

**APPLYING MOBILE TECHNOLOGY FOR A  
PERVASIVE UNIVERSITY INFORMATION  
SYSTEM**

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**APPLYING MOBILE TECHNOLOGY FOR  
A PERVASIVE UNIVERSITY  
INFORMATION SYSTEM**

**By**

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## **DEDICATION**

*To my family and Erisa for their encouragement and support in every step of my life*

## **ABSTRACT**

### **Faculty of Architecture and Engineering**

Advisor: Igli Hakrama

Technology has become an important asset in contemporary human life. It is the fastest growing area and its influence and importance in the lives of people or companies is increasing together with the demand for faster and more efficient technologies.

Every person or company needs to be in touch with changes at any time. Also in an education system, such as university the need for having updates and notifications has become a must. Students and professors are facing the problem of not being notified in real-time regarding updates that are done to the system since neither of them is in front of a computer 24/7. For example, professors may not be able to post the new grades or notifications in time. This would result in late notification for the students, which will not see the changes in time and if necessary appeal in time for their grades to their professors. Such kind of problems effect the university efficiency and performance. Mobile technologies seemed the solution of choice to tackle this problem. During this thesis, an entire analyse, structure and design of a mobile university information system has been done. The work is focused on making this mobile system as flexible as possible, so that the functionalities it provides will keep the end-user as top priority. The system will enable the professors to put new grades or other updates regarding their courses at any time and any place and the students from the other side will be able to be notified in time.

During the analyse and design, it was discovered that also other staff members of the university, such as registration office personnel, or student affairs may be in need for such a system, so the analyse takes into consideration even them as users of the system, of course with different privileges. Currently, the implementation part related to these members has been let as a future work. The implementation phase was focused in the two main members, the professors and students as I strongly believe that if the bond between students and professors strengthens so will the university's overall efficiency and performance.

## **ABSTRAKT**

### **Fakulteti i Arkitektures dhe Inxhinierisë**

Udhëheqës: Igli Hakrama

Teknologjia është bërë një pjesë e pandashme në jetën e njeriut të sotshëm. Duke qënë fusha që po zhvillohet më shpejt, ndikimi dhe rëndësia e saj në jetët e njerëzve apo kompanive po rritet sëbashku me kërkesën për teknologji më të shpejta dhe më efikase.

Çdo person apo kompani ka nevojë që të jetë në kontakt me ndryshimet në çdo moment. Gjithashtu në një ambient edukimi siç është universiteti, nevoja për t'u lajmëruar në kohë për të reja, është bërë tashmë një detyrim. Duke qënë se as studentët dhe as profesorët nuk e kanë mundësinë të jenë para kompjuterit 24/7, nëpër universitete jemi duke u përballur me problemin që të dyja palët mund të mos arrijnë të lajmërohen në kohë rreth të rejave në universitet. P.sh. Profesorët mund të mos jenë në gjëndje t'i postojnë në kohë notat apo lajmërimet e reja. Kjo do të sjelli si rezultat që studentët nuk do të jenë në gjëndje t'i shohin ndryshimet në kohën e duhur dhe n.q.s do të jetë e nevojshme të apelojnë në kohë për notën tek profesori i tyre. Probleme të kësaj natyre ndikojnë shumë në efikasitetin dhe performancën e universitetit. Teknologjitë mobile duken si zgjidhja ideale për këtë problem. Gjatë kësaj teze, është bërë një analizë, strukturim dhe disajn i plotë për një system informacioni mobile për universitetet. Puna e bërë është fokusuar në faktin që ky sistem mobile të jetë sa më fleksibël, në mënyrë të atillë që të gjitha funksionalitetet që mundëson të kenë përdoruesin si prioritet kryesor. Sistemi do i mundësojë profesorët të vendosin në çdo kohë dhe kudo që të ndodhen, notat si dhe çdo të re tjetër rreth lëndëve të tyre. Studentët nga ana tjetër do kenë mundësinë të lajmërohen në kohë, pa asnjë vonesë të panevojshme.

Gjatë analizës dhe dizajnit, doli në pah se edhe pjesëtarë të tjerë të stafit universitar, si p.sh. personeli i zyrës së regjistrimit, apo zyra e marrëdhënieve me studentin mund të kenë nevojë për një sistem të tillë, kështu që analiza e bërë merr në konsideratë edhe ata si përdorues të sistemit, kuptohet me privilegje të tjera. Për momentin, pjesa e implementimit që ka të bëjë me këta përdorues është lënë si punë për të ardhmen. Faza e implementimit, e ka pasur fokusin kryesor tek pjesa e sistemit që ka të bëjë me profesorin dhe studentët duke qënë se unë besoj se n.q.s marrëdhënia midis studentëve dhe profesorëve forcohet po ashtu do të përmirësohet efikasiteti dhe performanca e universitetit.

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## **DECLARATION**

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Epoka University or other institutions.

Briland Hitaj  
24 May 2013

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## **LIST OF ABBREVIATIONS / NOTATIONS / GLOSSARY OF TERMS**

App – short for Application

CRUD – Create, Read, Update, Delete

GPS – Global Positioning System

ICT – Information and Communication Technologies

IS – Information System

JSON – JavaScript Object Notation

MySQL – My Structured Query Language

OS – Operating System

PC – Personal Computer

SSL – Secure Socket Layer

TAM – Technology Acceptance Model

TTF – Task Technology Fit

UI – User Interface

XML – Extensible Mark-up Language

## **CHAPTER 1 INTRODUCTION**

Nowadays, together with the rapid development changes in the world of technology, the necessity for everyone, company or individual, to be always updated and running toward new technologies in order to be victorious, has become a must. It is a well-known and accepted fact that in companies all around the world, computers handle with the highest efficacy and in the shortest time possible the majority of tasks given to them. Thanks to computers, the jobs are done faster with a high efficiency and at the same time with a considerably reduced human effort as well as error probability, bringing higher benefits to the companies or individuals.

Even though the computers are powerful and efficient, the human desire to get the jobs done faster with real-time results feedback has brought an emerging trend toward the mobile environments. Mobile applications are the new wide spreading trend that the companies are willing to follow in order to get their jobs done faster and to have real-time notifications, increasing the company's efficiency and profits as Benjamin Franklins' famous quote says "Time is Money"<sup>1</sup>.

As we all know, a person cannot be in front of a PC or laptop at all times for 24/7. This may cause problems to company's success and benefits as it cannot get notifications in time regarding the changes or stages of a project. This type of situation is faced in every working environment and especially in an education

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<sup>1</sup> The Autobiography of Benjamin Franklin

environment such as a University. In universities, the professors and all other staff members have the necessity to be in synchrony with the updates occurring in the information system and also need to update or read information from the system at any time, which as can be deducted brings the necessity for other members to be instantly notified regarding these changes or updates. This is valid not only for staff but for students as well, whom use the university's information system to make their course selection, see the curriculum, see the transcript of grades and also check for their exam grades. In order to increase the student – professor interaction, but also to increase the students or professors individual awareness regarding updates don in the university's system, it is necessary to have a system which will instantly notify the students for any change that is done in their grades, curriculum, course selection etc., and will also notify the professors for any kind of update done to the system by them or by other members of staff.

However, as mentioned even above, it is not possible for a person to be in front of a computer at all time and perform these updates as well as it is not possible for the others to stay in front of the computer to get these updates. This brings the need for a mobile application to support these duties and facilitate university's information system tasks and at the same time establish a real-time notification environment between university's members. An increase in members awareness will consequently result in an increase in university's efficiency.

The main problem with mobile environments, which can be easily noticed by everyone, stays in the fact that there exist restrictions and limitations in mobile devices which cannot be surpassed and no matter of the improvements done, are

bound to Physics laws. For example, it is impossible to have a large database information within a mobile device even though this device might be the newest technology brand and its features might be extraordinary. This brings the need to create a distributed software system by the help of which the users' data might be elsewhere and yet again the user will be able to create, read, update or delete it at any time and in any place by the help of the application found in his/her device. This would bring as a result an increase in overall university's system efficiency.

## **CHAPTER 2**

### **LITERATURE REVIEW**

As mentioned even above, technology is evolving with each passing day and its impact on our lives increases exponentially. An important section of technology is also the mobile area, which with our will or not, has entered in our lives and has become an inseparable part of our daily routines. Since it is an expanding field, mobile technology has attracted a lot of persons to delve into its unexplored areas and bring out solutions which help the users to get their jobs done better or even for the simple amusement of the user. This chapter provides an overview of key concepts found in the field of mobile educational information applications as well as the effect of mobile applications in the efficiency of a person's work.

#### **2.1 Information Technology Impact**

Starting from the very beginning, we as human beings have relied our trust on machines to handle our daily jobs and solve our problems. People have invented tools for almost everything; tools to work the soil, tools, for playing, travelling and even fighting. All of these tools enter in the set of technologies which have come to light as a result of the human desire for learning, seeking, improving himself and benefiting from any resource surrounding them. Information and Communication Technologies, ICT in short, enter in the set of tools whose success has been exponentially increasing and their effects, too. ICTs' have become an important asset in the path of success for any company or organization [1]. Nowadays, the

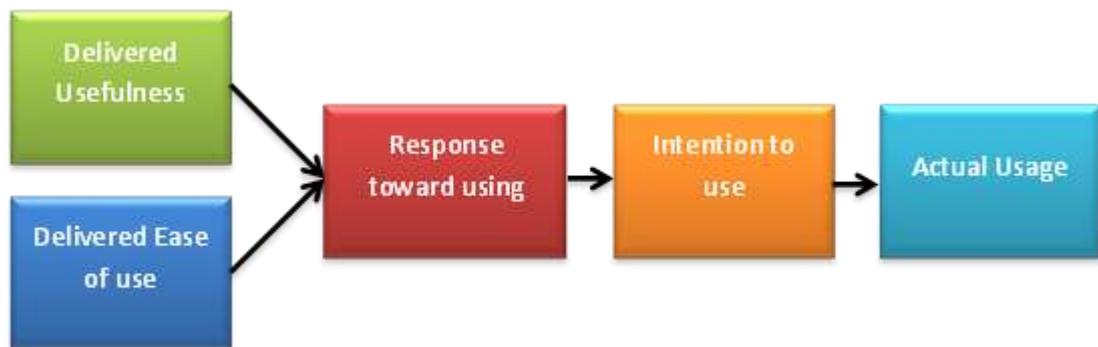
success or failure of a company is strongly bonded with the way how it uses ICT to manage its information or tasks [2]. Persons have understood the importance of ICT in their lives and each day persons and organizations are struggling to get information and communication technologies even in villages in order to establish communication between them and provide information to everyone [3]. From this it may be concluded that human society will improve itself by usage of information and communication technologies and extend its limits of knowledge further more [4]. Well, all of these improvements and benefits cannot pop out of nothing. Development and deployment of an Information System (IS) needs careful design and a lot of job needs to be done in order to deliver to the end-user a successful product. In order to achieve this, several models and methods have been developed throughout the years and the coming sections some of these methods will be investigated in order to observe their benefits and at the same time to choose the right one to solve the problem that this thesis presents.

### **2.1.1 An overview on different ICT models**

In the field of information Systems, a person cannot just specify or follow a single path for solving a certain problem or issue. As in math, also in this field understanding the problem requirements helps in defining the correct path to follow in order to succeed [5] [6]. The researchers in the field of IS agree that there are three factors affecting an Information Systems' success. They are task, technology and user behaviour [6]. These may be considered as the key-factors for a successful system implementation. Information Systems are becoming omnipresent in every corner of business, corporation and even in health sectors [7]. Having ICT enter in crucial aspects of human life such as those related to health, brings high

responsibilities for the ones designing and deploying those systems and at the same time strengthens the importance of the three factors mentioned above. In order to assure the success of an Information System, several models have been built and improved throughout years such as Technology Acceptance Model (TAM), Task-Technology Fit (TTF), Resistance Model and plenty of other software engineering methods [5] [8] [9].

Technology Acceptance Model is uniquely designed to explain and structure the user acceptance of IT. As shown also in Figure 1 below, TAM brings us three main results: Firstly, the usage of computer is strongly related to a person purposes. At the same time, the ease of use and usefulness that an information system transmits and delivers to the user are the two other important factors affecting whether a user will accept a system or not [5].

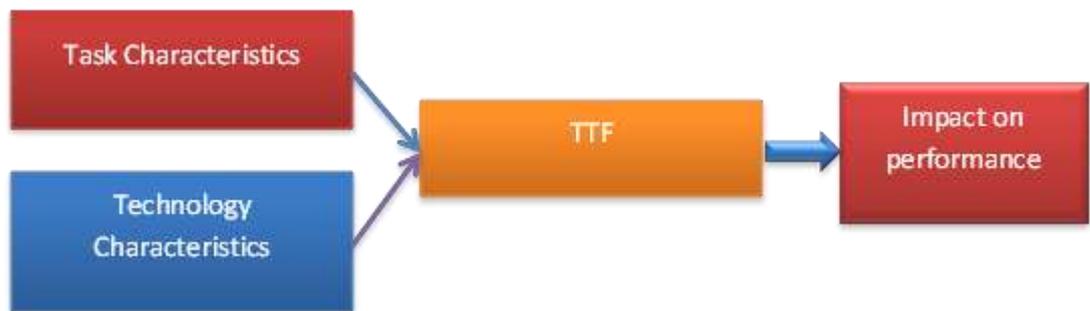


**Figure 1 - TAM Schema**

A good example that shows the importance that TAM gives to the user and the user response toward the application is also mentioned in the “*iOS Human Interface Guidelines*” where experts from the Apple company say that the response of the user toward an application is of vital importance for the success of that application.

Essential importance is given to user experience and every part of the application is structured by having UI as its top priority [10]. Also, an important point that needs to be mentioned here is the fact that users are more likely to use the system if they feel that they are in control, and that the system responds to their actions and is not acting on its own [11].

