The Implementation of Mobile Technologies in Higher Education: A Mobile Application for University Course Advising

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Abstract

Mobile technologies have become the most rapidly growing and adopted technology in recent years. Currently, many higher education institutions are using mobile technologies, due to their portability and accessibility, to support a variety of activities in the education process. Course advising is an important part of the education process and it plays an essential role in students' academic success. However, course advising is a challenging task due to the intensive human effort required from advisors; the unavailability of committed advisors due to other academic commitments; the advisors lack of knowledge; the time-consuming nature of this task; and the unavailability of related information on academic curriculum to the advisors. Nevertheless, such problems make the use of an automated course advising system desirable and helpful. This paper presents the design and implementation of a mobile application for university course advising, called m-advisor, that can be used to reduce the time and effort for both the students and advisors during the course advising process at the beginning of each academic semester. The evaluation results of the m-advisor application revealed that informative advices for students can be given on which appropriate courses, that can fit their needs in accordance with the requirements of the student's academic program, to register in the upcoming semester.

Keywords: Mobile technologies, Higher education, Mobile application, Course advising, Parsing

1 Introduction

Mobile technologies have grown noticeably during the last decade and become a familiar part of our lives. Mobile technologies are a combination of diverse technologies, protocols, standards, and services [1-2]. Mobile devices such as smart phones, tablets, PDAs, and other handheld devices are used as a reliable tool to access the mobile Internet. Mobile Internet penetration, which is the percentage of people who access the mobile internet, is expected to reach 71% by 2019. Noticeably, Mobile applications are expected to be the major means of access to the mobile Internet as they facilitate the access to the full features of the smart devices. For example, in the US by 2014, 86% of users' time on mobile devices was spent on mobile applications (the remaining 14% was spent on the mobile web) [1-2]. Accordingly, the industry of mobile application is growing faster than would have been anticipated as the need for mobile applications is gradually increasing due to the increasing usage of smart phones and low-cost of data usage. According to a leading technology research company, Technavio, there are currently more than 3 million accessible mobile applications on different app stores. Technavio also declared that the market of global mobile application is estimated to raise at a compound annual growth rate (CAGR) of 31.05 percent in the period from 2014 to 2019 [3].

The use of mobile technologies has increased considerably in the recent years in the education sector because of their ubiquity. The use of mobile technologies facilitates learning in innovative ways and makes education easily reached as it allows learners to access learning materials and carry out their studies through mobile devices from anywhere and at anytime according to their own timetable [1, 4]. As the ownership of internet-enabled mobile device (e.g., Tablet, Smartphone, etc.) has extremely increased by students in recent years, the use of mobile applications for diverse educational purposes is emerging. According to a report published by a market research company, Markets and Markets, the market of mobile learning is expected to raise from $7.98 billion in 2015 to $37.60 billion by 2020 at a CAGR of 36.3% [5]. Mobile applications in education are used to better manage the education process, provide remote access to educational resources and services, and resolve educational tasks [6].

Course advising in higher educational institutions is an important factor for the student academic retention and performance [7-9]. In most higher education institutions, students are required to get together with their advisors at the beginning of each academic semester so that advisors can help students in selecting courses that best satisfy the requirements of the

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student's academic program. The advisors should be able to access the students' transcripts and should know: the courses offered for the upcoming semester and the scheduled time of the courses; the requirements of the student's academic program; and the prerequisite chains for the department's courses [9- 10]. However, course advising is considered as a challenging task [7, 9, 11-13]. Accordingly, much research is needed to develop automated course advising systems to simplify the course advising process and provide effective and efficient course advising services.

To this end, this paper presents the design and implementation of a course advising mobile application, called m-advisor, that can be used to reduce the time and effort for both the students and advisors during the course advising process at the beginning of each academic semester. By using the m-advisor application, informative advice for students are given on which appropriate courses, that can fit their needs in accordance with the prerequisite requirements, to register in the upcoming semester according to their academic study plan. The rest of this paper is structured as follows. The research background and literature review as well as the contribution of this study are described in Section 2. The main architecture of the m-advisor application is described in Section 3. Section 4 presents a scenario to demonstrate and test the features of the m-advisor application. Section 5 provides the evaluation results of the m-advisor application. Finally, conclusions and future work are given in Section 6.

