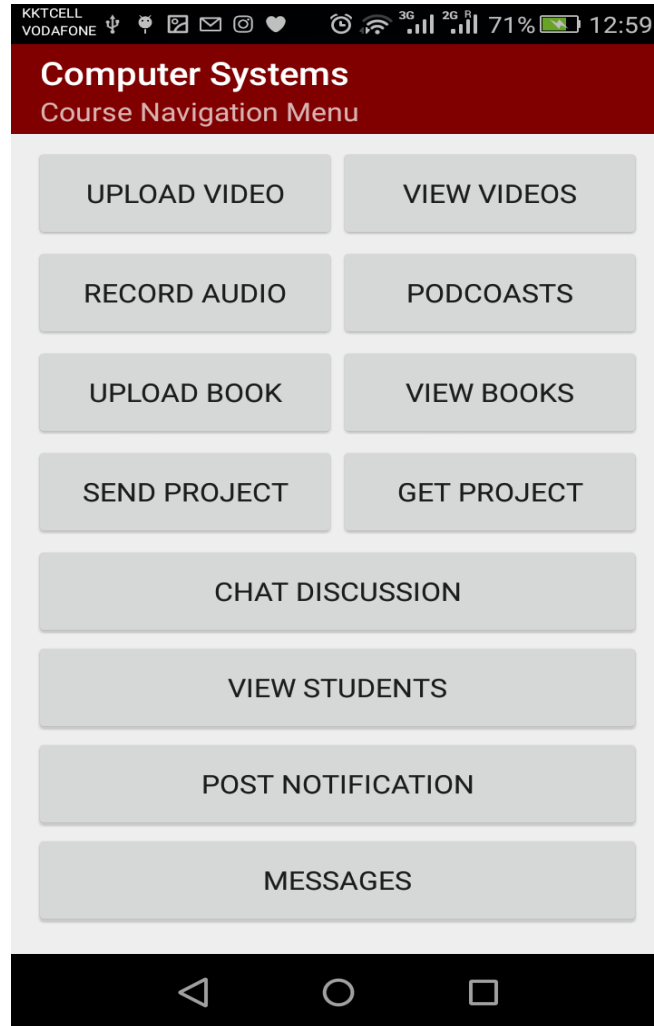
### 5.2.4 Lecturer Add Course



**Figure 5.4:** Add Course Activity

The above figure depicts the interface where the lecturer can add courses to the system. This shows a pop-up dialog box that appears when the 'add course' button at the bottom of the view courses interface is clicked. The add course dialog shows the name of the lecturer that is adding the course, and input fields for entering the course code, course name, department that is offering the course and the enrollment code that will be required by the student when enrolling for the course. The course will be added by pressing the 'add' button or the lecturer can choose to abort by pressing the 'cancel' button.

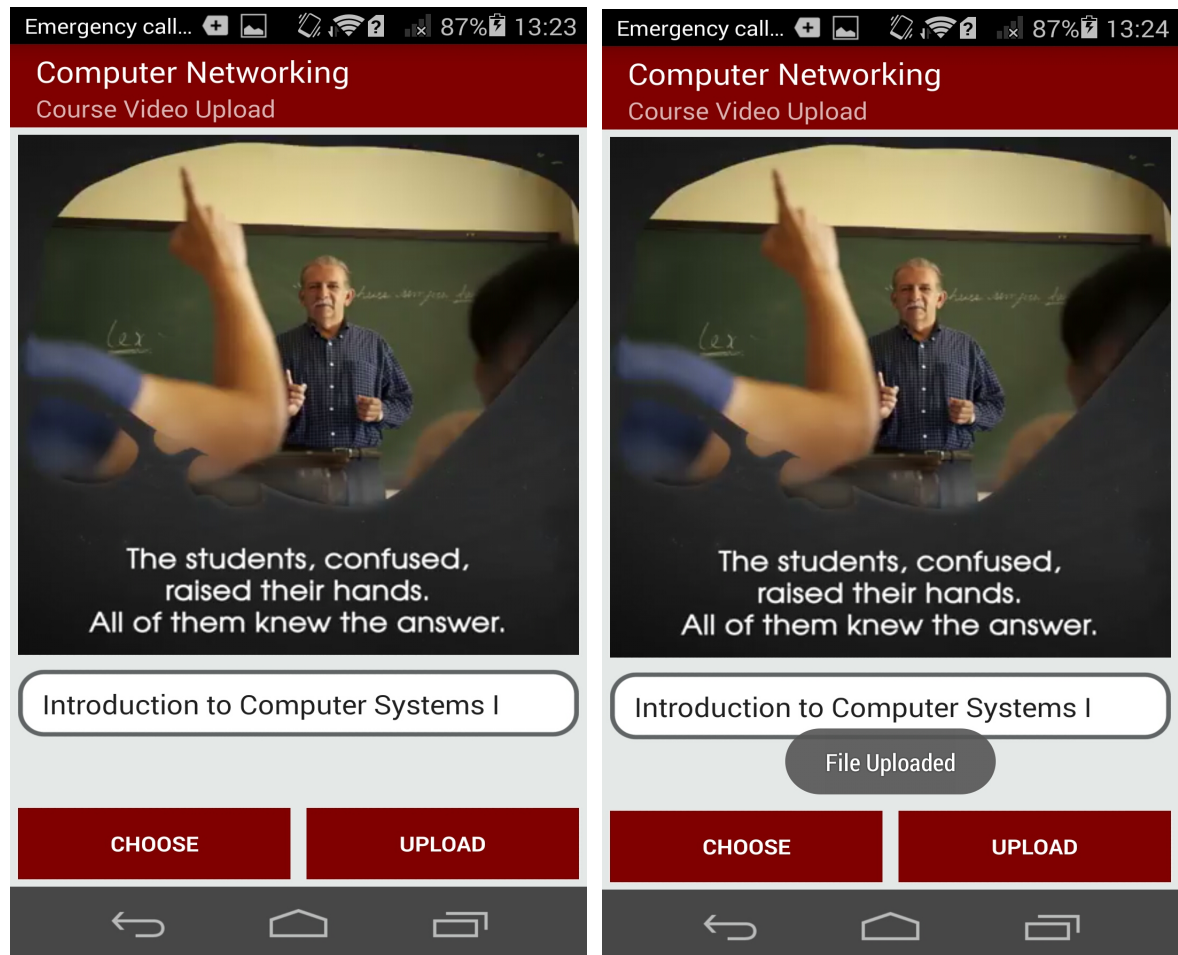
### 5.2.5 Course Management Menu



**Figure 5.5:** Course Management Menu

The figure above depicts the image of the course management navigation menu. At the top most part of the image is the title bar, which displays the name of the selected course and the active screen. This interface shows the navigation for the activities that can be performed on the course. The course management activities that can be navigated from this interface include upload of videos, recording of podcasts, upload of eBooks, upload/sending of projects, course discussion forum, viewing students enrolled on the course and sending of important announcements to students that are enrolled on the course.