On the other side, Task – Technology Fit (TTF), as its name implies, it is based on the relation between task and the technology needed to respond appropriately to that task [12]. If a proper match is done between characteristics of the task needed to be performed and the technology characteristics necessary to solve it (Figure 2), the result will be a positive impact on the overall system performance [5] [6].



**Figure 2 - Task Technology Fit model**

The third, but in my opinion the most successful way of designing and implementing a good information system is by using software engineering methods. By carefully specifying the requirements of a project, which is a crucial point in software engineering, we can rest assured that we have done a good step ahead in the path of structuring a high quality system [13] [8] [9]. Defining the functional and non-functional requirements of the system properly and then following any of the above models or other software engineering models such as V-model or waterfall model, will enable us to correctly meet the three factors for a successful system which were, as mentioned previously in this section task, technology and user behaviour [8]. Keeping them in mind and working accordingly, we would be able to deliver a system which will properly respond to users' needs and demands and at the same time facilitate their jobs.

In this section, we had a look at these models and options for developing a system for the pure reason of using the possibilities that they provide, in order to give a proper solution to the problem that this thesis discusses. In the coming section the focus will be on seeing the influence that ICT has in nowadays education system and the opportunities it provides to the students but also to the entire academic and administrative staff of a school or university.

### **2.1.2 ICT and Education**

As mentioned even in the previous sections, nowadays, the influence of ICT in human life is enormous and present everywhere. ICTs have important roles in the success of a business, hospital, personal workplace, and even for entertainment

reasons [2]. As it can be deduced easily, even the area of education has been affected by the power and possibilities that the information and communication technologies provide. ICTs contribute in a constructive learning and also increase the activity of the students [14]. By making use of the facilities the ICT provides, students can get access to the extensive amount of information available on the Internet, find additional information related to their courses or assignments or even follow online courses provided by some of the top universities in world. Beside this a lot of platforms have been built for the students and also for their professors. Most of these platforms are web based thanks to the possibilities that the web provides for better interaction and facilities. Web based platforms enable the students to get information regarding their grades, courses, attendance and more and also make it easy for the professors to update and maintain these tons of data getting rid of the old-fashioned grade books [15]. Most of these tools are web based and little work has been done to provide their mobile version leaving in dark all the potential that mobile technology provides, and the aim of this thesis is to give a solution to this problem. Information and communication technologies enable an increase of the performance and efficiency of the education system and using the words of Mrs. Fisseha Mikre in her paper saying: *“If schools train children in yesterday’s skills and technologies they may not be effective and fit in tomorrow’s world [16]”*, the importance of ICT in education is more than obvious.

## **2.2 Mobile Technology Effect in Nowadays Life**

The previous section provided us with an overview of the work done in the field of ICT and also the influence that ICT has in the success or failure of an organization.

Also, it was shown the effect and importance that has a proper ICT implementation in the education system, ending up in the conclusion that information and communication technologies are a key point in the education of the minds of tomorrow.

In this section, the focus will be on mobile technologies, the branch of ICT whose expansion nowadays is exponential. A comparison between mobile devices and PCs is going to be done and also the advantages and disadvantages between mobile web apps and native apps are going to be revealed. After that, the challenges faced while developing a native app will be explained and finally there will be provided a look on the work done so far in integrating mobile technology in the educational system.

In the “*Oxford Advanced Learners Dictionary*”, the word mobile is defined as something that can easily and quickly be moved from place to place<sup>2</sup> and that’s the root of mobile technology success. The fact that mobile technology permits the users to move freely and still be in touch with their work without having the necessity to be in front of a PC in their workplace gives it a major advantage compared to static workplaces such as personal computers [17]. Also, this is noticed by the PC sales which are declining compared to mobile devices [18]. Mobile devices with the capabilities they have, the apps they provide, and possibilities that they give to the users are now a threat to the PC legacy [19].

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<sup>2</sup> Oxford Advanced Learners Dictionary

Well not only PC usage is threatened by the mobile technology but also the web accessibility from a desktop device. As we all know, unlimited resources of information are there on the web and we are all using the web to get in touch with our beloved ones, or talk with friends, listen to music and even get information regarding our assignments or buy something online. All of this activities have the necessity of a computer with Internet connection, but even this now belongs to the past. Nowadays the majority of these activities are done through mobile devices such as tablets or smartphones as they are accessible at any time and everywhere [20]. For example, there is an increasing number of mobile applications that enable mobile payment which also enable the customers to look for their desired items and make purchases using their tablets or smartphones even though they might be at a coffee bar or at their homes [21]. Also, nowadays mobile applications for event promotion, concert ticketing, games, GPS location and more are spreading through app markets and their download number is only rising and smartphones are becoming omnipresent everywhere [22].

Up to this point, we have seen that mobile technology is the one becoming more and more popular nowadays. The biggest advantage of mobile devices and applications that come with those devices relays in the fact that mobile technology makes the services accessible to the user at any time and any place in the moment they request for them [17] [23]. So far we have seen that mobile devices have a noticeable advantage toward PCs for accessing the Internet or other tasks. Now we should have a look also inside mobile devices and find out which is better web view in mobile browsers or native apps.

### **2.2.1 Mobile Web app vs. Native app**

With native app, it is understood the applications that come with the mobile device or are built in language such as Java, C# or Objective C which perform specific tasks and are capable to use resources of the device such as camera or keyboard whereas mobile web app are called all of the web applications whose structure has been formatted in order to match smartphones and other mobile devices [24]. Mobile web apps are accessed by making use of the devices browser whereas native apps are installed in the device and can be accessed by a simple click.

The main advantage that mobile web apps have toward native ones stays in the fact that mobile web apps have the possibility to run in any platform whereas native apps should be uniquely and carefully designed and implemented depending on the type of device [25]. The disadvantages of mobile web app are many; mobile browsers are limited compared to their elders, PC browsers and mobile web apps require active Internet connection in order to work properly [24].

Native apps from the other side are more attractive and since they are designed for the device specifically, they can make use of the device capabilities easily. Also, native apps provide a rich user experience, can be run offline and can easily re-sync back in the moment that a connection is available [24] [26]. From a security point of view, native apps provide better security than mobile web apps due to the fact that they do not need to stay connected to the network all of the time [25]. Native apps can come preinstalled with the device or can be downloaded from mobile app stored

in the Internet. Here, we should point out that there is an increasing number of app stores in the Web where users can look up for their favourite apps [19].

### **2.2.2 Challenges in Native app development**

As mentioned even above, mobile devices enable their users not to stay connected behind their desk all day [17]. This is the major advantage that mobile devices have toward desktop. Developing native apps for a mobile device is a challenge for every developer. Most of the persons have a misunderstanding regarding this topic. They think that developing mobile apps is pretty much the same as developing traditional apps but when working on a mobile app a lot of things should be taken into consideration such as device type, operating system (OS), display size, capabilities and more [20]. Also, the developer should take into consideration whether the app will be stand-alone or it will run on a remote server and only the results will be provided to the user [19]. Native apps should be designed such that their usage is easy understandable for the user and response is fast and smoothly presented [10].

Seen from another point of view, native apps, especially those that have to do with crucial user information such as their bank credentials should make security of data as their top priority. Developer should consider the algorithms to use for data encryption always by keeping in mind the devices computational power and capacities or should also consider keeping critical information on remote servers and call them only if and when necessary [27]. From these it can be deducted that developing a native mobile application should be a carefully designed process where each step plays an important role in the success or failure of the entire application.

### **2.2.3 Mobile Technology usage in Education**

Mobile devices and apps are becoming omnipresent in our lives every day and sometimes it seems as we cannot live without them [19]. Seeing the impact that these technologies provide, a lot of work has been done to integrate them also in education environments starting from schools up the higher levels of education, in universities. The possibility of accessing information everywhere and at any time is intriguing and fascinating for everyone which will lead to changes in the way how and where education is provided [23]. Since the majority of students own his/her mobile device, this makes it a must for the university to provide them with data accessible via mobile devices and most of top universities in the world nowadays have their mobile version of their websites available for their students [28]. This would enable for the students, information regarding university and lots of other information such as course information or exam timetable and more. Concluding this section, it can be said that mobile technologies effect positively the education and further improvements and work done in this area would improve the education as a whole and especially university education.

### **2.3 Choosing the adequate technology**

In the development of a proper application, where this application might designed for desktop, web or even mobile, the selection of the proper technology is one of the most important steps. In this section we will have a look and reveal the reasons why some technologies are chosen above the others in order to work on the mobile

application for the university's information system which will facilitate the job of students and also members of staff.

### **2.3.1 Why Android?**

Android is an open source mobile operating system provided by Google [29]. One of the main reason for choosing Android above the other OS, is right in the first sentence; open source, meaning that the developer can view and modify the systems source code based on his/her needs. Also, Android is nowadays entering in every device having more than 1(one) million new Android devices activated each day worldwide [30]. The fact that Android uses Java framework for the development of Android apps makes Android a must while developing apps that have also to do with security like students or staffs username and password in the university's information system. An Android developer may make use of Android SSL in order to secure its data over the network. Secure Socket Layer makes it possible to crypt information so that it can be securely transferred over the network [31]. From the other side, Java is one of the most popular and important programming languages whose object-oriented programming methodology enables more security better programming of the application. At the same time, Google enables the developers to publish their apps online without having the necessity to take any permission as you should do while you develop for other platforms.

Seen from a business perspective, Android is the most popular OS in America, owning 43% of the market [32], which is also a good indicator why to select Android above others for the development of this thesis project.

Throughout this literature review the importance that proper ICT implementation has in the success or failure of a corporation was brought into focus. At the same time, we noticed that the field of education has also been deeply improved by the use of information and communication technologies. After doing so, the focus was turned to a fast growing area of ICT, the mobile technology. Here we saw, that mobile technology is doing giant steps and the facilities it provide to the users are simply amazing, enabling them to perform their activities and even work without having the necessity to stick behind a computer. Mobile technology enabled the developers to prepare different types of applications and we compared two of those types: native and mobile web apps, showing the advantages and disadvantages of each of them and also proving why a native app development is chosen to solve the problem that this thesis lies. Finally, the literature review is concluded by showing the reasons why Android is superior for the development of a system for the students and staffs of university.

## **CHAPTER 3**

### **SOFTWARE ANALYSIS AND DESIGN**

In the previous chapters, the need that university's staff and students have for real-time information was brought into attention. Both sides, student or staff, have the necessity to be informed in real-time regarding to the updated done in the University's Information System, and since nobody is able to be in front of a PC or laptop 24/7, a solution which brings into scene the mobile applications was introduced. Creating a mobile application which will facilitate the job in University's Information System and notify in real-time the university's members for the changes done to the system may result in an increase in university's performance and efficiency. This will also bring an increase in university's credibility since the requests will be performed faster and this will result in an increase of the members satisfaction. In order to bring up such kind of system for a university, in our case for Epoka University, and develop a mobile application which will perform these tasks, a careful analysis and design is necessary together with the correct and efficient use of different technologies.

#### **3.1 Functional Requirements**

Defining functional requirements during the analysis phase of the project enables us to identify what kind of services should be provided by the system, what kind of inputs are expected and their output [9]. By doing so, it is possible for us to provide to the audience enough information for them to approve the project and also support it [6]. The functional requirements for the university's information system mobile application are as follows:

### **3.1.1 Usability Requirements**

The Epoka University's Mobile Information System will be a mobile application which will be downloaded and installed in the persons personal smartphone, so that the person can access content related to university in general and him/her in person.

The application will be easy to install and use. Since it is going to be built in Android the users will be able to immediately download it from the Google Play or the .apk file will be installed to their smartphones by the systems administrator. The application will be easy to use and maintain. When the user opens the application a logo of the Epoka University will be shown first, and then a menu will be provided to the user. There will be menus which will be distinguished by one another by understandable icons, based on the fact that human brain it works better in recognizing the images rather than remembering names. The first menu will give information regarding courses, faculties, timetable, university fees, university's latest news and also a menu which will redirect the user to system login.

If any menu contains any submenu they will be listed in another window, without removing the users possibility to go back to the main menus. For example, if the user clicks on Admissions, he/she will be presented with another window where he/she can get information regarding scholarships, loans, application forms etc. The transitions will be done smoothly without delaying the user. If any menu, or task needs more time than predicted to load, the user shall be notified with an alert window. The user will get notification alerts for his/her actions, increasing so his/her awareness towards the system.

If the user selects the login option, he/she will be redirected to login window, where the user can enter his/her credentials, which will be his/her Epoka webmail username, and his/her predefined password. Members of Epoka University who have the application installed into their smartphones will have the possibility to login into system from the same login window, and then the system will automatically recognize them based on their category, and provide the response window based on their privileges, so students will have student information system content whereas staff members will have staff information system content. If any incorrect login occurs, the user will be notified by an alert window, and if several attempts are tried, the system in that specific device will be locked for a certain amount of time. The user will be able to leave their sessions open in the application and continue to use their smartphones for other purposes, even though a session timeout will be activated if the user has not performed anything in the system for a certain amount of time. Also, in cases when the user wants to send a message from the application, a default message shall be provided to the user, which he/she can use or modify.

If any change is done to the system, the user who is related to that change will be instantly notified. For example, if a professor enters a student's midterm grade, that specific student will automatically be notified by the system.

### **3.1.2 Performance Requirements**

In order to provide the highest speed possible, the applications requests to the server will be as less as possible. The response coming from the server will come in the

JSON format which can be fast and efficiently parsed. The application will be reliable by preserving the user's personal information from others access and also automatically logout if the user is not performing anything on it. Since in mobile applications, there exist limitations if large amounts of data are requested from the server, this will be provided to the user in parts by performing smaller requests in different time intervals.

### **3.1.3 Supportability Requirements**

The application is intended to be user friendly, and the menus used to be intuitive, in order to avoid the necessity of special training for the users. If any upgrade will be done to the application, the user will be notified by the application itself for the upgrade and anything necessary regarding that upgrade. Complete application and system documentation will be in the hands of the system administrator.