2 Background and Literature Review

2.1 Mobile Technologies

Mobile technologies have been rapidly growing in the world throughout the recent years. Henceforth, there are more mobile devices in the world more than people. According to the GSMA's[1] real-time tracker (https://gsmaintelligence.com/), the number of global mobile devices is almost 7.53 billion while the US Census Bureau (http://www.census.gov/popclock/) reports that the number of people in the world is around 7.26 billion. In addition, for example, the implementation of mobile technologies in Jordan has been growing in the last decade. This is mainly because of the growing number of internet users as well as mobile devices. According to the Internet World Stats (http://www.internetworldstats.com/me/jo.htm), Jordan currently has 5,700,000 internet users which is 86.1% of the whole population. Nevertheless, according to recent survey published by the Ministry of Communications and Information Technology in collaboration with the Department of Statistics [14] (see page 42), Mobile Broadband becomes the most broadly used way to access the internet approaching to 98.7% of the Jordanian households due to the increase use of mobile devices in Jordan.

The mobile Internet is an evolution in the Internet in which online information can be accessed using mobile devices such as smartphones and tablets. Since 2013, smartphones are the most popular mobile device sold worldwide, whereas tablets have outsold the PCs and laptops. For example, in developing countries, smartphone shipments go over 50% of all mobile handset shipments by September 2014 [2]. According to eMarketer estimates [15], more than 25% of the world residents will use smartphones in 2015, and this percentage will grow up to over 33.3% of the global population by 2018. Although, smartphones via browsers offer open access to the internet, mobile apps are the most common way of accessing the mobile Internet. In the US, time spent using mobile applications exceeds time spent on mobile browsers and on desktop combined. Hence, the availability of mobile apps is very important. Mobile apps can be downloaded from online digital distribution platforms called App stores. Each store provides apps written for a particular operating system, and considered to run on particular devices. Nevertheless, there are more than 1 million apps available, which have been downloaded billions of times from app stores [2]. There are two leading mobile app stores in the world, the Apple App and Google Play stores. Generally, the number of apps in both stores is gradually increasing. Currently, as of August 2015, there are 1,800,670 iOS apps in the Apple App store and 1,626,003 Android apps in the Google Play store [16-17]. Taking into account the portability of users and the highly developed features of smart devices, mobile apps have provided many advantages in our daily lives. In particular, mobile apps have shifted the way people interact with each other, businesses, and governments. Also, they provide people with entertainment, accessibility to important information, news, and so on [2].

Mobile devices are categorized by their vendor and their operating system. In this regard, Android is free open source operating system software developed by Google to any smart device vendor and revealed in 2008. Android is the most widely used operating system on smartphones, obtainable by several vendors. The market share of Android in the operating system market for smartphones and tablets has risen exponentially over the last few years. By 2014, Android has dominate the mobile operating systems in which it has an 84% share of the smartphones market, and 72% share of the tablets market [2].

2.2 Course Advising in Higher Education

Academic advising is an essential component of the higher education's mission. Academic advising

[1] GSMA Intelligence is the definitive source of mobile operator data, analysis and forecasts, delivering the most accurate and complete set of industry metrics available.

improves students' academic experiences and has a significant impact in students' success and retention [18-19]. According to Gordon et al. [20], Academic advising defined as "situations in which an institutional representative gives insight or direction to a college student about an academic, social, or personal matter". Course advising is a challenging task involved in academic advising. Course advising refers to the process of an academic advisor assisting a student in selecting appropriate courses to register in the upcoming semester in order to satisfy the requirements of the student's academic program. An advisor is required to have a suitable knowledge on study plans, academic program requirements that students must meet, and school regulations to be able to undertake the course advising process. The academic program requirements include university compulsory and elective requirements, faculty compulsory and elective requirements, and major compulsory and elective requirements. Nevertheless, there are sequencing rules, that must be taken into account during the course advising process, in which particular courses must be completed prior to others (called as prerequisites). Considering theses prerequisites imposes advisors and students to do a long-term course planning for several semesters in advance to guarantee that the student completes the degree on expected time [19].