## 5.2.6 Upload Video

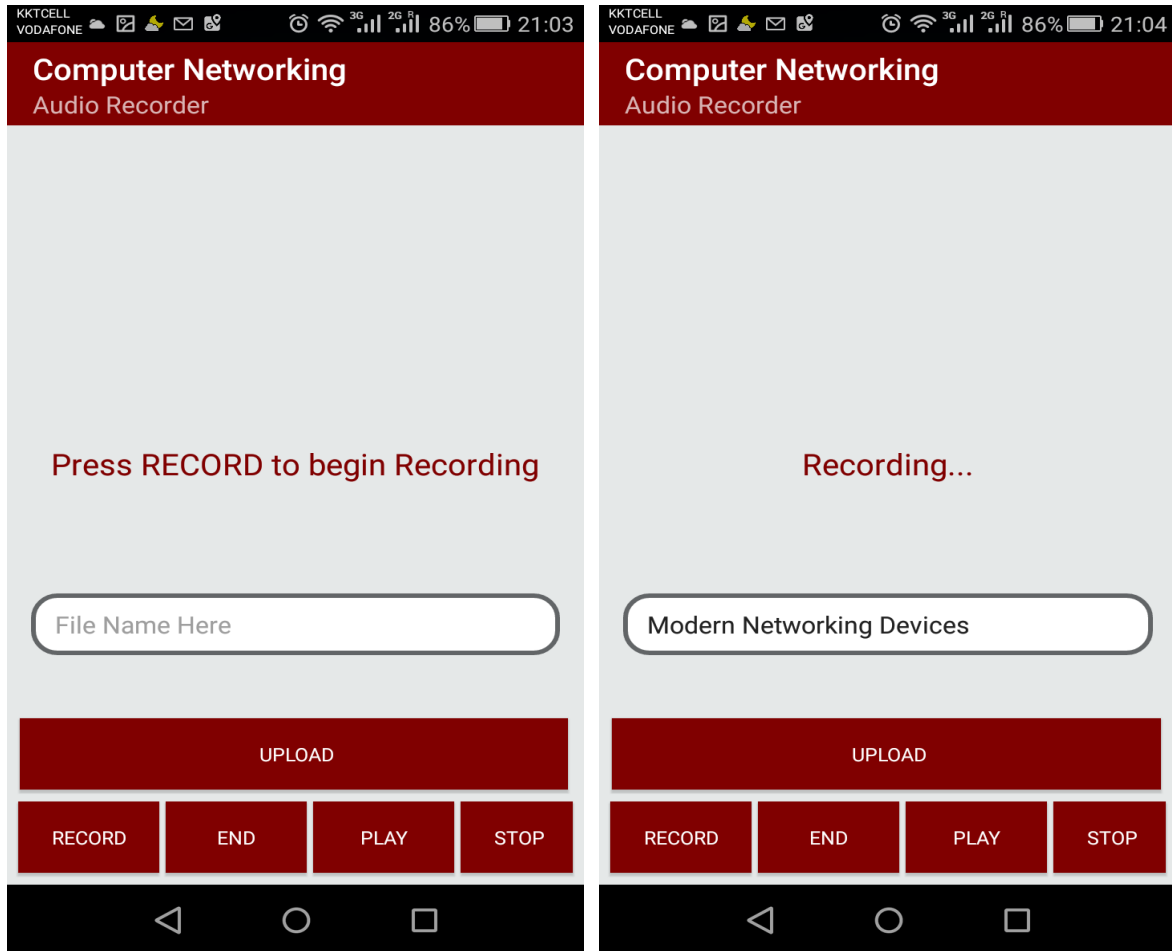


**Figure 5.6:** Video Upload Interface Design

The above figure depicts the image of the video upload interface of the application. As seen from the image, at the top most part is the title bar, which shows the title of the current interface and below the title bar is the video viewer. The video viewer is used to preview the selected video. Just beneath the video viewer is a text input field where the name or title of the video can be inputted. The 'choose' button at the bottom of the interface is used to browse and select a video from the device storage or other medium while the 'upload' button is clicked to upload the video to the cloud sever so it can be accessible to the students anytime anywhere.



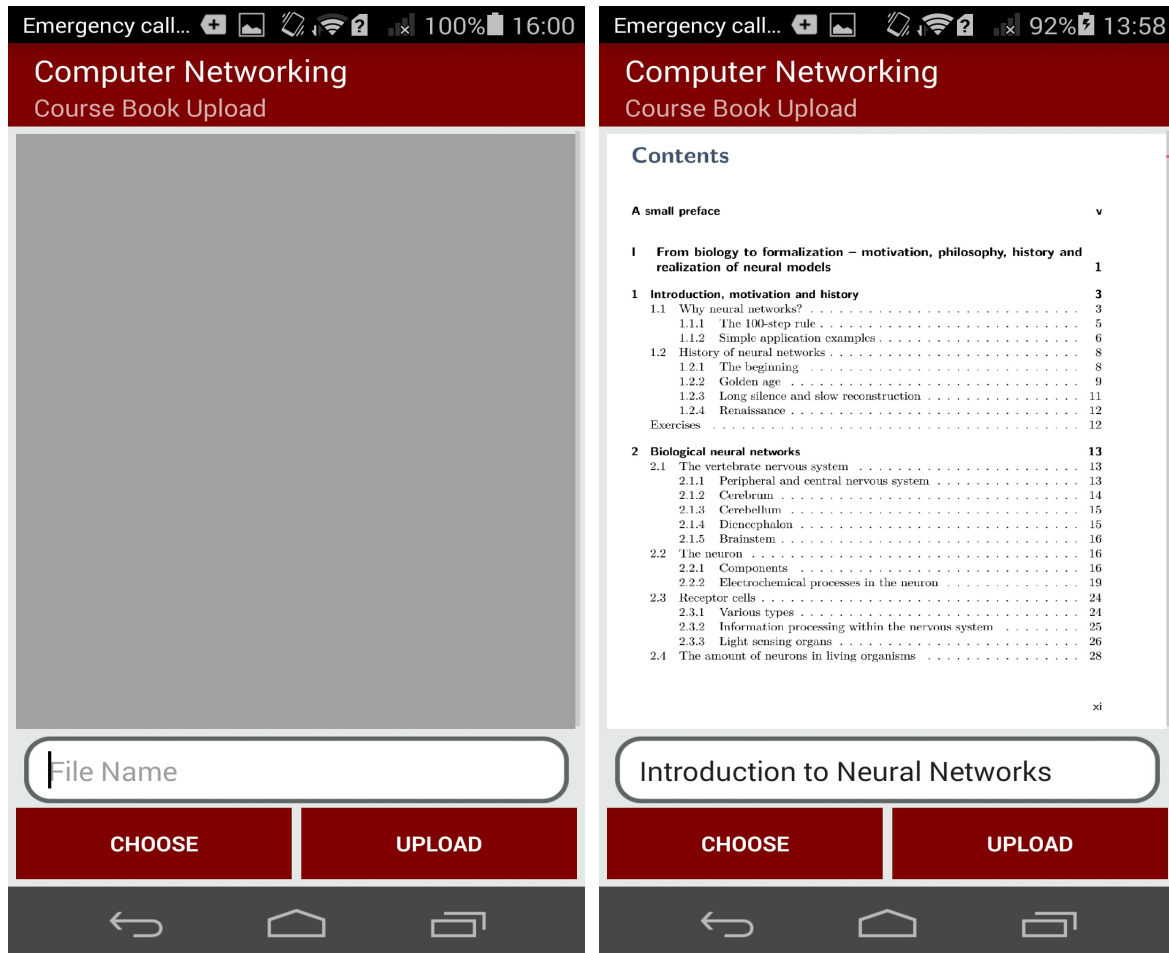
### 5.2.7 Record Audio/Podcast



**Figure 5.7:** Record Audio/Podcast Interface Design

As seen from the figure above is the sample of the activity or interface for recording and audio lecture. From the upper part is the title bar, showing the title of the present screen. At the middle of the interface is a text showing a guiding instruction relating to the operations. Below the text preview is a text input field for giving a name to the recorded file. The 'Record' button at the bottom left is clicked to start the recording, the 'End' button is clicked to terminate the recording operation, the 'Play' button is clicked to playback the recording audio file and the 'Stop' is clicked to stop the playback of the recording. Above the four control buttons is the 'Upload' button. The 'Upload' button is clicked to upload the recorded file unto the remote server direct from the mobile application to made accessible to the students at anywhere and anytime.

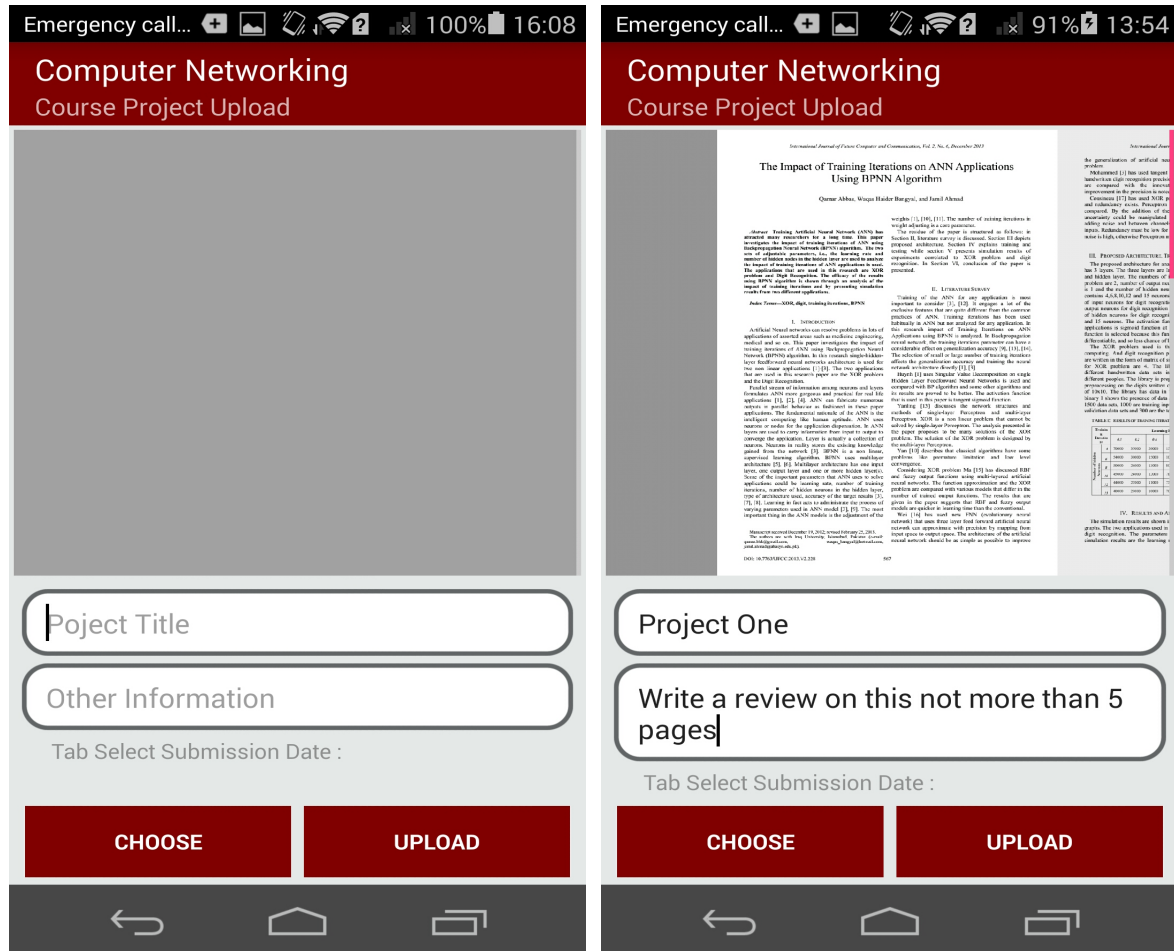
## 5.2.8 Upload Books



**Figure 5.8:** Upload Books Interface Design

The figure above depicts the image of the book upload activity design. At the top is the title bar showing the title of the current interface. Below the title is a pdf viewer for previewing the selected book. Below the pdf viewer is a text input field for entering the name or title of the book. The 'Choose' button at the bottom of the interface is clicked to choose a book from the device storage or other storage medium and the 'Upload' button to the right side is clicked on to upload the book unto the cloud server from the mobile application so it can be accessible to the students from anywhere and anytime.