### **3.1.4 Security Requirements**

The users will be able to log in to the system only if the correct username and password is provided. The users will be able to change their login credentials if they want to. They will not be able to access areas of the application for which they have no privileges. Instead a notification alert shall be displayed to them and then they will be redirected to the previous menu. According to the login credentials the necessary user information and windows will be created by the system automatically. Automatic logout will happen if the user leaves or forgets his/her session open and no activity is performed for a certain amount of time.

### **3.1.5 Interface Requirements**

User will be provided with intuitive menus to navigate throughout the system. If the user is logged in to the system, data shall be provided according to his/her privileges. Notification windows, or alert windows will be given after any action performed by the user, where he/she makes some change in his/her data or tries to perform something outside his/her credentials. Menus will be allocated compliant to the smartphone window. In case of any loading delay in information retrieval the user will be notified by a loading window. The application will automatically call features of the smartphone such as keyboard in cases when they are required to satisfy a user's need. The application will always require users permissions to access data stored in users smartphone, such as his/her phone-number etc. The transitions from one action to another, such as passing from one window to the other will be as smooth as possible, facilitating the user and not lowering his/her desire to use the system.

### **3.2 Non – Functional Requirements**

Non – functional requirements differently from functional requirements are characteristics of the systems which actually do not do anything on the system, but they are important to show to audience like the project manager, client/user or any stakeholder the quality of the system, that's why sometimes non – functional requirements are also known as “Quality of Service” [8].

### **3.2.1 Hardware Requirements**

A Linux based server is necessary for the proper work of this project. The server will contain the database with the necessary data that need to be accessed by the mobile application starting from the general information regarding the university, to user's personal information. A smartphone which is Android based is also necessary in this project in order to perform the application testing before unleashing it to users. Testing on emulator is quite efficient but emulators are very slow and yet again a real device is necessary to see how the application really responds to real-life environment.

### **3.2.2 Software Requirements**

Eclipse IDE which has installed the Android SDK in order to develop Android Applications. Adobe Dreamweaver or Notepad++ in order to work with the PHP programming part of the project together with the MySQL as well. Android SDK Tools installed on PC or laptop in order to get the latest Android versions and also to create Android device emulators according to the needs. Detailed information regarding to the coding languages or technologies is provided in the coming chapter Implementation.

### **3.2.3 Supportability Requirements**

Naming of the applications menus and interfaces will be such that decreases the user's effort to understand it. Regarding to coding standards each function should be

called in such a way that can provide brief information about its task, also each function should be well documented. In the top of each function, there should be comments specifying the function name, characteristics, what it does, and what type of parameters it takes. Classes and functions descriptions should be well documented inside the specific files, and also in an external PDF file which will be kept by the system administrator. If upgrades are available for the application, the end-user should be automatically notified for the upgrade by the application and should be asked whether or not he/she wants to integrate that update into the application lying on his/her device.

#### **3.2.4 Security Requirements**

The user's credentials such as its login password will be stored in an special encrypted format by an algorithm defined by the system administrator.

#### **3.2.5 Availability Requirements**

The system and application should be able to respond to user's request 24/7. If any maintenance operation is performed on the system the user should be notified prior to that by Notification Alerts given by the mobile application automatically.

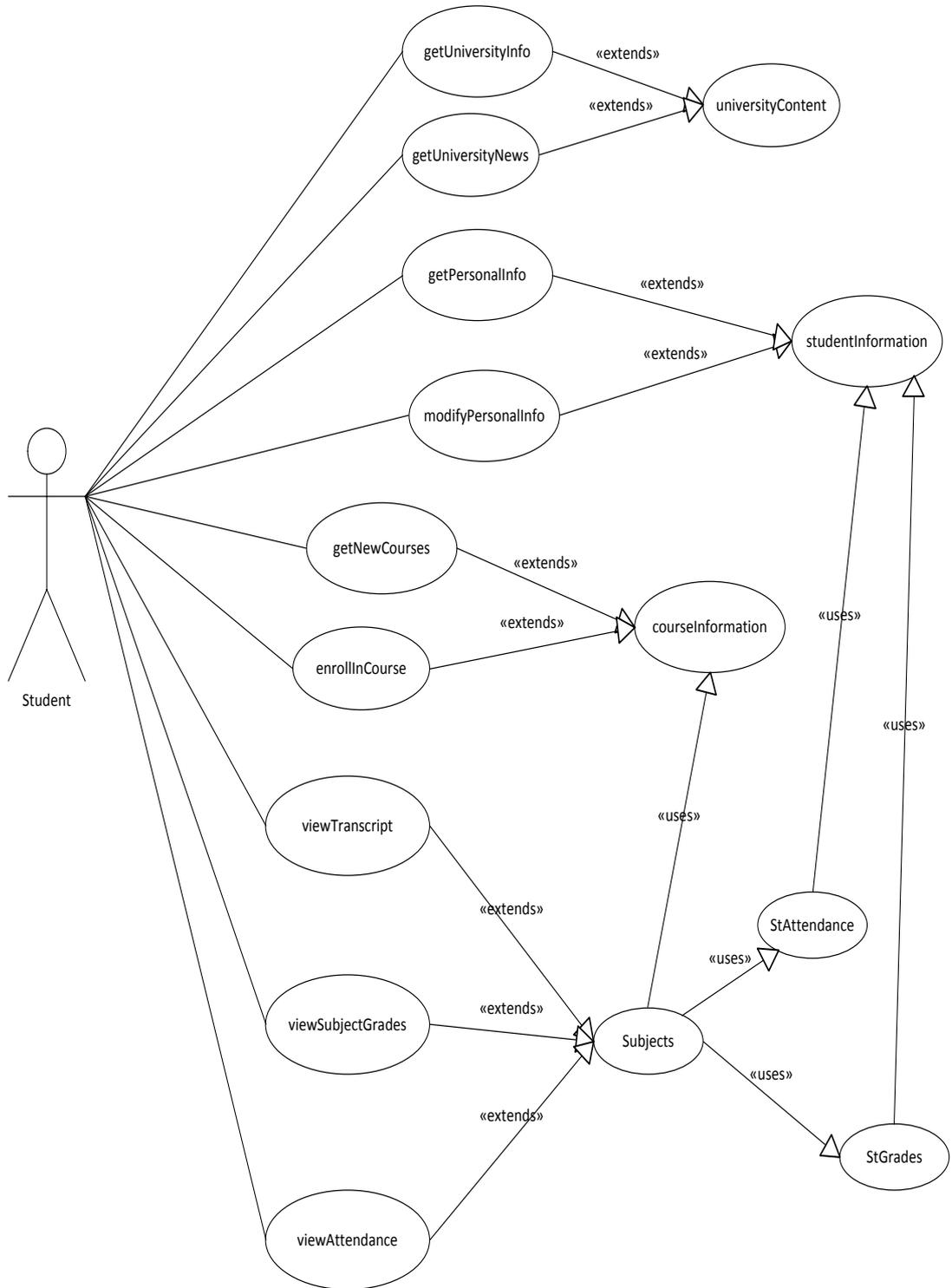
#### **3.2.6 Compliance Requirements**

The application interface should be compliant to any device running on Android. At the same time, it should be easy adaptable even for old Android versions.

### **3.3 Users Profile**

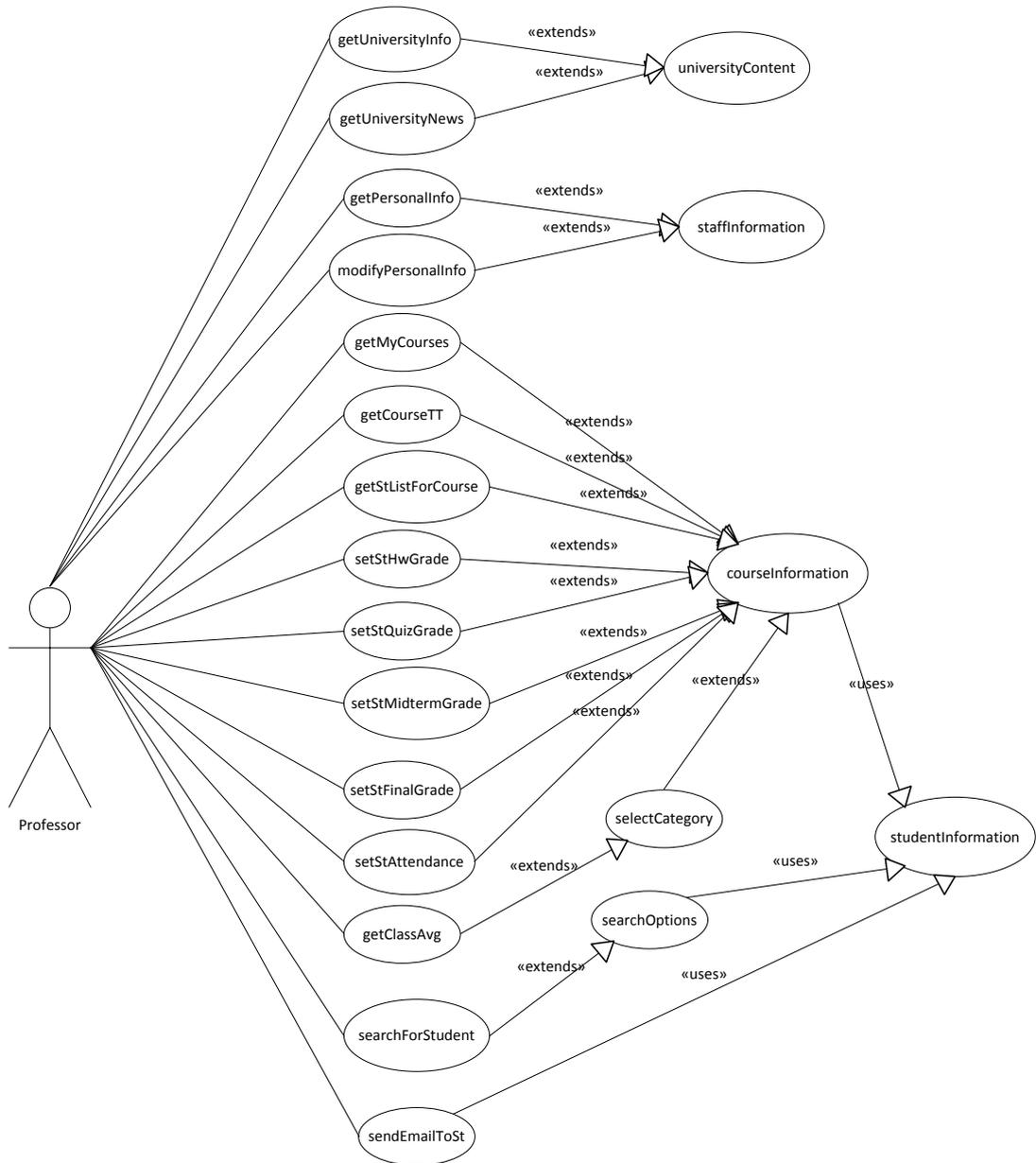
This section will be dedicated to two of the main actors of the application; the professor and the student. The use case diagrams related to these two actors are going to be explained together with the functionalities that each of them will have respectively. The rest of diagrams related to other users such as IT personnel or registrars' office personnel, head of department and system administrator are going to be attached under Appendix 1.

Student (Figure 3) is one of the main actors who will be using this application and together with the professors usage, the overall university's information system usage will be increased. In an online information system, the most important parts for a student are his/her course registration, transcript and his/her grades, so having the application in his/her smartphone, the student will be able to get real-time notification for his/her grades, immediately in the moment that the course professor has done any kind of update in his/her grades. Also, the student will be able to perform his/her course registration, view his/her transcript, update his/her personal information and at the same time be able to instantly send a message to the any of the professors in whose courses he/she is enrolled. The student will not be able to perform any change into his/her grades or see any of his/her classmates or other students information. Not, only for students but for all of the members who will be using the application, the application will respond to them according to the privileges assigned to them, and if any inappropriate attempt will be done, the system administrator will automatically be notified by systems automatically generated messages that systems or applications reliability is being threatened.



**Figure 3 - Student Use Case Diagram**

The next main user is the professor (Figure 4). Professor is an member of the Academic Staff of the University, so together with the common features which are going to be provided to all users, such as viewing general information regarding Epoka University, reading the latest news feeds from the university, getting information for studies provided at University etc., having the application installed in his/her smartphone, the professor will have the capability to view information regarding his/her courses, like student list for a specific course, ability to view student information, enter grades for a specific student, search for a student in several ways (i.e. by name, or surname, or year, or course), have the possibility to automatically send message or e-mail to students of e specific course, update his/her CV, update his/her personal information etc.