However, as mentioned before, course advising is still considered as a challenging task, thus, the implementation of computer technologies to support and automate the course advising process is significantly needed [7, 9, 11-13, 21]. Accordingly, by developing automated course advising systems to support the increasing demands on course advising by students, advisors will spend less time on course advising, and more time on student support, planning student education roadmap, career counseling, and goal clarification [10, 22-23].

Consequently, many higher education institutes investigated the use of computer technologies in course advising to overcome the limitations and difficulties faced by the traditional way [7-13, 19, 21-23]. Albalooshi and Shatnawi [13] proposed a web-based higher education advising system that can be utilized by students, advisors, and heads of departments. The proposed system offer students many services such as: access to recommended courses that students need to register for to keep on the right degree path; access to information regarding the students graduation requirements; access to a dependency diagram viewing the students progress in their degree plan; and other services. Advisors and heads of departments are able to access students' records and are allowed to produce a number of helpful statistics, graphs, and reports. Al-Ghamdi et al. [11] developed a postgraduate advisor expert system (PAS) for aiding postgraduate students of Computer Science (CS) major in King Abdulaziz University (KAU) in selecting the proper courses for their schedules during the postgraduate program. The PAS allows the students to choose appropriate courses for each semester without the need to seek advice from academic advisors. The results of the PAS system were compared with the traditional way of course advising, and the testing outcomes of the PAS were satisfied. Al-Nory [22] developed a decision support tool for academic advising to automate tedious tasks in advising students of Information Systems (IS) major in Effat University. The proposed tool assist advisors in arranging pre-registration plans for students, also it supports the strategic decisions on identifying the courses that have to be offered in the upcoming semester. Lam and Choi [7] implemented an efficient academic advising system, that employs a preference model, that allows students to choose courses based on their interest more willingly than the program requirements. Given a student's preference on the available courses, the model utilizes mathematical programming techniques to select the best possible set of courses that maximizes the students' total preference score. Roushan et al. [23] proposed a novel online-based course advising system that aims to overcome the difficulties encountered during the traditional course advising process. The proposed system: eliminates the paperwork and the redundant tasks involved in the traditional course advising process; makes the traditional course advising process easier, efficient and intelligent; and provides additional time for advisors to pay more attention on students' development. Shatnawi et al. [12] proposed a smart course advising system that uses association rule mining to assist undergraduate students in selecting courses that best suit their current needs and enhance their academic performance. The proposed system employs association rule mining to locate associations among courses that were registered by similar students in prior semesters. Daramola et al. [9] proposed an intelligent course advisory expert system (CAES) that can utilize the student's academic history to recommend courses that should be registered in the upcoming semester. The CAES integrates the case based reasoning (CBR) and rule based reasoning (RBR) techniques to achieve an acceptable performance in terms of usability and reliability of its recommendations. The CAES was successfully tested by the Computer and Information Sciences department of Covenant University. Mattei et al. [10] proposed a decision-theoretic advising tool for supporting undergraduates at University of Kentucky. The authors carried out two surveys in multiple majors and colleges asking students about their preferences regarding advising, course selection, and paths of career. The results of these surveys reveled that although advising support tools, in general, can enhance the student-advisor relationship in terms of course planning, they should not substitute in-person advising. Laghari [21] developed an automated course advising system

(ACAS) to assist students in selecting suitable courses to register. The ACAS software can be used by students at whatever time to create a plan of course selections for the upcoming semesters. Mohamed [19] proposed a novel approach called interactive decision support for course planning (IDiSC$^+$), which exploits optimization techniques to provide meaningful support for academic advisors and students in generating a long-term course plans towards graduation. The IDiSC$^+$ approach is an improvement of an earlier approach, named IDiSC. The results gained from a real-world case study were encouraging.