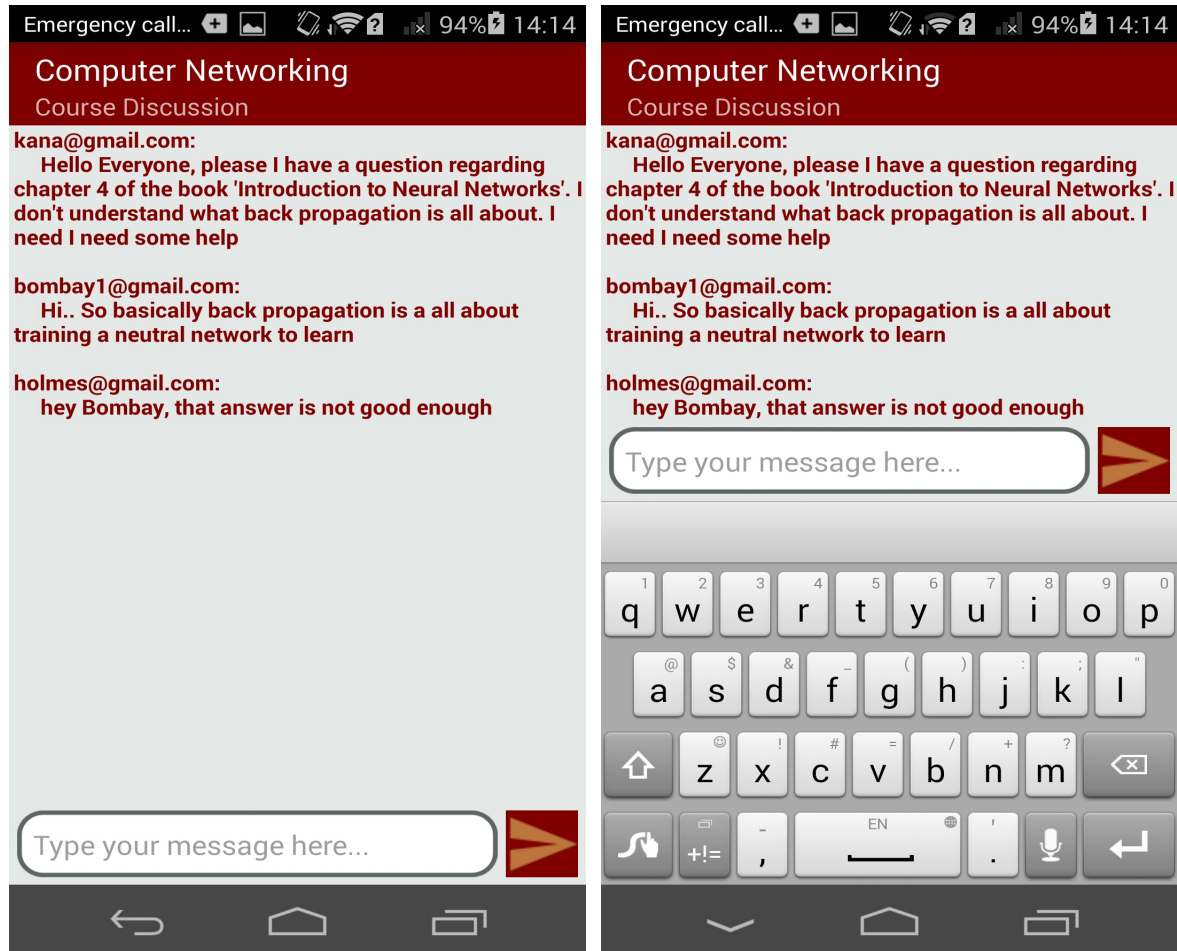
## 5.2.9 Upload Project



**Figure 5.9: Upload Project Interface Design**

The above figure depicts the interface for recording and uploading the file to the application cloud storage. This audio recording interface seen above can be used to record a lecture by the lecturer and uploaded to the cloud for the students to playback and listen to the lecture over and over again. The recording begins by pressing the *Record* button and terminated by pressing the *End* button. The *Play* button is pressed to playback the recording and listen to it before it is uploaded to the cloud storage and the *Stop* button is pressed to stop the playback of the recorded audio file. The filename can be renamed from the field provided for the file name or uploaded with a default name.

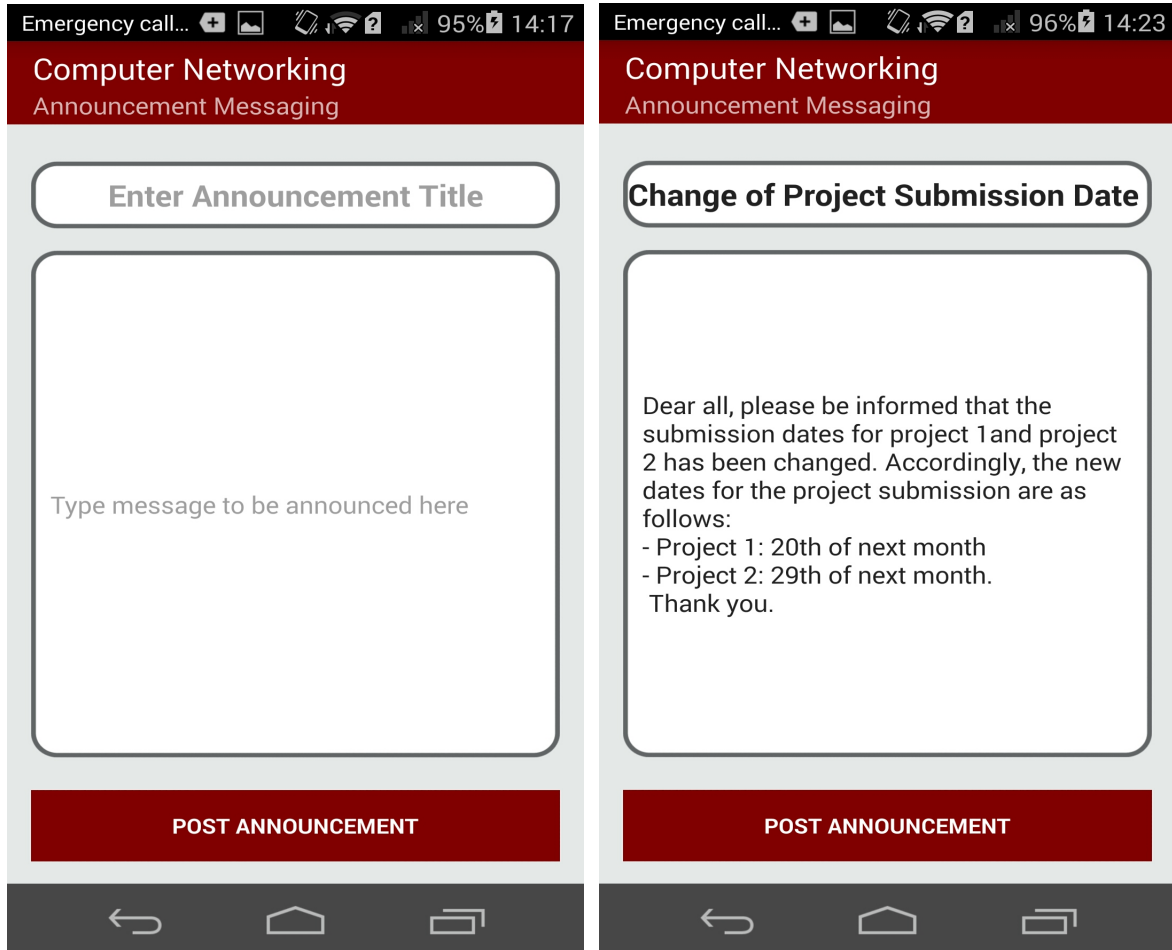
### 5.2.10 Chat Discussions Forum



**Figure 5.10:** Course Discussions Interface Design

The figure seen above depicts the image of the course discussions interface. The course discussion interface from the top has a title bar that displays the title of the current interface as well as the name of the particular course the user is in. Below the title bar is the text area where the id of the lecturer or student is displayed together with the educational and informative messages they post for other course members to see in real-time. From the bottom of the interface is a keyboard for typing the messages and shown in the text input field above the keyboard with a 'Send' button to the right that is pressed to send the message to other course members instantly.