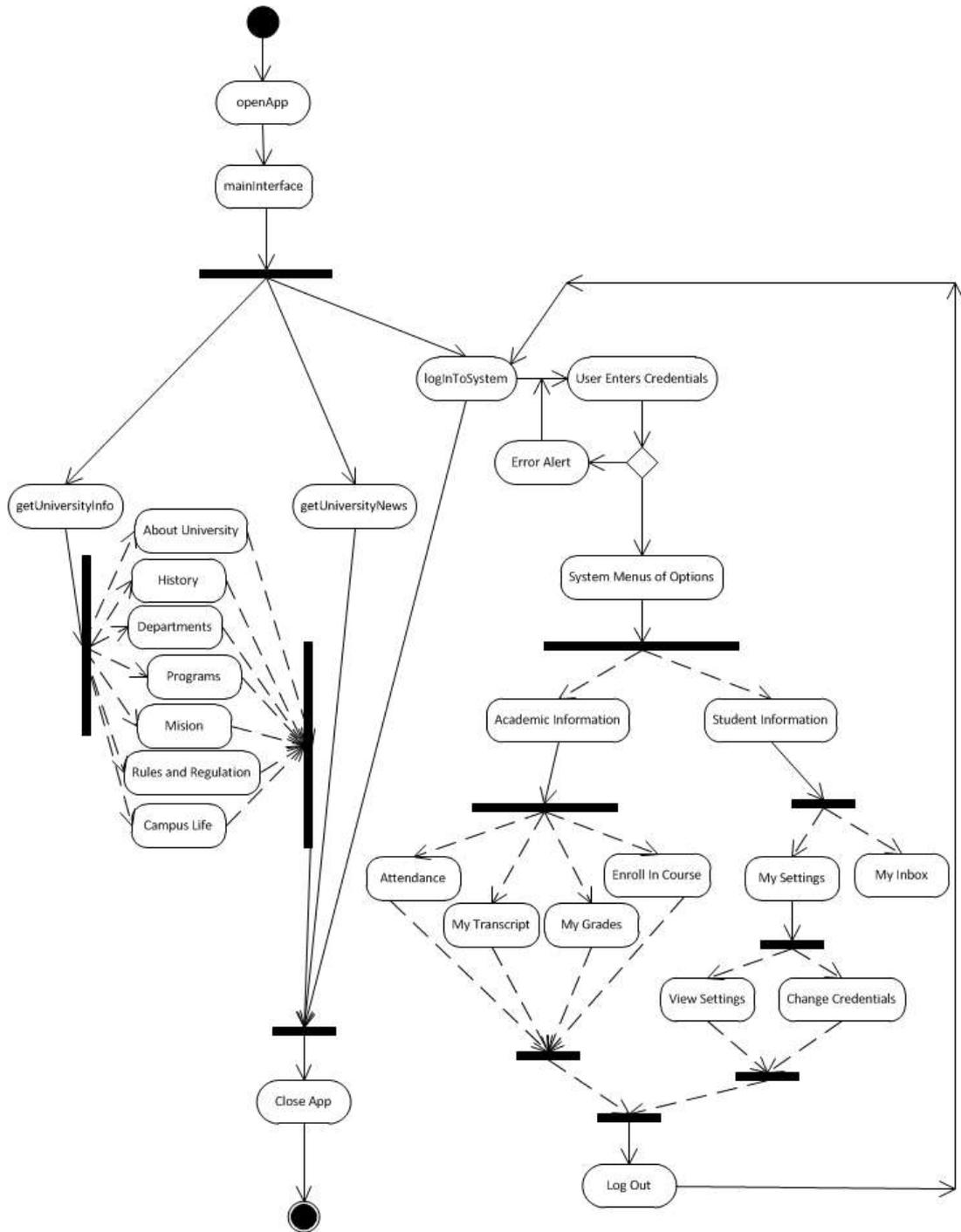
**Figure 4 - Professor Use Case Diagram**

### 3.4 System Design

In order to bring out a good application and especially a successful one, it is necessary to give importance to details. This section will focus on some of the main

software engineering diagrams of the mobile system. The rest of the diagrams will be available at the Appendix A section.

Activity diagram shown in Figure 5 below provides the main activities that students are expected to perform while using the application. As mentioned even earlier, users will be provided with a native Android application, meaning that they will have to install the software in their smartphones in order to benefit from its' features. The student is one of the main actors expected to use the application. As shown also in the activity diagram below, the student will be able to get information regarding the university, such as information about university, departments, programs provided etc. Also, they will be able to get the latest news that have taken place in Epoka University. This kind of facilities will be provided to other users as well. The most important part of the application is the section where they can login into the system. The student will have to enter his/her credentials first, such as his student id and password. As soon as, he/she logs in, a menu interface will be shown to him, giving to the student the opportunity to modify his/her student information such as change his/her password or other settings, or check for new incoming notifications. In the menu related to academic life, the student will be able to get information regarding to his/her attendance into courses, view transcript, see his/her grades and even enrol into the new courses. At the end, the student will have to log out the system, or after a certain amount of time, his/her session will automatically expire.



**Figure 5 - Student Activity Diagram**

In the Figure 6 below, a state machine diagram is shown, which as its name also implies will provide to us, different states under which the machine undergoes while performing the user requests. Again the condition when the student is interacting

with the system is taken into consideration. This is done, in order to have a flow of explanation from one diagram to the other and in the end if the diagrams explain clearly what one of the users is expected to do with the system, than it will be very easy for everyone to understand the rest of the diagrams placed in the Appendix section.

So, the system is firstly in the idle state. Then when the student wants to login into the system, it passes into the ready state, in order to respond to user request. After that, credentials are processed. If they are not valid, an error alert is shown to the user and he/she is again redirected in the login window. If the credentials are valid, the student interface is provided, where the student has several menus to choose from. If the student wants to change his password, he enters in the personal information section, where he selects the change password menu. After changing the password, the information is processed and the database is updated. If there is an error, or the update takes longer than predicted the user is notified and redirected again to the personal information window otherwise if the update is successful, the student is redirected to the student interface where he/she can proceed to the other menus or log out the system. From the other side, beside the personal information section, the students are mostly interested about their academic information such as their grades, attendance or transcript. So, if the student enters in the academics interface as shown also in the diagram below, he will be provided with several possibilities. If he/she desires to see the transcript, the student selects the view transcript menu. His request is processed further on by the system, which will return information in the JSON format. Later on this information is processed and the results are returned to the student unless the processing takes longer than predicted and a timeout occurs. From the academics window the student can also select to see





other classes. Together with each class, there are given the attributes and methods that it will have and also the interactions and dependencies that each class has. For example lets, take into consideration the Professor class. As it can be noticed in the figure it has two attributes, the pId which is the person id and the pCourseId which is the id of the courses that professor teaches. This class has a one to one connection with the user class, since after credentials validation, if the user is a professor only the Professor class will be called and not the other classes, such as Student or IT\_Personnel class. Professor class will provide the logged in professor the possibilities to get his/her courses, get the students participating in a course, or set grades of students and many other methods. The professor class is depended from the StaffInformation class based on the fact that the professor is a member of the staff. Also the professor class has a relation with the CourseInformation since professors are the ones teaching the courses. StaffInformation class from the other side has a one to many relation with the Department class based on the logic that one department can have one or more professors, and the department class itself has a one to many relationship with the Faculty class based on the same logic that one faculty can have one or more departments. Also, in the diagram there are shown other classes and relations that are aimed to be created in order to make the system fully functional.

In Figure 8 below, there is provided an object diagram where the classes attributes are filled with values like for example the DBConn class has taken as values for its attributes: localhost, root, root, for the serverName, suserName and spassword attributes respectively. Such a diagram enables the reader to have an overview of how the system is going to work in real-time environment and how the objects are going to interact with one another.

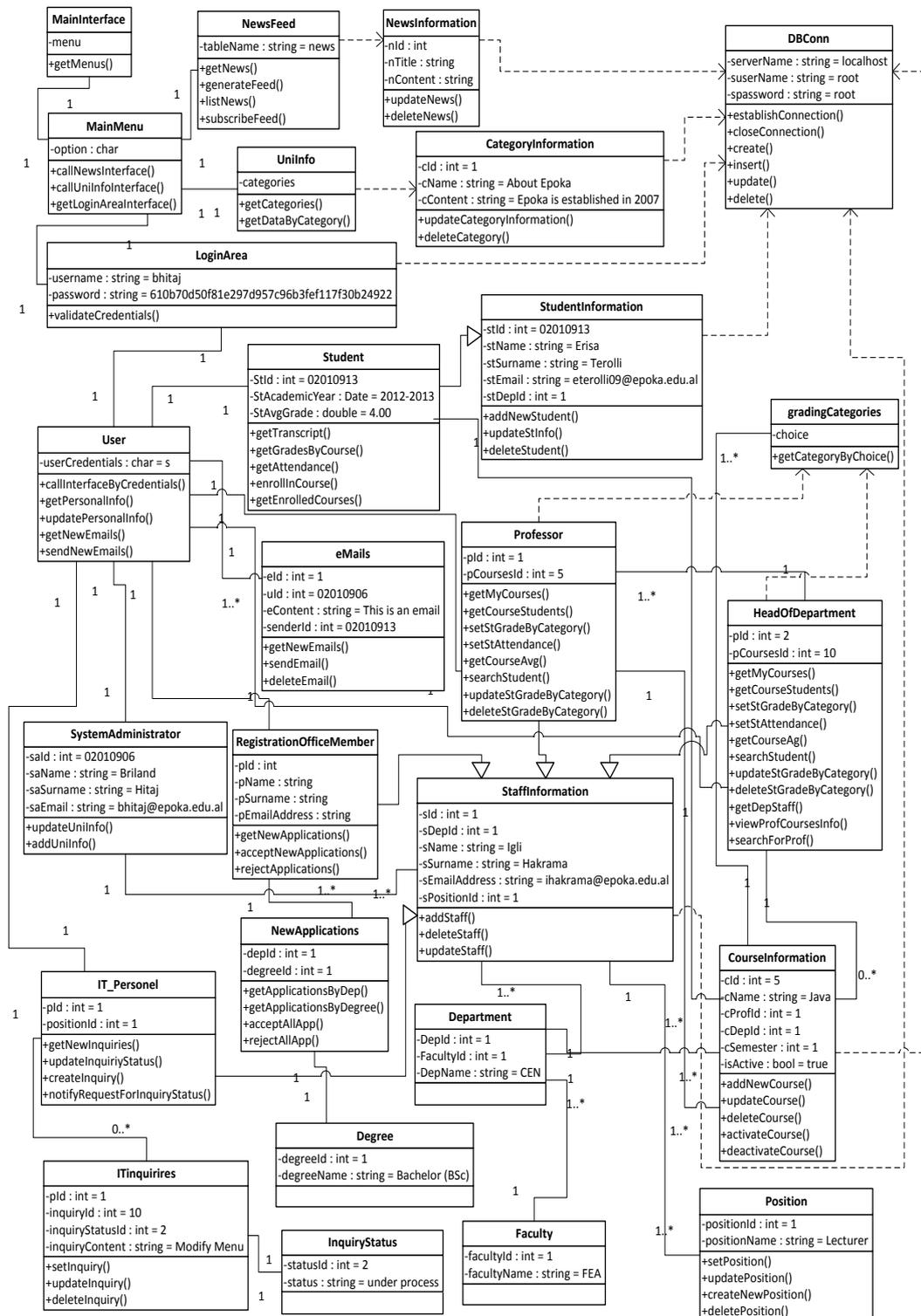
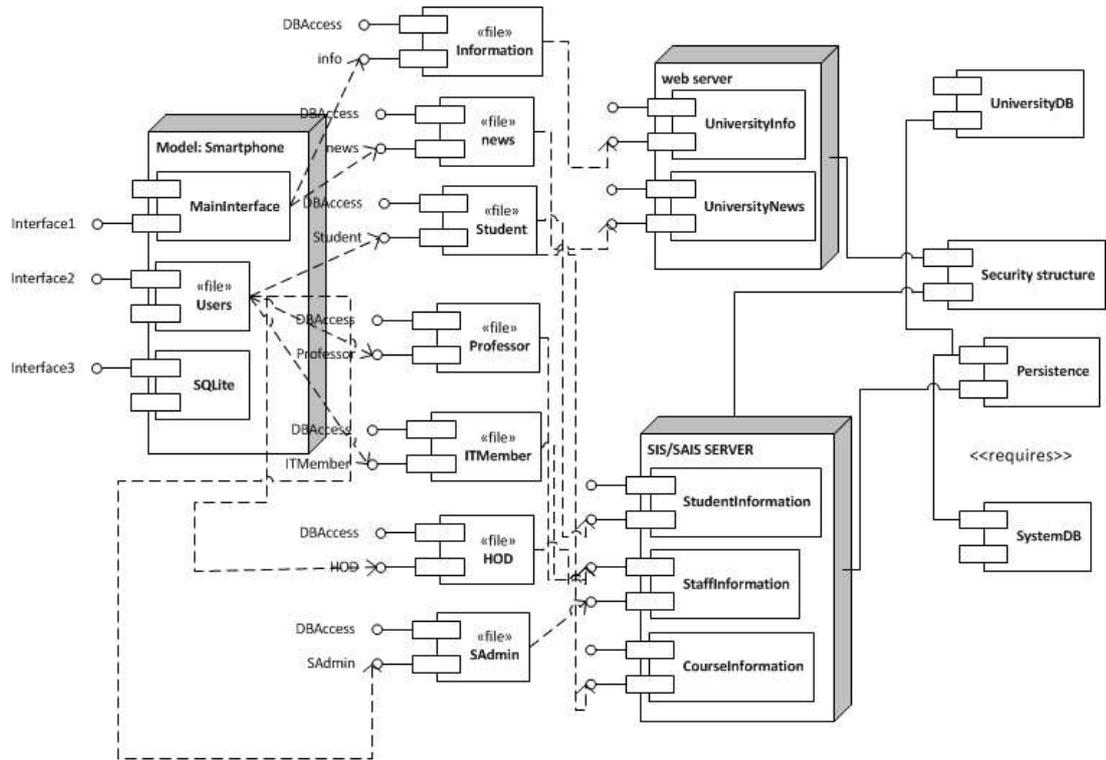
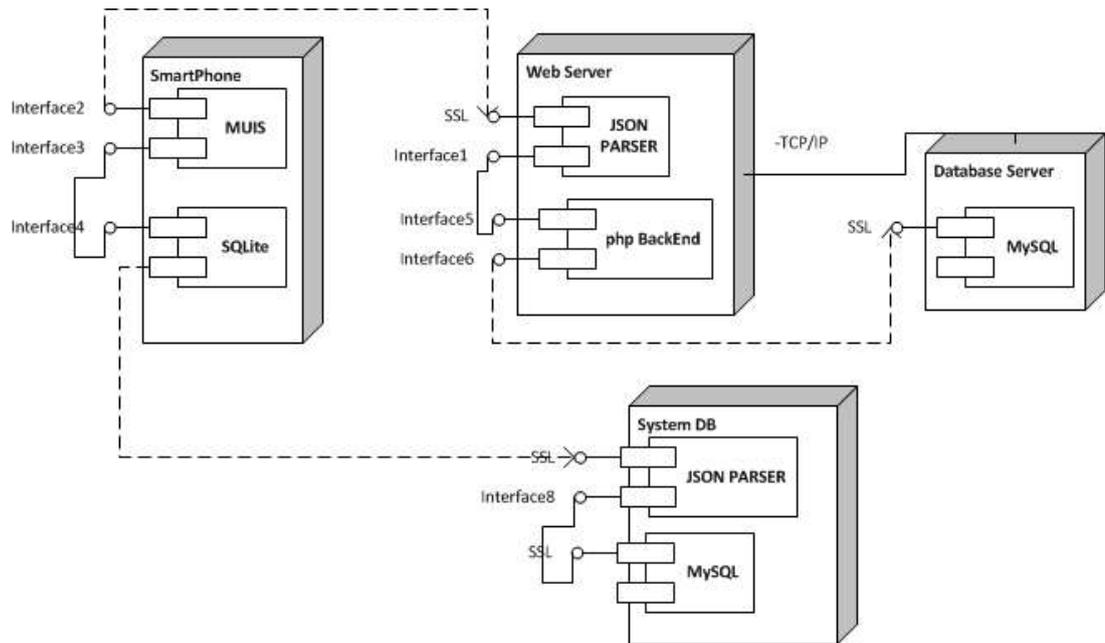


Figure 8 - General View of the Systems' Object Diagram



**Figure 9 - General Overview of the Systems' Component Diagram**

In Figure 9 it is shown a general overview of the component diagram of the system we are going to implement. Component diagrams are very helpful in aiding to build high level software systems. In the diagram above are shown the components needed and also the interfaces on each component necessary to make the application work properly. For example, the smartphone needs three interfaces, the main interface which will contain the applications menus, users which will select interfaces according to user credentials and SQLite which will be used as local database to save important information on the smartphone for faster and more efficient retrieval of information. The other components are the web server and the student/staff server which will contain information for university and staff/student respectively. In the backend there are the interfaces necessary to provide the parsing of information, security and persistence.



**Figure 10 - Deployment Diagram**

Last but not least, there is the deployment diagram which gives an overview of the architecture of the system and the way how the software components are related with each part of the system [9]. In Figure 10, it is shown the deployment diagram of the mobile university system that we intend to implement. So, as mentioned even above, will consist of the smartphone device, the web server, university database server and student/staff information container database. The smartphone will be the device containing the application, so as it can be deduced, it will consist of the application and its interfaces and also of the SQLite mobile local database. The university's web server will contain the PHP backend support and the JSON parser, so that information like university's news, retrieved from the database will be parsed and processed faster. The system DB will contain the MySQL databases and also the JSON parser in order to parse the student or staff requested information.

## **CHAPTER 4 IMPLEMENTATION**

Nowadays, we are part of a world where even the milliseconds can make the difference between being successful and failing. The desire for more is rooted deep in the human soul, and the desire for more speed and access at any time and any place grows with each new development in the field of technology. In order to solve the issue presented in this thesis and increase the university's efficiency it is important to select the adequate technologies to integrate. These technologies must fit with each other and fulfil the needs of the other pieces of code so that the implementation process may be considered successful. This chapter will provide information regarding the technologies and methods followed during the implementation phase of the mobile application for the university information system.

### **4.1 Technologies**

As mentioned even above, technologies play an important role in the development of a system. If they are chosen properly and adequately, the odds of bringing up a successful project are high. In order to give life to the mobile application for the university IS, it is necessary to use technologies and programming languages such as Android, Java, XML, JSON, SQLite, PHP, MySQL and last but not least a hosting server.

As shown in the second chapter of Literature Review, Android was shown to be the best choice for the development of such an application as it has been built on Java

Framework and being open source provides to the developers full control to structure it in the way it suits them best [30]. For the project, MySQL databases are used, based on the fact that they are widely spread and they are quite powerful databases which combined with the functionalities that PHP provides to the programmer makes it very easy to use and very flexible to work with. Android makes it possible to structure its layouts by making use of XML (Extensible Markup Language). XML can also be used for data-interchange thanks to its flexibility, but JSON seemed the best solution to be used for data-interchange, since it is very lightweight, a property this which makes JSON very easy to parse and generate. Research done in this area, comparing JSON and XML as data interchange formats, has come to the conclusion that JSON is faster than XML[34]. As mentioned earlier, while working on mobile environments, we have physical limitation, meaning that we need to optimize our code as much as possible. A small delay in response would have a negative reflect on end-users, effecting their desire to use the application.

Each of these technologies has its' own positive sides, but using them separated from one another, would bring no benefit and no result. In Albania there exists an old saying; "Union makes power", so it was crucial making these technologies work together. In the coming sections, there will be given information regarding the way how these technologies are combined together, bits of code and at the same time screenshots from the running mobile university information system application.

## 4.2 Database Structuring

Databases are the core of nowadays systems. Data and information, which are the most important part of the application for the end-user, are stored there. Based on this, database structuring is a task which should be done carefully and in a detailed manner. If not done so, the entire system performance and usability will be greatly affected, resulting in unsatisfied end-users.

As mentioned several times, throughout these pages, even though mobile devices are very handy, they have physical limitations, making it impractical storing huge amounts of information in the device especially when we are talking about large information databases like the ones used to store the university data.

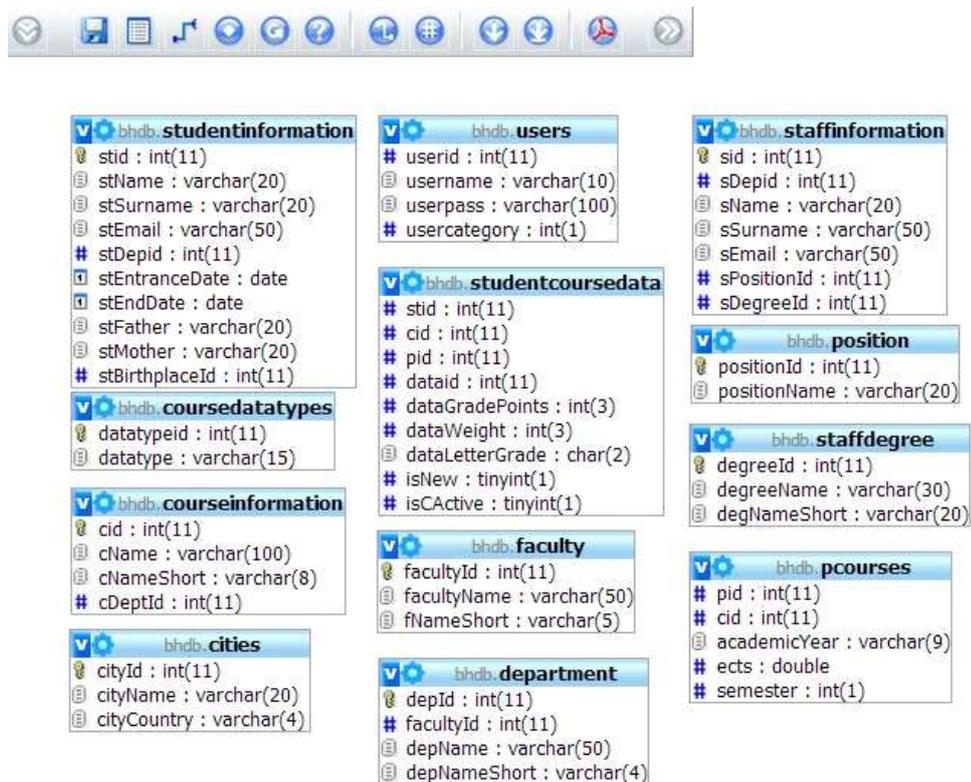


Figure 11 - Overview of the database structure

In Figure 11 there are shown the top most important tables of the application. Tables ‘studentinformation’ and ‘staffinformation’ will have information related to the students and staff respectively. For example the ‘studentinformation’ table will have information such as student id, name, surname, email, the id of the department he/she is part of, the entrance date to the university etc. Field ‘stBirthplaceId’ is the id of the city where the students comes from. This id is stored in the ‘cities’ table, for optimization purposes and also making possible not to have duplicates for the same city name due to mistyping or different languages that might be used by the persons entering information. Table ‘department’ is related to table ‘faculty’, in order to know the faculty that a department is part of, whereas ‘depId’ is the key which is visible in student table and also in the staff and course table, showing the department that the student, staff or course belong to. Tables ‘position’ and ‘staffdegree’ are built in order to provide and store necessary information for the staff of university, respectively revealing the position that a certain staff member is currently holding in the university and also his/her degree, whereas he is a BSc, MSc, PHD and so on (Figure 12).

	sid	sDepid	sName	sSurname	sEmail	sPositionId	sDegreeId
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	1	1	Elton	Domnori	edomnori@epoka.edu.al	1	6
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	2	1	Igli	Hakrama	ihakrama@epoka.edu.al	1	5

	degreeId	degreeName	degNameShort
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	1	Bachelor of Science	BSc
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	2	Bachelor of Arts	BA
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	3	Master of Science	MSc
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	4	Master of Arts	MA
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	5	PhD Candidate	PhD Candidate
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	6	PhD	PhD
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	7	Doctor	Dr
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	8	Post-Doctorate	Post-Doctorate

	positionId	positionName
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	1	Lecturer
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	2	Head of Department
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	3	IT Specialist
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	4	Human Resources
<input type="checkbox"/> Edit <input type="checkbox"/> Copy <input type="checkbox"/> Delete	5	Economist

Figure 12 - staffinformation, staffdegree, position tables

The above figure gives an overview of how these tables are related. So in the first table if we take into consideration the information provided for Igli Hakrama, we learn that he is part of the department with id = 1 and looking at the 'sPositionId' and 'sDegreeId' fields we see that he has the position with id = 1 which corresponds to Lecturer position in the 'position' table and his degree is the one found in the 'staffdegree' table with id = 5 corresponding to PhD Candidate, so in case of searching information regarding to Igli Hakrama, we can easily find out that he is a PhD Candidate that holds the position of a lecturer in the university.

Same kind of logic is followed in relating other tables with one another like for example relating the 'courseinformation' table with 'studentcoursedata' table.

Least but not last, we would want to keep the staff section of the application separated from the student section so that when a student logs in, his/her student side will be provided and when the professor does the same thing, the professor section will be provided. In order to tackle this issue, there was the need to design the 'users' table which would contain the login credentials for the users and at the same time their category. The solution that came into my mind was a logical one. The table 'users' would have the field 'userid' which would correspond to the id of the user in their respective tables 'staffinformation' or 'studentinformation', and in order to differentiate between them, there was the need for 'usercategory' field, which will have only two possible values. If 1 (one) means that the user is a staff member, else if 0 (zero), the user is a student (Figure 13).



userid	username	userpass	usercategory
1	bhitaj	f317494edcc93d5cdcflee24ef2ea05403f5eba6	0

**Figure 13 - users table**

### 4.2.1 Query Optimization

Beside designing and structuring the database properly, it is important to be careful also with the use of queries. From my experience, I have learned that even the order of placing the AND conditions in the WHERE statement of a query may deeply effect your programs' performance. It is important to write down such queries that bring the necessary results at the shortest time possible and with the minimal cost. For this reason, several times during the work, I made use of the keyword EXPLAIN or EXPLAIN EXTENDED. These two provide information related to the way how the MySQL executes a statement. After that, it is possible to find the leaks in the query and search for a better way to approach that query.

For example if we have a query like: "SELECT `cid`, `cName` FROM `courseinformation` WHERE `cid` IN (SELECT `cid` FROM `studentcoursedata` WHERE `stid` = 1)", where we want to get all course ids' and course names for the courses taken from student with `stid` = 1. `courseinformation` table contains all the data related to the courses (Figure 11), but it does not have any field `stid`, based on the fact that a single course may be taken from more than one student. For this reason the student course information is stored in a another table, `studentcoursedata`. As it can also be seen, this query also contains a sub-query, meaning that the WHERE condition of the parent is related to the result coming

from the sub-query. If we add the EXPLAIN EXTENDED keywords to the above query we get the result as shown in Figure 14 below.

id	select_type	table	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	courseinformation	ALL	NULL	NULL	NULL	NULL	42	100.00	Using where
2	DEPENDENT SUBQUERY	studentcoursedata	ALL	NULL	NULL	NULL	NULL	9	100.00	Using where

**Figure 14 – Output of EXPLAIN EXTENDED**

From the output above, the query writer can easily see that `courseinformation` is the main table to look into whereas the `studentcoursedata` is the dependent sub-query, meaning that the main query is dependent on the result of the sub-query. In the table can also be seen that the query has filtered the information at 100% and in both of these queries WHERE statements were used.

#### **4.2.2 Applications' Local Database**

In order to prevent requesting data always from the main database, the main information necessary for the application is gathered at login and stored in local SQLite database. SQLite are databases which are used to store data in mobile devices. They don't use complex relational schema like MySQL, but are similar to files where you can write and then execute queries to get information from them. Being that SQLite databases are local in the device, storing user's crucial information in local database during login, will make it possible for the user to get data faster. Also, another feature implemented in the mobile application is the one, I prefer to call, the offline login. So, in case the user does not have network

availability, at the moment when he/she tries to log in and his/her data were stored previously in the SQLite database, then this user has the possibility to login into the system and check specific information.