### 5.2.11 Announcement Messaging



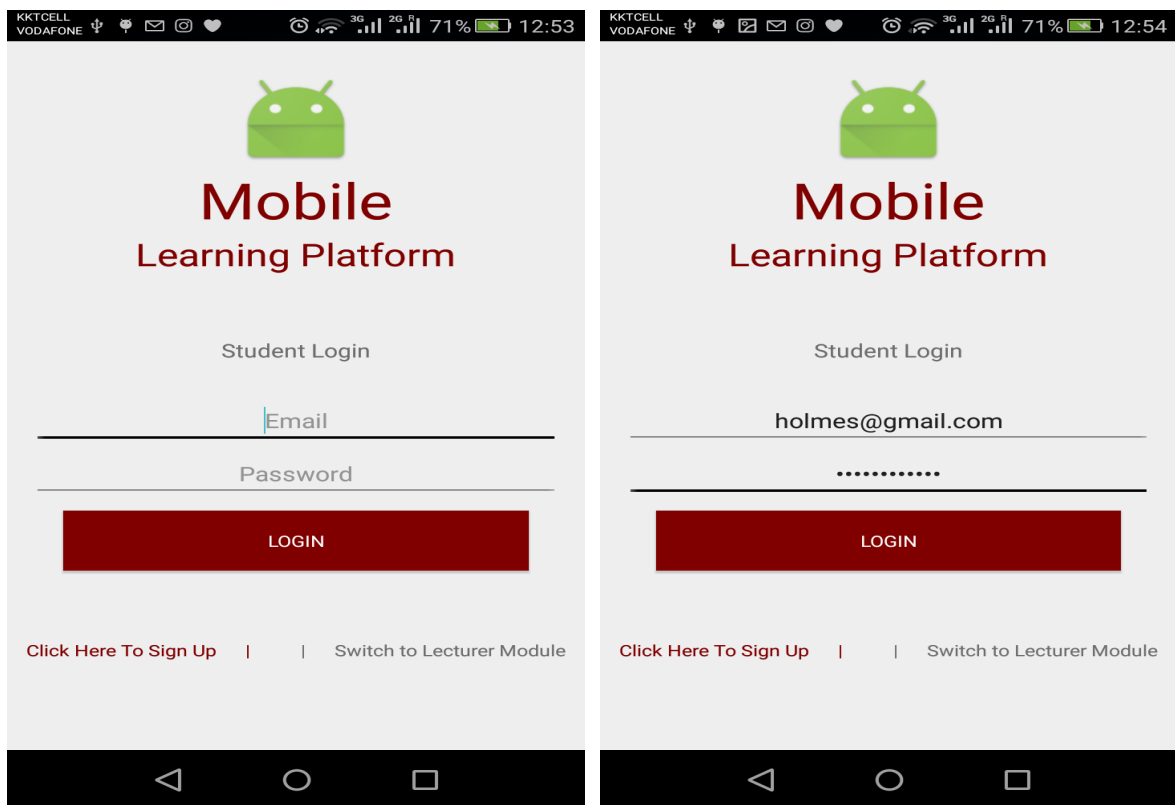
**Figure 5.11** Course Announcement Messaging Interface

The figure above depicts the interface of course announcement messaging. From the top part of the interface, the title of the current interface and the particular course that the user is in is shown on the title bar. After the title bar is a text input field for putting the announcement title and below that in the text input area for inputting the announcement message irrespective of character count or word count. Tapping on the text fields as seen from the above image, the keyboard will automatically pop up. To the bottom of the interface is a button labeled 'Post Message'. Pressing this button will post the message in real-time, which can be viewed instantly by the students anywhere and can always be viewed anytime whenever the student wants.

### 5.3 Student

The student is the primary and major beneficiary of this mobile learning application. The application is designed to make student interested in learning by having access to learning resources and materials in different form with ease at anywhere and anytime. The application will also aid learning for the student, being like a mini personal digital library where the student can have access to contents that will enhance understanding and impact new knowledge and skill by watching, listening, reading and getting information.

#### 5.3.1 Student Login Screen



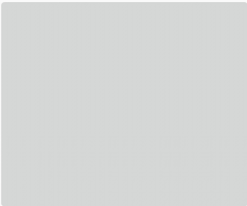
**Figure 5.12:** Student Login Activity Design

The figure above depicts the student login interface. This student login screen is the initial and default interface that appears when the application is first opened. The application can be switched to the lecturer login screen from this interface as well as a new student can register on to the learning application. The student can gain access to learning materials after providing a valid login credentials, a registered email address and a matching password in the fields provided and seen above.

### 5.3.2 Student Register Interface

Emergency call... 85% 12:35

**Student Registration**



Student ID

Student Name

Email

Department

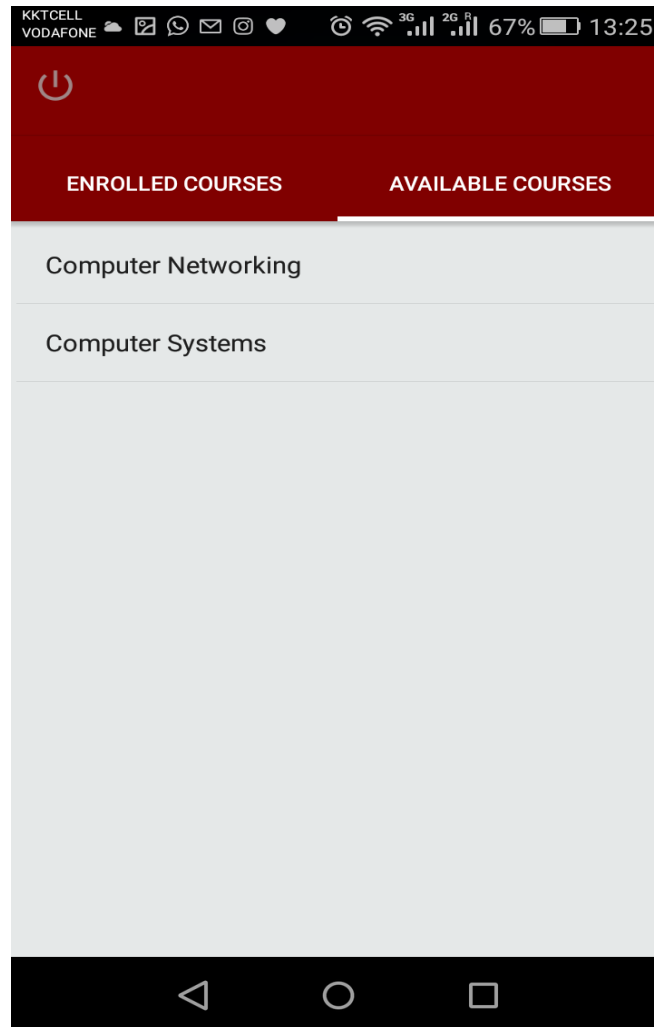
Password

**REGISTER**

**Figure 5.13:** Student Register Activity Design

The figure seen above depicts the student register activity. The student register activity is the interface where the student can register on to the system. As seen from the above image, the title of the interface is shown on the title bar and below which is an image view for selecting and previewing the image of the student. Clicking on the image view with the finger will display a pop up option for selecting the source of an image, either from the device storage or from the camera. After choosing a picture, the selected picture will also be displayed on the same image view. Below the image view are text input fields for entering the student details as clearly labeled for each field respectively. Beneath the last text input field is a button that is labeled 'Register', when the button is clicked, it register the student on the system and display a confirmation message and whereas any of the text input fields is left blank, an error message will pop up in respect of the concerned field.