### **4.3 Server side programming**

From the server point of view, as mentioned in the technology section, every task in the server will be done by the PHP. In order to make the optimize the job and make the project adequate, object oriented PHP programming is used. The key class, is the DBConn class, which will enable the user to perform all of the necessary operations with the database, such as establishing connection, querying from the database, and closing the connection. In order to query the database, I decided that it was better to ease the job by making the PHP create the queries itself based on the parameters passed to the modules. So, functions like insertInformation or getInformation based on the parameters they get they construct the necessary query themselves, making it easy to work with the application and retrieve the desired results easier.

```
/**
 * @param: $query -> query written manually from the user
 */
public function userDefinedSelectQuery($query)
{
    $this->_query = filter_var($query, FILTER_SANITIZE_STRING);
    $res = $this->executeQuery();
    $this->_checkExecutionSuccess($res);
    $results = $this->_getQueryResults($res);
    return $results;
}
/** END OF FUNCTION ***/

public function getInformation($tableName, $limit = NULL)
{
    $this->_query = "SELECT * FROM {$tableName}";
    $this->_constructQuery($limit);
    $res = $this->executeQuery();
    $this->_checkExecutionSuccess($res);
    $results = $this->_getQueryResults($res);
    return $results;
}
/** END OF FUNCTION ***/
```

**Figure 15 - userDefinedSelectQuery and getInformation Functions**

Figure 15 shows two of the functions of DBConn class. Both of them are written to execute SELECT queries. getInformation() function takes as parameter the table name where it is going to query and a limit and the rest of the select statement is generated by the module itself, by calling out other functions like \_constructQuery() to do the job. As it may be noticed the getInformation() functions generates a SELECT query which selects all of the fields from the specified table, but there are cases when the user wants to state the fields specifically in order not to get redundant data. This brought the need to write down a second function which will take a manually written query as its parameter, execute it and finally return the result. For this reason userDefinedSelectQuery() was created.

Another important class is the class UserData which extends the class DBConn. As it can easily be deduced from the name, this class will enable us to get the necessary information related to the user. For example the function getUser will be called when user tries to log in and will look in the database whether the user with the provided credentials exists or not (Figure 16).

```
private function encryptPassword($password)
{
    return sha1("6x!7z".md5($password)."H!t@j");
}
/** END OF FUNCTION ***/

/**
 * @param: $username
 * @param: $password
 */
public function getUser($username, $password)
{
    $encryptedPass = $this->encryptPassword($password);
    $uNamePass = array('username' => $username, 'userpass' => $encryptedPass);
    parent::whereCondition($uNamePass, "AND");
    $result = parent::getInformation('users', 1);
    return $result;
}
/** END OF FUNCTION ***/
```

**Figure 16 - Functions encryptPassword() & getUser() of the UserData Class**

These classes together with the modules that they will be used when different requests are done from the application. Also, in case of a request the response is given in JSON format which is generated using PHP as well and later on will be parsed by the Android application using JSON parsers (Figure 17).

```
{ "category": "0", "sid": "1", "stcourses": [ { "courseid": "39", "cName": "Advanced Object Oriented Programming", "course": [ { "did": "1", "dtype": "Final", "points": "95", "weight": "60", "letter": "AA" }, { "did": "2", "dtype": "Midterm", "points": "85", "weight": "50", "letter": "BA" } ] }, { "courseid": "40", "cName": "Senior Design Project (thesis)", "course": [ { "did": "3", "dtype": "Project", "points": "100", "weight": "20", "letter": "AA" } ] }, { "courseid": "41", "cName": "Programming Languages 2", "course": [ { "did": "2", "dtype": "Midterm", "points": "100", "weight": "50", "letter": "AA" } ] } ] }
```

**Figure 17 - Courses information of student with id = 1**

Above in Figure 17, is JSON response of a request coming from the application requesting the course information of student whose id is 1(one). As it can be also noticed, the JSON contains all of the courses taken from that student and for each course provides the grade information. This JSON is parsed from the mobile application and the result is displayed to the user as in Figure 18 below.



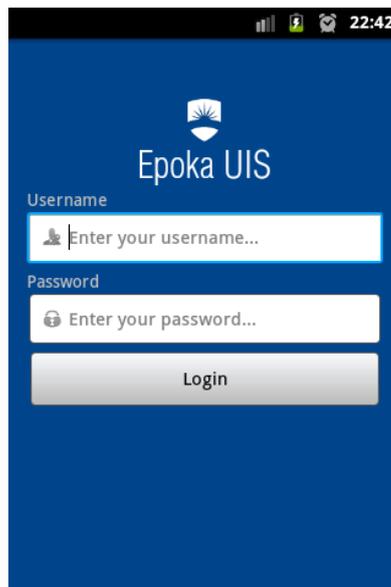
**Figure 18 - Student Course Information**

#### 4.4 Android Mobile Application

Mobile application is the top of hierarchy, is the place where all the results of combinations of the above technologies are presented to the user by the help of

Android application. As student and professors are the two main actors expected to use the application, the part of the application related to them has taken priority before the parts related to other actors like registration office staff or student affairs office staff.

The application provides the same login area to all of the users (Figure 19), but based on users category the application differentiates itself whether the user is a student or a professor and provides the respective areas to the users.



**Figure 19 - Login Interface**

#### **4.4.1 Student part of the application**

As mentioned even before student and professors are the two main actors of this mobile application. If the bond between the student and professors strengthens, so it will be the university's efficiency. Student is the actor who mostly uses the information system to see his/her course grades, attendance or see the transcript,

which as it can be translated into database language, it means a lot of SELECT statements. At the moment the user logs in (Figure 19) and he/she is authenticated as a student, his/her personal information is stored in the SQLite database and a view of tabs is provided to him/her. Also, if there are any new grades entered in the system for that student, then notification messages alert the student for new grades in the system. The student can see his/her university profile, or in the course tab check the new grades or attendance for each course, or he/she can see the transcript and have a look at his/her performance.

Android, especially the latest versions of it do not allow to perform request that can increase the load of the main thread. For this reason, in order to get data from the server, it was necessary to use the AsyncTask class of Android. This class enables the program to execute a request in background and after the request terminates, the response is loaded into the view for the user. For example in order to get the course information of a student, is necessary to send a request to the server, which by use of PHP will generate a response in the JSON format. By using the doInBackground() method of AsyncTask, we may send the request, get the response and at the same time parse the JSON without effecting the main thread or overloading the application.

#### **4.4.2 Professor part of the application**

Professors from the other side have more possibilities and options than students. Also here, AsyncTask class is used for loading data in background. Professor interface has also a sliding menu, in which there are listed all of the courses that are

currently being taught by that professor, together with other settings regarding his/her profile or system. At the moment the professor selects one of the courses, the list of students taking that course is provided to him/her. After that the professor has the possibility to filter the list to find out the student he/she is looking for, and by clicking on the students name, a list of options is provided. In the list there are provided the possibility for the professor to enter the students course grades by picking a grade category i.e. midterm, final, project etc., view the student profile, update the student attendance and even send mail to the student.

#### **4.5 Applications performance**

How application acts under certain conditions, how it responds to the users and what kind of resources is it affecting while running are of vital importance if we want to have an effective system. Of course, the real test for the application will be when test in real-life environment, meaning being tested in an university environment where professors post the grades or other information and the students get that information in real-time but that doesn't mean that the system should not be checked earlier. There is an idiom saying "Better to prevent an illness than to get sick". In our case, it is better to check the system earlier before giving it to the users and face their negative response.

Android provides very handy tools to enable the developer perform different checks on the application. One of those tools is also TraceView, which enables the developer to debug the application and later on provide a graphical view of the results. This enables the developer to check the application performance, find the

leaking spots and improve his/her code. Below in Figure 20 is the TraceView applied to the scenario when the a student logs in and goes to the courses tab to get his course information.

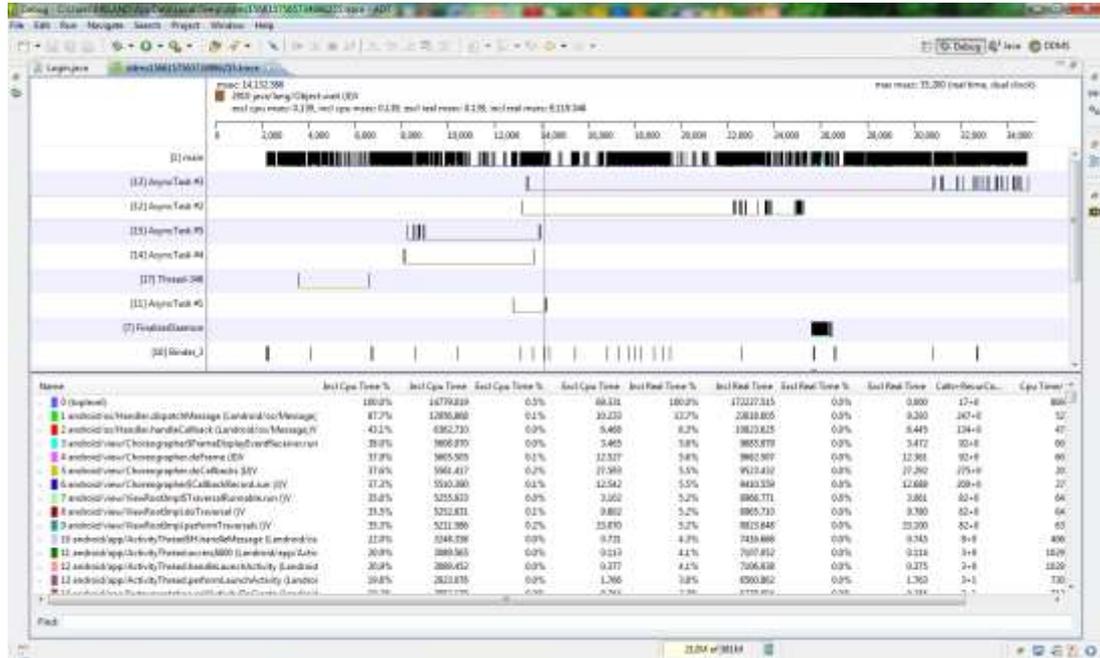
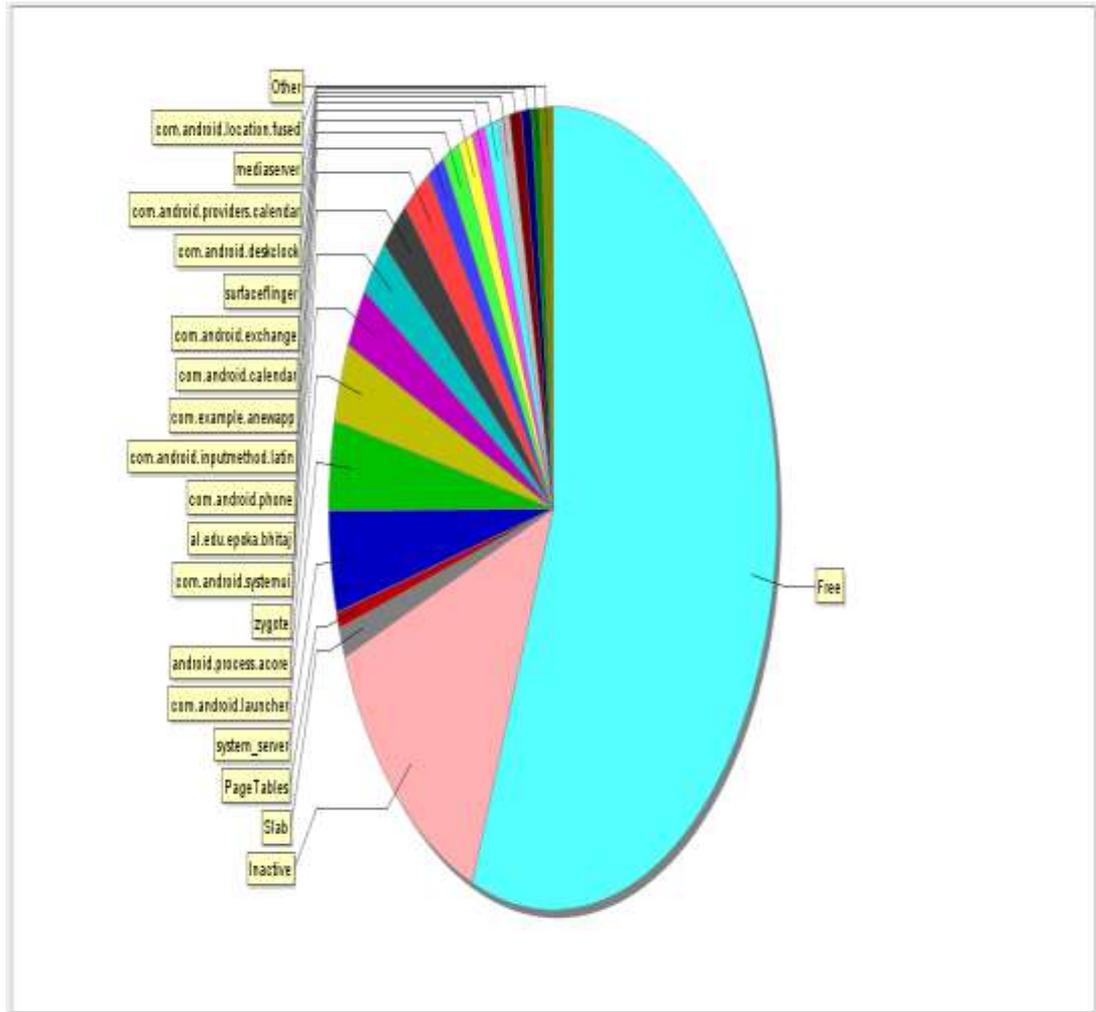


Figure 20 - Epoka UIS TraceView Results

Also, in Figure 21 there is shown the memory usage of the device. You can spot that the mobile information system, the dark grey color which is connected with al.edu.epoka.bhitaj takes only 11% of the memory while running.



**Figure 21 - Epoka UIS Memory Usage**

While working on this project, the aim was to make the application flexible, user-friendly and as optimized as possible, in order to satisfy the user requirements by providing an app which is handy and they would willingly use it at any time and any place. Hopefully this will lead to a win-win situation, where the users will be satisfied, and at the same time the university efficiency and performance shall be increased.