### 5.3.3 View Available Courses

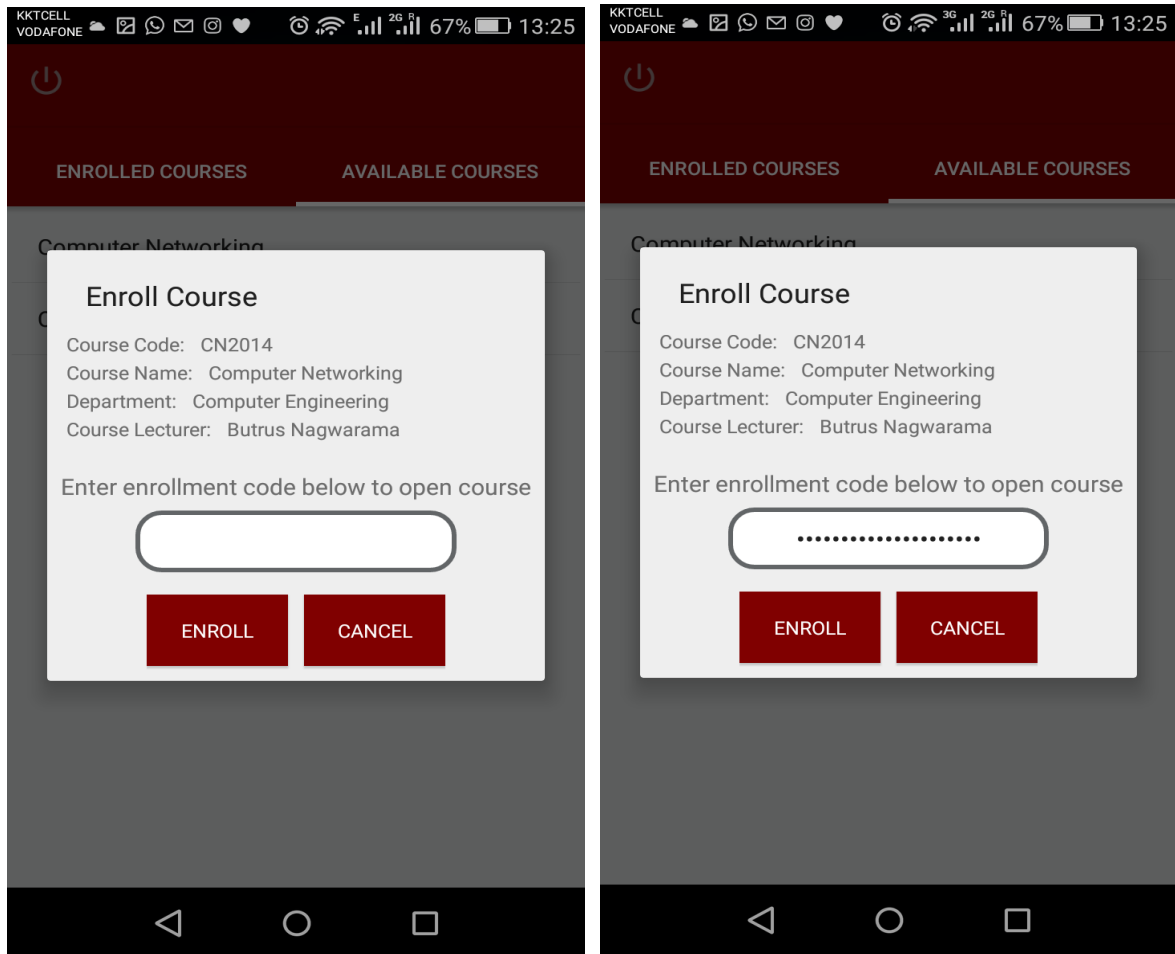


**Figure 5.14:** Student View Available Courses

The figure above depicts the view of available courses that are added by the lecturer. After a successful student login into the application, this is the first activity that displays. The tabbed bar shows two tabs and to the right is labeled 'Available Courses'. On the 'Available Courses' tab that can be seen from the above image, it contains the list of courses that the student can choose to select and add to the list of courses the student wishes to learn. Clicking on any course on the list will display the course details as well as a field for entering the course enrollment key for ascertaining the originality of the student.



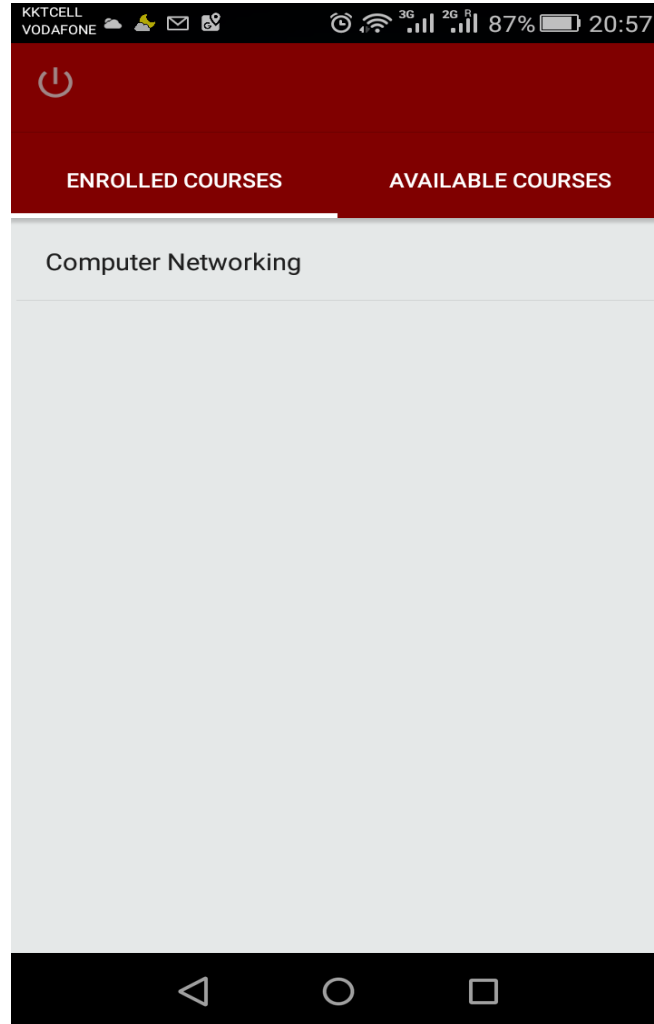
### 5.3.4 Student Enroll on Courses



**Figure 5.15:** Student Course Enrollment Activity Design

The figure seen above depicts the course enrollment activity. The course enrollment activity as seen from the above image is a dialog box that pops up when a course is clicked on from the available course tab. The course enrollment pop up interface design has a title at the top followed by the course details and a text input field for entering the course enrollment code, which should be gotten from the lecturer that will authorize the student to have access to the course. When the text input field is left blank and the 'Enroll' button below it is pressed, an error message will display, same with if a wrong enrollment code is entered. If a correct enrollment code is entered, the student will be enrolled to the course and the course will be added to the list of enrolled courses and the student can have access to the course learning resources.

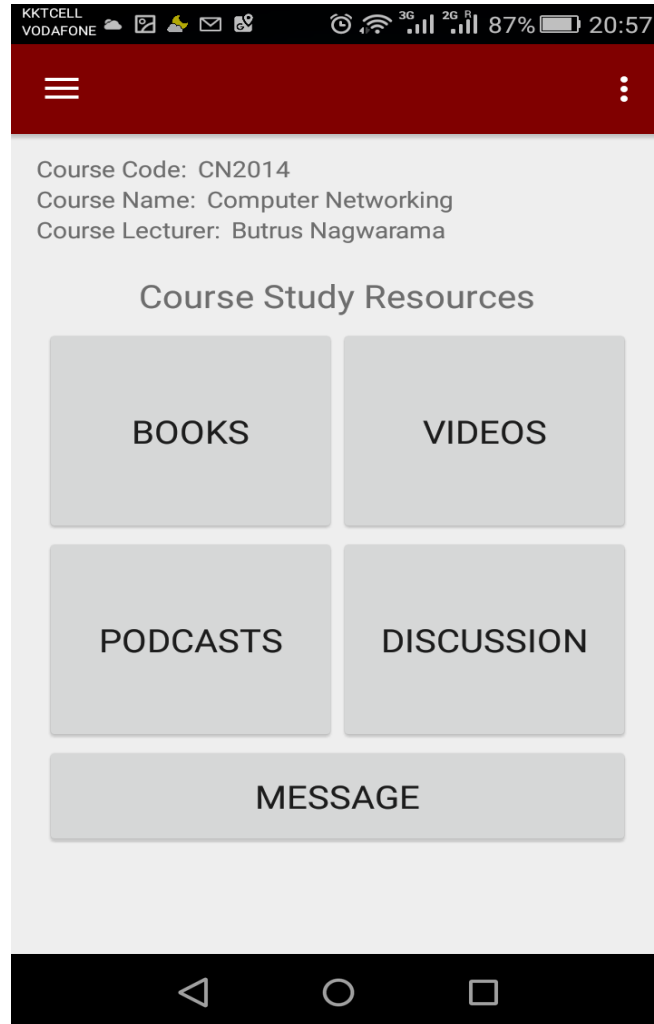
### 5.3.5 Student Enrolled Courses



**Figure 5.16:** Student View of Enrolled Courses

The above figure depicts the enrolled courses view of the application. This is the activity or interface that first appears when a student is successfully logged in. The initial tab to the left labeled 'Enrolled Courses' shows the list of courses that the student has enrolled. Where the student is not enrolled on any courses, the 'Enrolled Courses' tab will display no course. Courses on the 'Enrolled Courses' tab are added from the 'Available Courses' tab to the right. From the 'Enrolled Courses' tab, the student can access the course navigation menu by just clicking on any course to proceed with their desired operation.

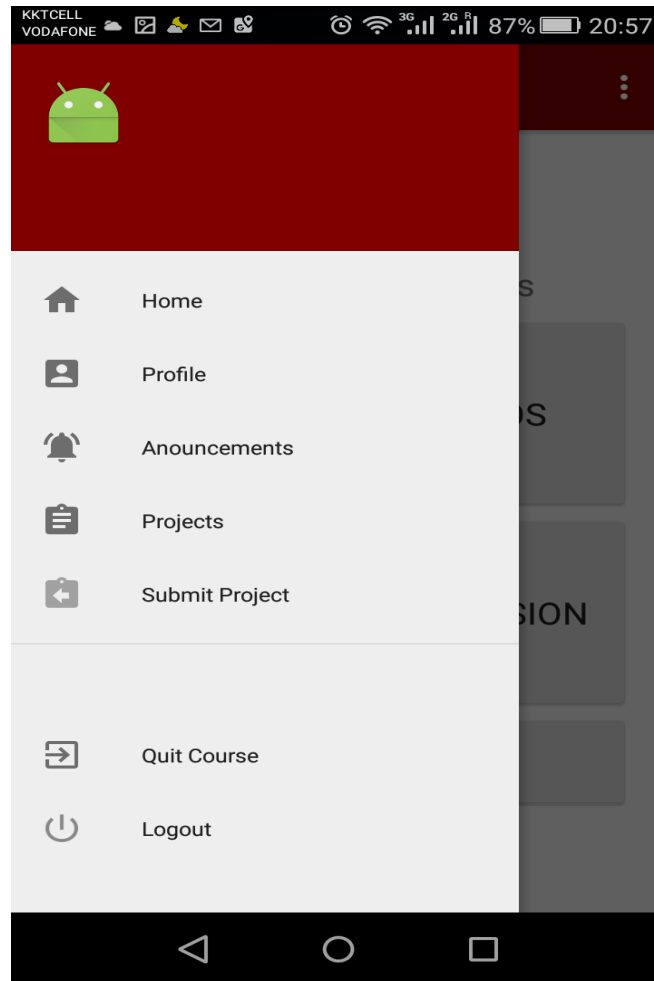
### 5.3.6 Course Home Navigation



**Figure 5.17:** Student Course Navigation Interface

The above figure depicts the image of the course home menu. As seen from the image, the top contains a title bar with three horizontal lines to the left, which is an indication of more other navigation options hidden which can be revealed by pressing the three horizontal bars or swiping the screen from the extreme left to the right. Below the title bar by the left is some of the selected course details. From the middle of the interface down, clearly labeled buttons for the different types of educational resources can be seen.