## **CHAPTER 5 CONCLUSIONS AND FUTURE WORK**

Nowadays, in the fast lane of technology, starting from individuals to large scale companies, there exists a need for fast, real-time systems to perform the tasks and notify the users regarding the results. Computers are the selection of choice nowadays for performing most of the hard labour, and doing all of the tasks which previously were done by men. But even though computers are extremely fast, companies need to get real-time notifications about any change done to the system and they need to access that data anywhere and in anytime. This makes mobile applications a necessity for the companies nowadays.

In a university information system, such kind of mobile application will reduce the efforts of the staff and students and at the same time increase the efficiency of the system. Epoka University has extensively integrated its information system into daily operations. Each member of the personnel performs specific tasks in the system and also students get information regarding to their courses schedules, registration, or grades by this system, but unfortunately, it is not possible for any person to be in front of the computer 24/7 and as a result no update notification are retrieved on time. A mobile application which will have the information systems capabilities and more is the most opportune solution to this problem. Having the application on the smartphone, each person can log in with his/her credentials to the system and perform updates which will be then distributed automatically to the persons related to that specific change.

At the same time the mobile application will ease the user interaction with the system by the help of notification windows or notification bars.

In order for the system to be complete, it has to be completed in such a way that all the member can have the application corresponding to their needs and requests. So, as soon as possible the parts of the application related to other members such as registration office personnel or IT personnel should be completed.

After doing the above, two features are top priority to be added to the application, which are believed to increase its functionality and effectiveness. The first one will be, adding the capability which is known as “side-by-side” installation, in which when the user downloads the application for the first time, in order to be lightweight, it will be separated into packages. In the moment that the user will try to login into the system, based into his/her privileges the specific package will be downloaded and immediately installed into the device as part of the application as a whole.

The second feature, will be adding the GCM feature or as it is known the Google Cloud Messaging feature, a possibility this which enables the developers to send data from servers to the Android application even though the application might not be running. This data can be a lightweight message notifying application that it needs to fetch data from the server up to other more complicated tasks [33]. This kind of feature, we believe will increase the applications efficiency and performance since it will be possible for us as system administrators to send upgrade packages at any time to our application, but also we can tune the GCM feature so that the application, which has full control on message handling, to receive even faster

messages regarding to updates done to the data in the system by other users, and notify at any time the user for these changes, providing that the application is set up with the proper broadcast receiver and permissions.

These are only two of many features that can be added to the application. Also, as the users' awareness towards the system will increase also their demand for more specific features and faster functions will increase, which will push me to develop the application further more.

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## APPENDIX A DIAGRAMS

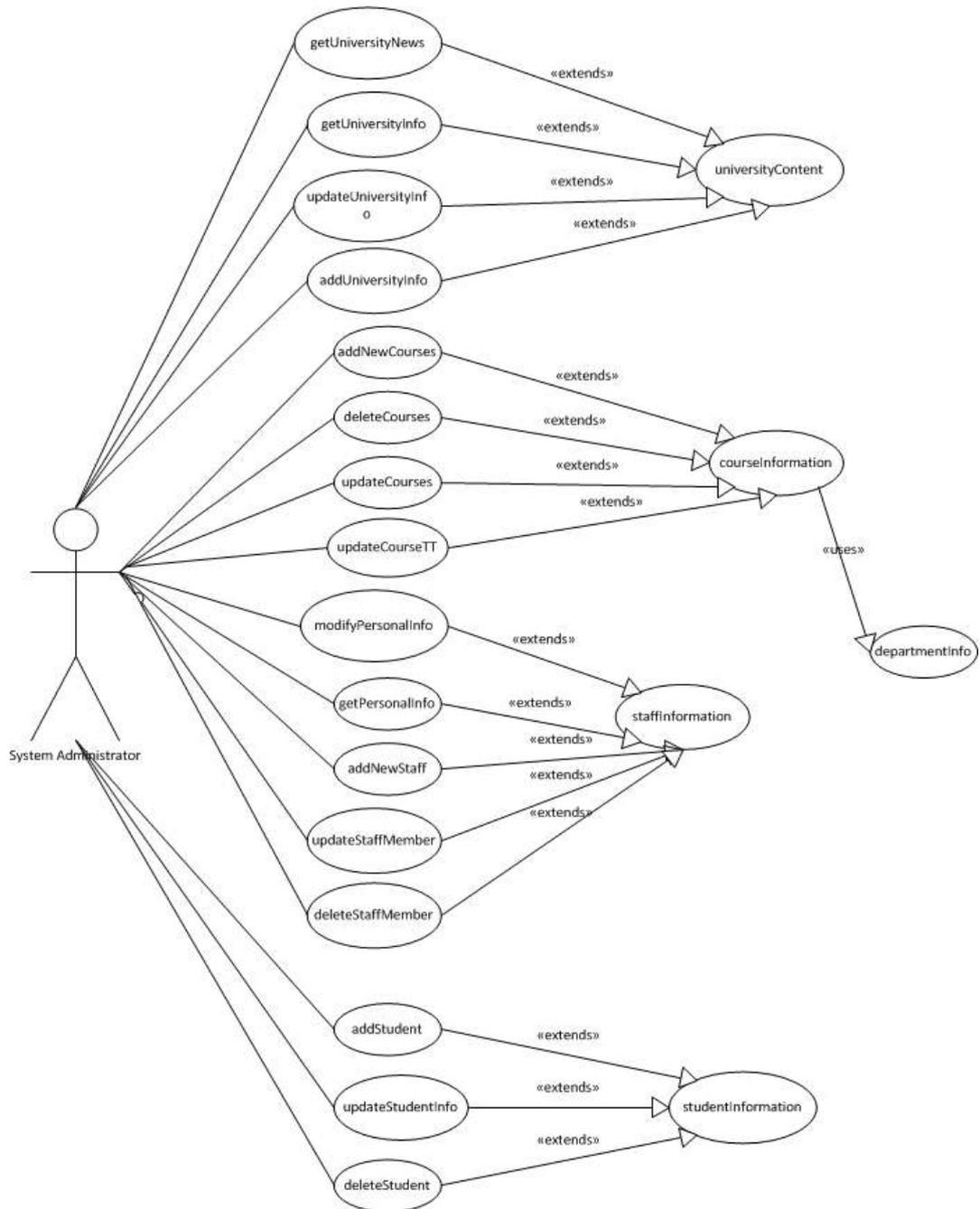
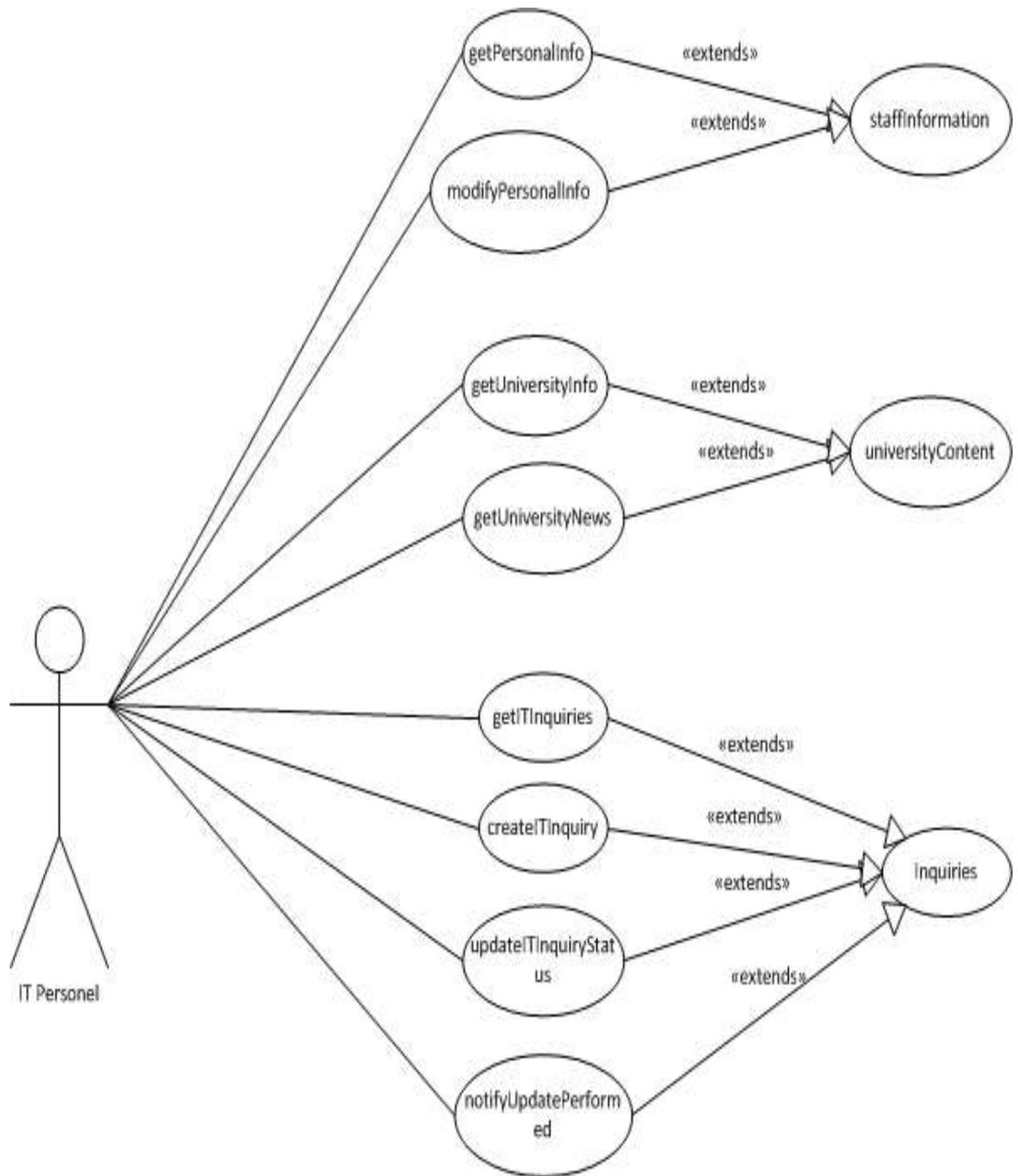