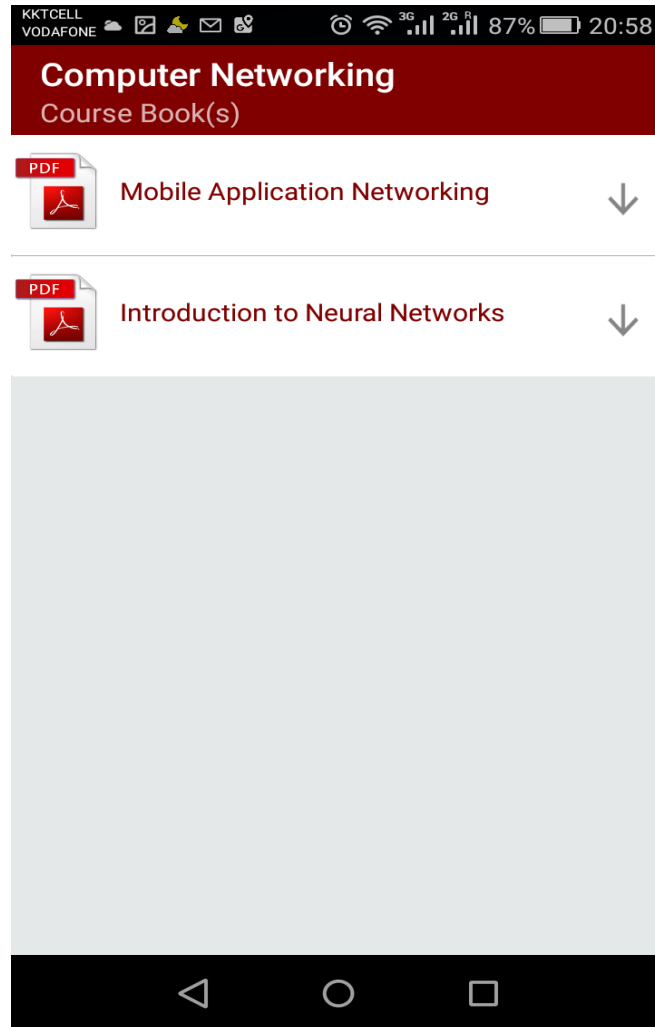
### 5.3.7 Other Navigation Menu



**Figure 5.18:** Student Other Course Navigation Menu

The figure see above represents the image of the other navigation menu within a course. This navigation is displayed when the three horizontal lines at the left of the course home navigation menu interface is pressed or the screen is swiped from the extreme left to the right on the same interface. This menu navigates to other activities as labeled, for instance 'Home' when clicked goes back to the course home navigation menu, 'Profile' when clicked goes to the current student's profile, 'Announcements' goes to the view announcement interface, 'Projects' goes to the where the student can view projects that were uploaded on the course, 'Quit Course' will remove the course from the student account and the student will no longer be enrolled in the course and the 'Logout' will sign out the student from the application.

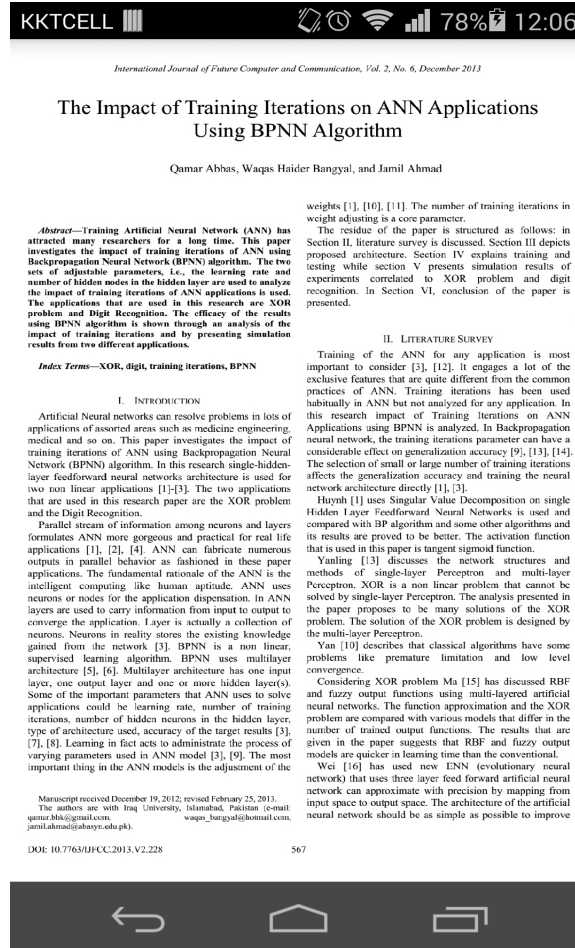
### 5.3.8 View eBooks



**Figure 5.19:** View Course eBooks Activity

The figure above depicts the view eBooks interface screen. This interface shows the list of eBooks available for the student to study. Each book is titled by the name of the book. Any of the listed books clicked on will open for reading.

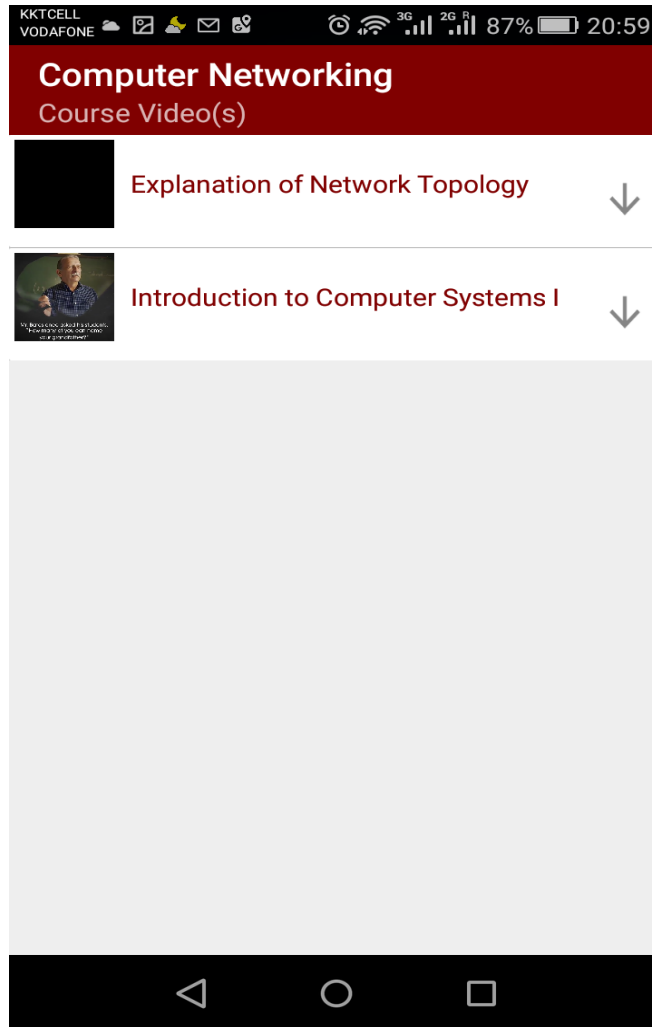
### 5.3.9 Read eBooks



**Figure 5.20: Read Course eBook Screen**

The above figure depicts an opened book. The interface appears like this when a book is clicked upon from the list of eBooks and a student can read the contents of the book. The interface supports features that makes reading convenient like scrolling and moving from page to page and even zooming in and zooming out to adjust the size of the texts by increasing and decreasing in size.

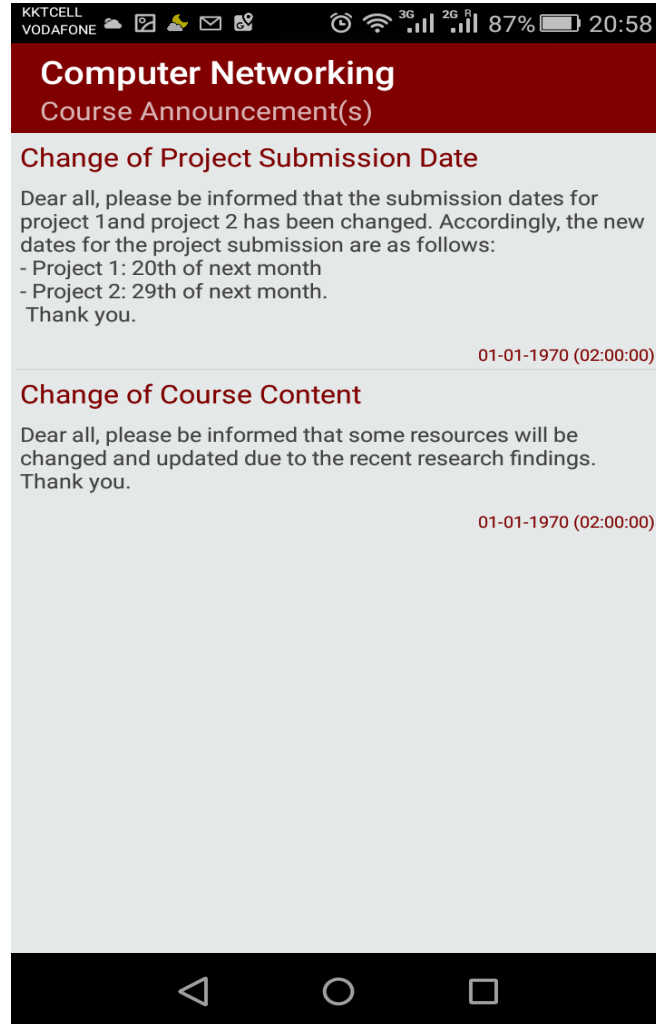
### 5.3.10 View Videos



**Figure 5.21:** View Course Video List Activity

The above figure depicts the interface of viewing the videos available for student learning on the application. This interface appears when the ‘*videos*’ button is clicked from the course home navigation menu. As seen from the interface, the top-most part of the interface contains the title bar and then followed by the videos in list format with a square preview of the video to the left side and the title of the video in front. Upon clicking or tapping on any of the video item, it open and expands for proper viewing by the student.

### 5.3.11 View Course Announcement

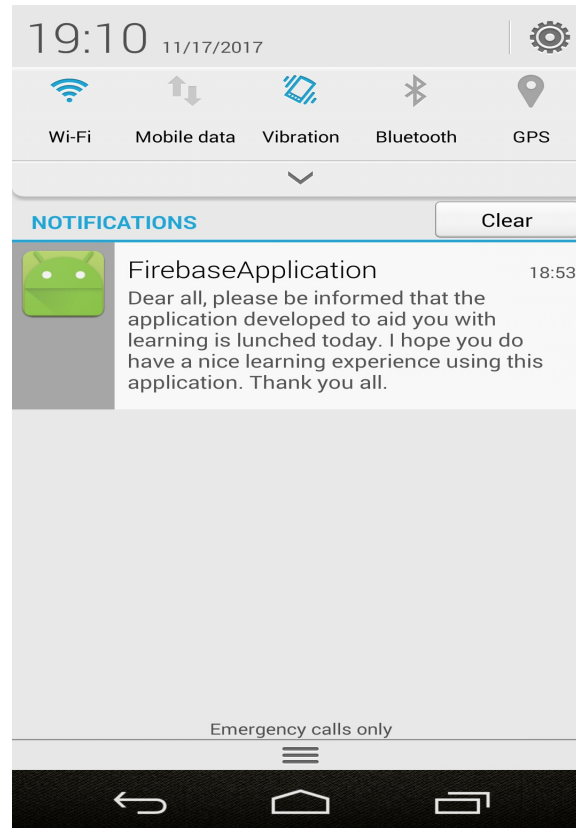


**Figure 5.22:** View Course Announcement Interface Design

The above figure depicts the design of the course announcement interface. As seen from the above image, the top part contains the title of the current interface and the name of the course that the student is inside. Below the title bar is the area where the announcement can be seen. The announcements are presented in a form of list order separated with a line. Each announcement item contains a title aligned to the left and the main message comes after. Each announcement item has a date and time that it was posted aligned to the right below the main announcement message.



### 5.3.12 Push Notification/Cloud Messaging



**Figure 5.23:** View of Push Notification for the application

A push notification is a message that pop up on a mobile device that is sent directly from the cloud server, hence it is otherwise called cloud messaging. It is received immediately it is sent via the application even when the application is not in use and logged out. This type of messaging is used to speak to users that have already installed the application directly. The use of this service in this application is for instant broadcasting of relevant and useful information that is general to the support of learning and irrespective of information related to individual course. The figure above shows the view of the push notification for this application.

### 5.4 Testing

Testing is basically the process of running a program or software with the aim of detecting errors or failures so that they can be corrected and to ascertain that the program or software works as expected. To determine if the application meets the specified functional

requirements in the previous chapter, each of the functions is tested to see that the desired result is achieved.

#### 5.4.1 Types of Testing

The type of testing performed on this application to determine the correctness and functionalities are exactly as expected can be seen below:

- **Unit Testing:** This is type of testing is done by isolated a unit or each part of a program and tested to determine or show that the individual parts are working perfectly or correctly. The unit testing is used to test the application functions individually and the results can be seen in the test cases further in this chapter.
- **Integration Testing:** This is usually done after unit testing. This is the type of testing done on a software where the individual units, components or modules of the software that have already been tested are combined and the interface between them are tested.

#### 5.4.2 Test Cases

The table below presents the test cases that was drawn to test the functionalities of the developed application.

**Table 5.1:** Test Case Showing the Tests and Results of the Test on the Application

Test ID	Function	Description	Actual Result	Status
TS001	User Register	New users (lecturers/students) should be able to register on the application with email and password	New users are registered on the system	Successful
TS002	User Login	Registered users (lecturers/students) should be able to login and gain access to the system with their email and password	Registered users gain access to the system with their email and password	Successful
TS003	View Course(s)	The lecturer should able to view the courses already added as well as the student should be able to view the courses that are available for enrolment and courses that are already enrolled	Courses added by the lecturer are viewed. Courses available for student enrolment are viewed as well as the courses a student is enrolled on are viewed.	Successful
TS004	Open eBook	The application should be able to open an eBook in PDF for reading	eBooks in PDF are opened and suitable for reading with scrolling and zooming	Successful

<b>TS005</b>	Play Video	The application should be able to play a video managed from the cloud storage	Video learning resource from the cloud storage is opened and played	Successful
<b>TS006</b>	Play Audio	The application should be able to play an audio managed from the cloud storage	Audio learning resource from the cloud storage is opened and played	Successful
<b>TS007</b>	Upload video	Lecturer should be able to upload a video resource to the cloud storage for a course from the application	Video learning resource was uploaded to the cloud storage on a course from the application.	Successful
<b>TS008</b>	Upload Audio	Lecturer should be able to upload an audio resource to the cloud storage for a course from the application	Audio learning resource was uploaded to the cloud storage on a course from the application.	Successful
<b>TS009</b>	Upload eBook	Lecturer should be able to upload an eBook to the cloud storage for a course from the application	Book learning resource was uploaded to the cloud storage on a course from the application.	Successful
<b>TS010</b>	Chat Discussion	The application should be able to allow communication between course members in group like a discussion	Chat discussion between course members in a group was executed and performed as expected.	Successful
<b>TS011</b>	Text Messaging	The application should allow a messaging communication between a lecturer and student	Message communication between a lecturer and student privately was performed as expected.	Successful
<b>TS012</b>	View Announcement	Student should be able to view announcement(s) posted on a course	Student was able to view course announcement for individual courses	Successful
<b>TS013</b>	Post Announcement	Lecturer should be able to post announcement(s) for a course	Announcement(s) on course related issues were posted as expected	Successful
<b>TS014</b>	Feedback	The application should be able to give lecturer feedback on the access to learning resource	Feedback on the access to a course learning resource was available to the lecturer	Successful
<b>TS015</b>	Enrol Course	Student should be able to enrol on a course from the list of available courses	Student was able to enrol on a course from the list of available courses	Successful
<b>TS016</b>	Drop Course	Student should be able to drop a course	Student was able to drop a course	Successful
<b>TS017</b>	Download Resource	Student should be able to download a learning resource on to their device storage from the cloud storage	Student was able to download a learning resource file from the cloud storage to the device storage	Successful
<b>TS018</b>	Delete Resource	Learning resources available on a course should be able to be deleted by lecturer any reason.	Learning resource required to be removed by a lecturer was deleted as expected.	Successful
<b>TS019</b>	Push Notification	The application should be able to receive push notification on to the mobile device it is installed	Mobile devices which the application was installed was able to receive push notifications.	Successful
<b>TS020</b>	Log Out	The users (lecturer/student) shall be able to log out of the application anytime.	users (lecturer/student) were able to log out of the application	Successful

## **CHAPTER 6**

### **CONCLUSIONS AND RECOMMENDATIONS**

This chapter is the final chapter of this document. This chapter presents the conclusion of the work done, pointing out and summarizing the important and notable point of the whole thesis. Recommendations based on the research findings as well as the outcome of this thesis for the possible and suitable implementation into the real-life environment is provided in this chapter.

#### **6.1 Conclusions**

The research focus of this thesis is to develop a mobile application on the android platform that will aid teaching and learning in the context of higher institutions. The goal and importance of this work is to provide the awareness, the need, necessity and to showcase the idea, the concept, benefits and importance of the mobile learning in general and integrated together with the traditional classroom method as well as pointing out the positivity of doing so. We have seen the reasons why the android platform is chosen for this application, because it is an open-source mobile platform that provides developers ease of application development that make mobile devices or hardware more useful and user-friendly and for the fact that it is the most commonly and widely used operating system on mobile phones and other mobile devices across different mobile hardware manufacturers. The mobile learning application developed can be seen to have features that provide the students with learning materials in multimedia format that include eBooks, videos, audio podcast to even group discussion on a course as well as private communication with a lecturer through messaging. Using the same application, the lecturer or course leader can upload files for the students and other lecture recordings. The lecturer can also perform these same tasks directly from the backend cloud server remotely over a network.

It can be undoubtedly perceived that the adoption and use of this mobile learning application have certainly serve well its intended purpose of being a very important and great educational tool that offers flexibility, comfort and effectiveness in teaching and learning in higher institutions.