Figure 22 - System Administrator Use Case Diagram



**Figure 23 - IT Personnel Use Case Diagram**

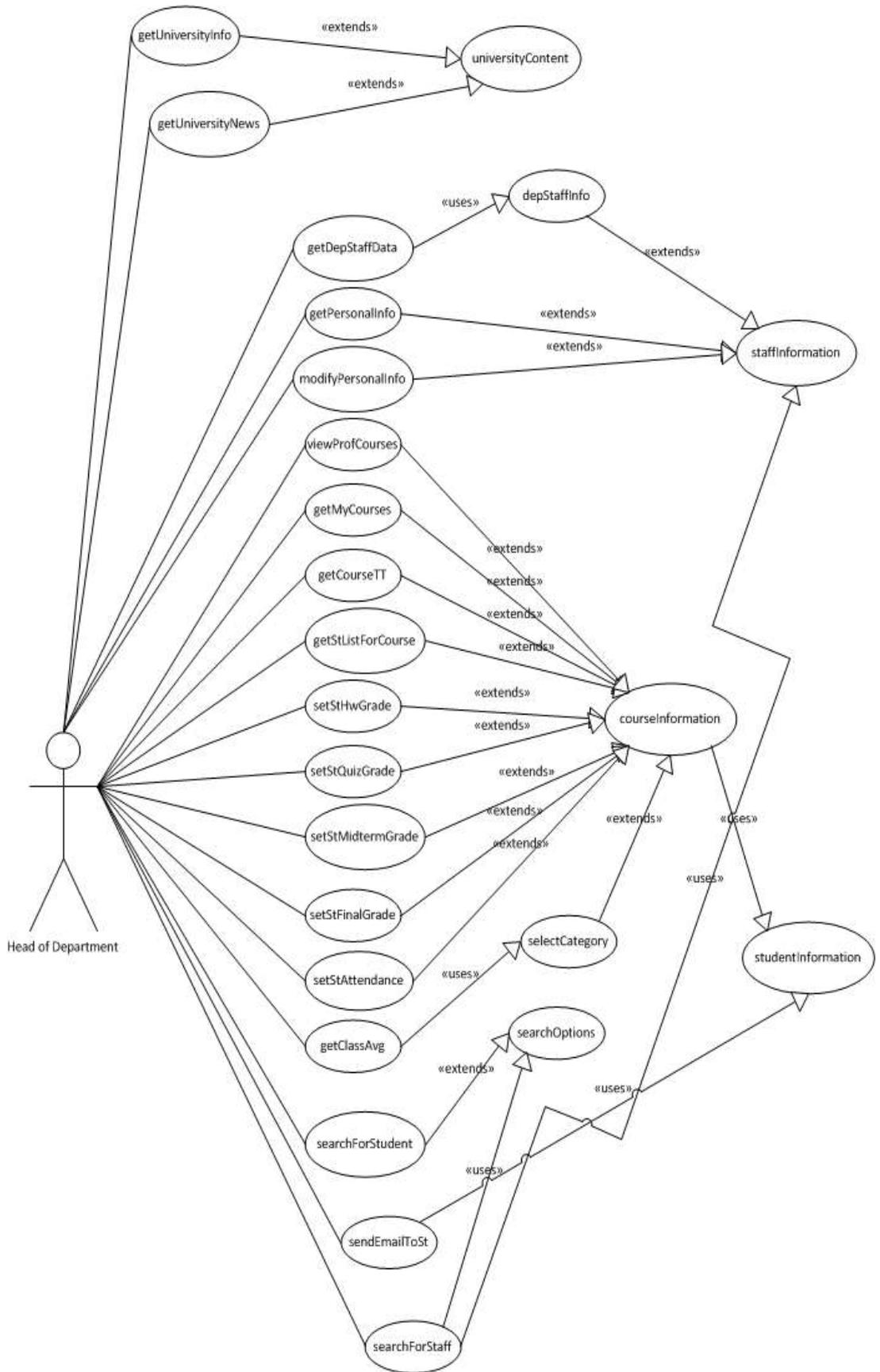


Figure 24 - Head of Department Use Case Diagram

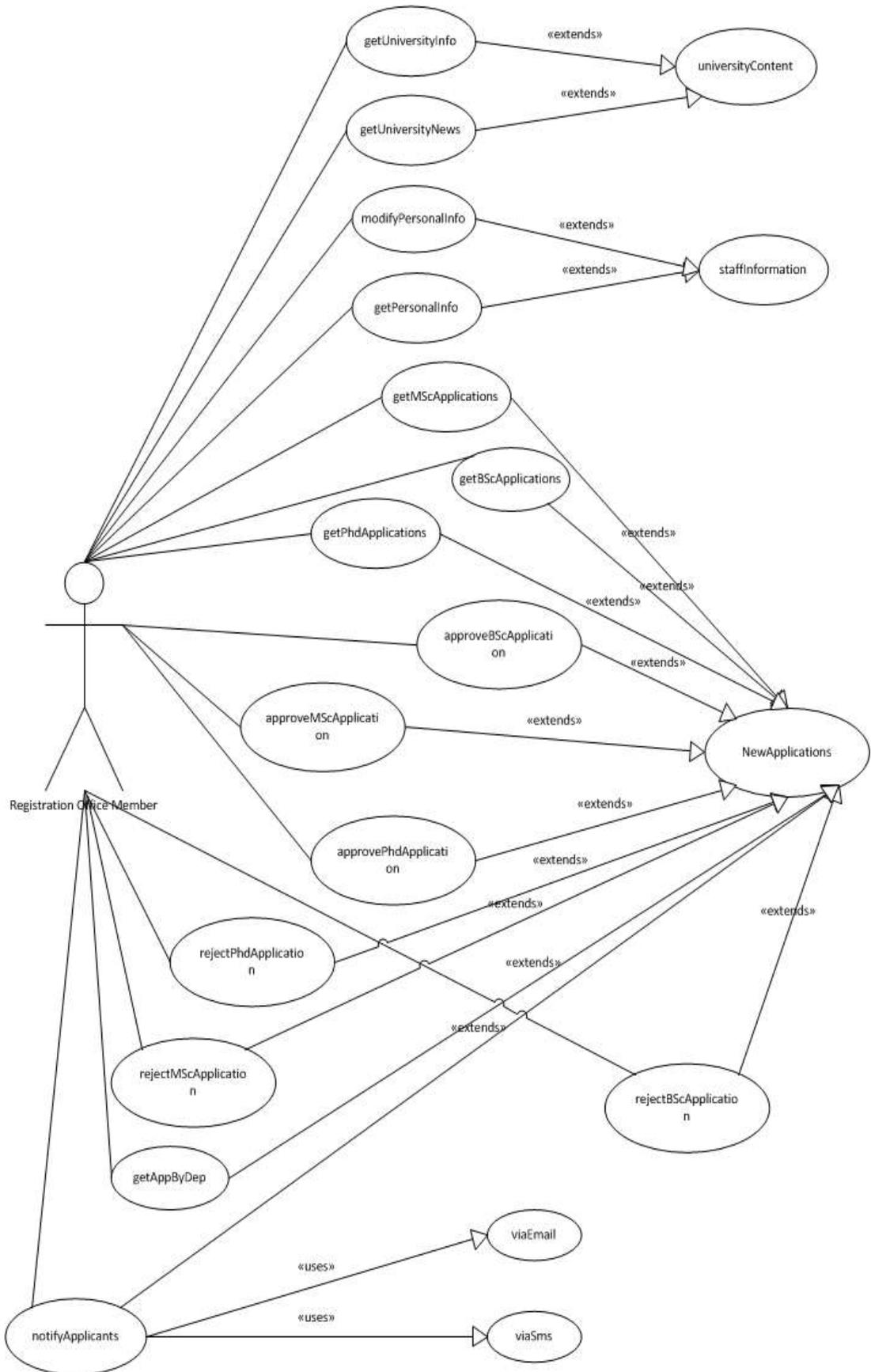
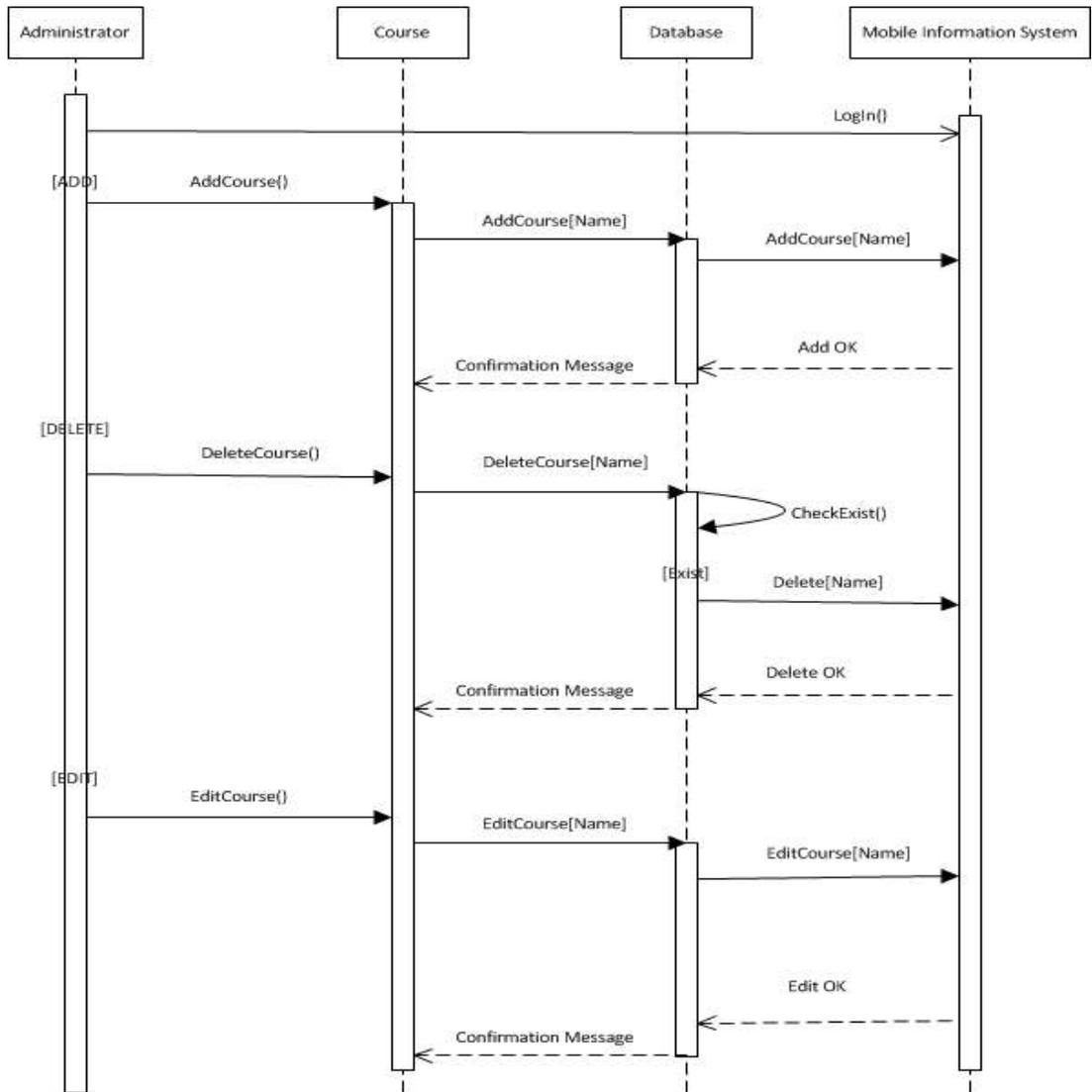
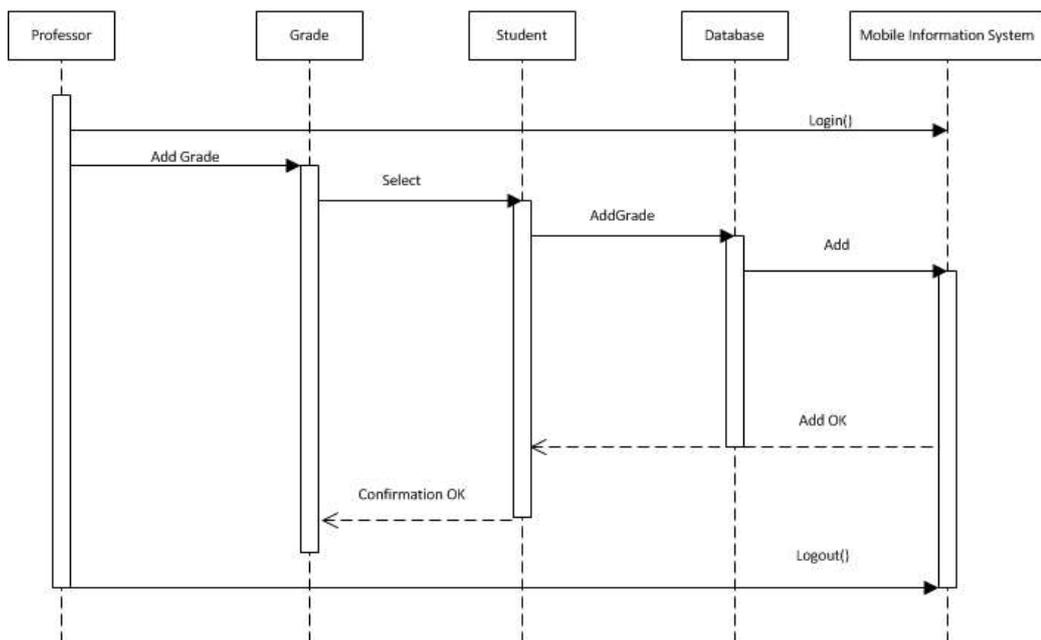


Figure 25 - Registration Office Member Use Case Diagram



**Figure 26 - System Administrator Course CRUD Sequence Diagram**



**Figure 27 - Grade Entrance Sequence Diagram**

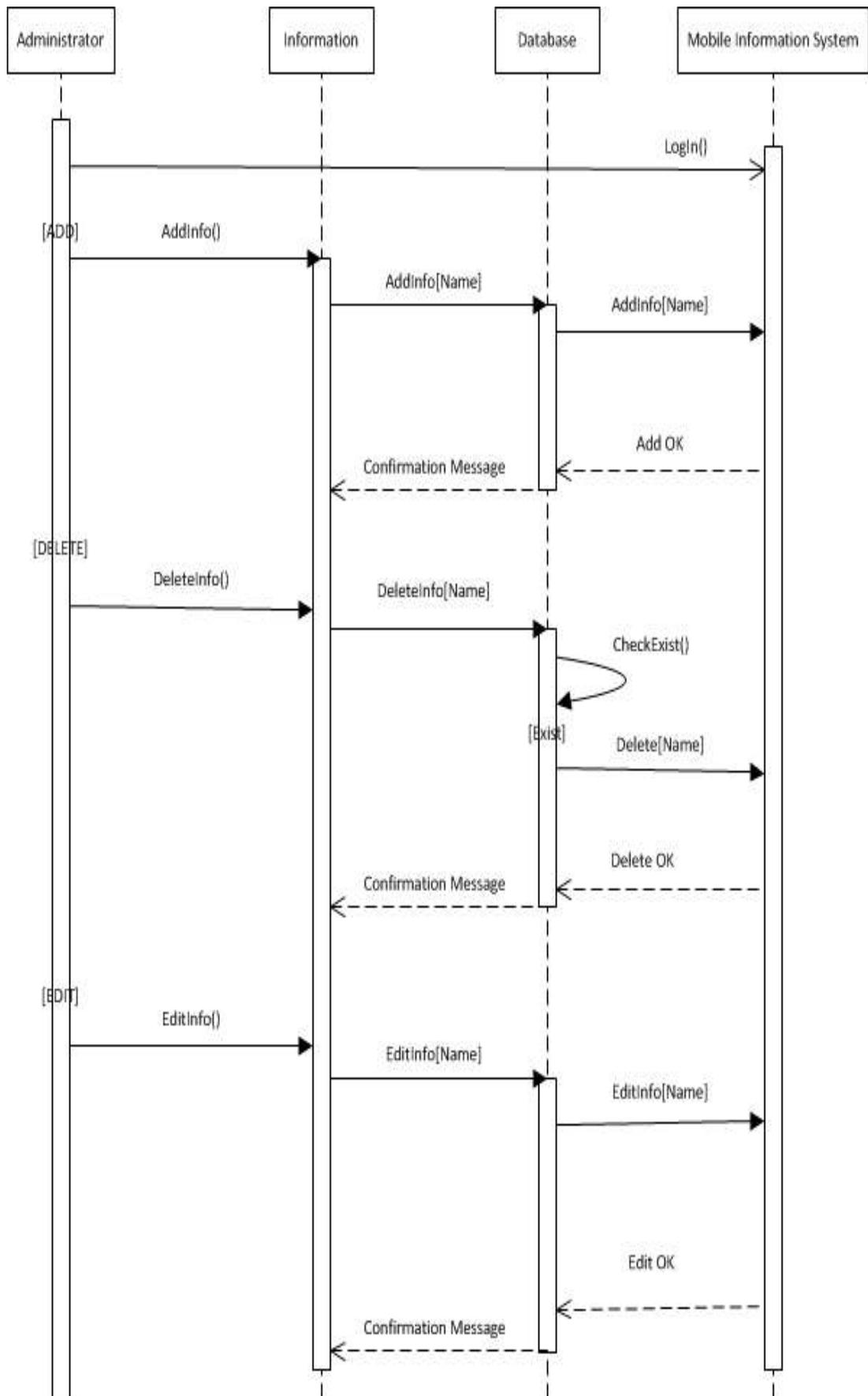


Figure 28 - System Administrator Information CRUD





## APPENDIX B APPLICATION SCREENSHOTS