## **6.2 Recommendations**

The idea of mobile learning cannot be over exaggerated and during the course of research for this thesis, it shows that mobile learning is a very vital method of learning. Mobile learning integrated into the university or other higher institutions to complement the traditional learning method or to even serve as an alternative to the traditional method of learning in the classroom, which will help increase or boost learning activities and educational engagement for the students. For students that cannot keep up with being in the classroom to learn for some reasons that might include sickness, inflexibility of jobs and some other reasons that might arise due to unforeseen circumstances, the adoption of mobile learning will bridge in to fill the gap and make learning continuous from any geographical location. Also during the course of this research, it shows that university students get the use of mobile learning vital and very comfortable. This is as a result of different individual students have different learning rate and mobile learning application like the one of this thesis can make each individual student adjust suitably to their learning rate because it provides available the course learning materials which can be accessed anytime and anywhere the student is comfortable in his/her mind and the surrounding environment, which will make learning very effective. This mobile learning application will also make teaching easy for the teacher or lecturer because the learning materials are made available to the students, which they can always have access to for more review, revision to enhance understanding and to make research using the learning materials to strengthen their knowledge as well as interact with other course members and the course teacher to discuss and improve ideas using messaging chat. Mobile learning in general, possibly holds more than all that.

The adoption of mobile learning into the university or other higher institutions' learning methods is strongly recommended. Using this mobile learning application for this thesis will first of all help the teacher or lecturer to be more flexible with his/her schedule and as much providing ease of teaching. Then on the student side, it will boost learning activities and engagement in educational lifestyle among students and it will efficiently make learning very much effective.

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## **APPENDICIES**

## APPENDIX 1

### SOURCE CODES

#### XML Source code

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#e5e8e8"
    tools:context="com.example.khalifabature.firebaseapplication.FileUploadActivity">

    <include layout="@layout/toolbarr"
        android:id="@+id/customToolbarr"/>

    <VideoView
        android:id="@+id/videoView"
        android:layout_width="match_parent"
        android:layout_height="390dp"
        android:layout_below="@+id/customToolbarr"
        android:layout_margin="5dp" />

    <EditText
        android:id="@+id/fileName"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:paddingTop="10dp"
        android:paddingBottom="10dp"
        android:paddingLeft="15dp"
        android:paddingRight="15dp"
        android:hint="Enter file name here..."
        android:layout_below="@+id/videoView"
        android:layout_marginTop="5dp"
        android:layout_marginLeft="5dp"
        android:layout_marginRight="5dp"
        android:background="@drawable/style_1"/>

    <LinearLayout
        android:id="@+id/linearLayout"
        android:orientation="horizontal"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:layout_alignParentBottom="true">

        <Button
            android:id="@+id/ChooseButton"
            android:background="@color/colorPrimary"
            android:textColor="#fff"
            android:textStyle="bold"
            android:layout_margin="5dp"
            android:layout_width="wrap_content"
            android:layout_height="wrap_content"
            android:layout_weight="1"
            android:text="Choose"/>
```

<Button

```

        android:id="@+id/UploadeButton"
        android:background="@color/colorPrimary"
        android:textColor="#fff"
        android:textStyle="bold"
        android:layout_margin="5dp"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_weight="1"
        android:text="Upload"/>

    </LinearLayout>

</RelativeLayout>

```

## Java Source Code

```

package com.example.khalifabature.firebaseapplication;

import android.app.ProgressDialog;
import android.content.ContentResolver;
import android.content.Intent;
import android.net.Uri;
import android.os.Bundle;
import android.support.annotation.NonNull;
import android.support.v7.app.AppCompatActivity;
import android.support.v7.widget.Toolbar;
import android.text.TextUtils;
import android.view.View;
import android.webkit.MimeTypeMap;
import android.widget.Button;
import android.widget.EditText;
import android.widget.MediaController;
import android.widget.Toast;
import android.widget.VideoView;

import com.google.android.gms.tasks.OnFailureListener;
import com.google.android.gms.tasks.OnSuccessListener;
import com.google.firebase.database.DatabaseReference;
import com.google.firebase.database.FirebaseDatabase;
import com.google.firebase.storage.FirebaseStorage;
import com.google.firebase.storage.OnProgressListener;
import com.google.firebase.storage.StorageReference;
import com.google.firebase.storage.UploadTask;

import java.util.HashMap;
import java.util.Map;

public class FileUploadActivity extends AppCompatActivity implements
View.OnClickListener {
    public static final int PICK_IMAGE_REQUEST = 234;
    private VideoView videoView;
    private EditText fileTextName;
    private Button chooseButton, uploadButton;
    private Uri filePath;
    private String param, temp_key;
    private MediaController mediaController;

    public static final String FB_STORAGE_PATH = "Videos/";

```

```

public static final String FB_DATABASE_PATH = "Videos";

private StorageReference storageReference;
private DatabaseReference databaseReference;

@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_file_upload);

    param = getIntent().getExtras().get("room_name").toString();

    Toolbar mToolbar = (Toolbar) findViewById(R.id.customToolbarr);
    setSupportActionBar(mToolbar);
    getSupportActionBar().setTitle(param);
    getSupportActionBar().setSubtitle("Course Video Upload");

    storageReference =
        FirebaseStorage.getInstance().getReference().child("CourseCollection").child(param).child(FB_STORAGE_PATH);
    databaseReference =
        FirebaseDatabase.getInstance().getReference().child("CourseCollection").child(param).child(FB_DATABASE_PATH);

    videoView = (VideoView) findViewById(R.id.videoView);
    fileName = (EditText) findViewById(R.id.fileName);
    chooseButton = (Button) findViewById(R.id.ChooseButton);
    uploadButton = (Button) findViewById(R.id.UploadButton);

    mediaController = new MediaController(this);

    chooseButton.setOnClickListener(this);
    uploadButton.setOnClickListener(this);
}

private void showFileChooser(){
    Intent intent = new Intent();
    intent.setType("video/*");
    intent.setAction(Intent.ACTION_GET_CONTENT);
    startActivityForResult(Intent.createChooser(intent, "Select a video
file"), PICK_IMAGE_REQUEST);
}

private void uploadFile(){
    if (filePath != null) {

        final ProgressDialog progressDialog = new ProgressDialog(this);
        progressDialog.setTitle("Uploading...");
        progressDialog.show();

        // get the file storage reference
        StorageReference fileRef = storageReference.child(FB_STORAGE_PATH +
System.currentTimeMillis() + "." + getImageExt(filePath));

        fileRef.putFile(filePath).addOnSuccessListener(new
OnSuccessListener<UploadTask.TaskSnapshot>() {
            @Override
            public void onSuccess(UploadTask.TaskSnapshot
taskSnapshot) {
                progressDialog.dismiss();
                Toast.makeText(getApplicationContext(),
72

```

```

"File Uploaded", Toast.LENGTH_LONG).show();
        FileUploader fileUploader = new
FileUploader(fileTextName.getText().toString(),
taskSnapshot.getDownloadUrl().toString());

        //save file into firebaseDB
        Map<String, Object> map = new HashMap<String,
Object>();

        temp_key = fileTextName.getText().toString();
        databaseReference.updateChildren(map);

        databaseReference.child(temp_key).setValue(fileUploader);
    }
}
.addOnFailureListener(new OnFailureListener() {
    @Override
    public void onFailure(@NonNull Exception exception) {
        progressDialog.dismiss();
        Toast.makeText(getApplicationContext(),
exception.getMessage(), Toast.LENGTH_LONG).show();
    }
})
.addOnProgressListener(new
OnProgressListener<UploadTask.TaskSnapshot>() {
    @Override
    public void onProgress(UploadTask.TaskSnapshot taskSnapshot)
{
        double progress = (100.0 *
taskSnapshot.getBytesTransferred()) / taskSnapshot.getTotalByteCount();
        progressDialog.setMessage(((int)progress) + "%
Uploaded...");
    }
});
};
} else {
    // display an error toast
}
}

@Override
protected void onActivityResult(int requestCode, int resultCode, Intent data)
{
    super.onActivityResult(requestCode, resultCode, data);
    if (requestCode == PICK_IMAGE_REQUEST && resultCode == RESULT_OK && data
!= null && data.getData() != null){
        filePath = data.getData();

        videoView.setVideoURI(filePath);
        videoView.setMediaController(mediaController);
        mediaController.setAnchorView(videoView);
        videoView.start();
    }
}

public String getImageExt(Uri uri){
    ContentResolver contentResolver = getContentResolver();
    MimeTypeMap mimeTypeMap = MimeTypeMap.getSingleton();
    return
mimeTypeMap.getExtensionFromMimeType(contentResolver.getType(uri));
}

@Override
        public void onClick(View view){

```

```

        if (view == chooseButton){
            //open file chooser
            showFileChooser();
        }else if (view == uploadButton){
            //upload file to firebase storage

            if(TextUtils.isEmpty(fileTextName.getText().toString())){
                Toast.makeText(this, "Please provide a name for the file",
Toast.LENGTH_LONG).show();

                } else {

                    uploadFile();
                }
            }
        }
    }

    public class FileUploader {
        public String name;
        public String uri;

        public String getName() {
            return name;
        }

        public String getUri() {
            return uri;
        }

        public void setUri(String uri) {
            this.uri = uri;
        }

        public FileUploader(String name, String uri) {
            this.name = name;
            this.uri = uri;
        }

        public FileUploader(){

        }
    }
}

```

## APPENDIX 2

### OTHER SCREENSHOTS