2.3 Using Mobile Technologies in Higher Education

A number of researchers have explored the application of mobile technologies in education using the phrase m-learning or, mobile learning. m-learning is any learning activity that is achieved using mobile technologies. Thorough m-learning, learners can use any learning device to study anywhere and at any time to complete their learning activities and assessments. According to literature, there are a number of key features of m-learning that need to be understood to ensure better learning outcomes, such as spontaneous learning, context awareness, collaborative learning and virtual interaction [24-26]. A recent studies of the application of m-learning are [24-26]. Huang and Chiu [24] develop an evaluation model for context-aware mobile learning (CAML) derived from the theory of meaningful learning using the analytic hierarchy process (AHP). Three diverse CAML learning activities have been tested via experts to verify the effectiveness of the model. Using the proposed model, developers can improve the learning activities of the context-aware m-learning. Pu et al. [25] proposed a learning model for occupational nursing education. The proposed model verified using home-visiting activities with the help of the mobile technology for a nursing practice course at an occupational nursing school in Taiwan. Using the proposed model, professional skill development and authenticity experience of nursing students can be improved. Chiu and Huang [26] proposed a m-learning decision support system. To validate the viability of the proposed system, the authors used the fuzzy analytic hierarchy process to study three types of participant: students, system developers and lecturers.

Furthermore, the use of mobile technologies has increased significantly in the recent years in the education sector because of their emerging features. The emerging features of mobile technologies such as the escalating processing power, enhanced ubiquity and smart applications have motivated higher education institutions around the world to provide students with sustainable, high-quality, technology-rich and innovative learning environments. Such environments allow students to access internet-based resources, such as course materials and activities, through ubiquitous connectivity and mobile devices from anywhere and at anytime according to their own schedule. Hereafter, higher education institutions focus on supporting ubiquitous access for mobile devices to university systems and infrastructure. However, for example, regardless of the noticeable benefits of using mobile devices for learning purposes, a small number of higher education institutions in Australia have enabled mobile access to university networks [27].

As the possession of internet-enabled mobile devices (e.g., Smartphones, Tablets, etc.) has extremely increased by students in recent years, the use of mobile applications for diverse educational purposes is emerging. According to Tan & Teo [28], there are four major factors that motivate the creation of mobile applications for educational purposes: (1) the availability of learning experience on anytime and anywhere using mobile applications; (2) the dynamic nature of mobile applications as they may include audio, video, and interactive animations (touch and response); (3) mobile applications can support personalized learning; and (4) the scalability of educational mobile applications as they increasingly reaching more and more students across the globe [28]. Consequently, the number of educational apps in both Apple App and Google Play stores is gradually increasing. Currently, by category, education has the third highest app count after games and business in the Apple app store, at 174,084 (10% of all apps); whereas education has the first highest app count at 131,287 (8% of all apps) in the Google Play store [16-17].

The implementation of mobile technologies in higher education is an active and recent research topic [4, 6, 27, 29]. Alzaza and Yaakub [29] presented a study that investigates students' awareness of mobile learning (m-learning) services in the higher education environment in Malaysia. The study reveals that students have good awareness and satisfactory knowledge in using mobile technologies in their educational environment. Murphy et al. [27] presented a survey that focuses on exploring the use of smart mobile technologies for learning at two Australian universities, the University of Southern Queensland and the University of South Australia. The survey shows that students' ownership of smart mobile devices is growing rapidly with a corresponding decline in feature phone ownership. Also, it indicates that students in both universities are using their mobile devices to support their learning. Almaiah and Jalil [4] conducted a survey to investigate the awareness of students of the application of m-learning and to examine the students' prospects of m-learning services throughout their studies at University Malaysia Terengganu (UMT). The results of the study show that the students have optimistic perception towards m-learning and intend to use their mobile devices for learning and administrative services. Also, the study

indicates that the use of m-learning will help students in increasing the flexibility of their learning inside and outside the classroom, thus, improving their academic achievement. Samochadin et al. [6] proposed a complete set of seven mobile services and explains their functionality based on an overview of existing services and demands of students and academic staff members. The authors also proposed an architecture of a novel system that enables students and teachers to securely use their personal mobile devices to access the services. The trial version of the system has been implemented in SaintPetersburg Polytechnic University. The authors plan to examine the system's efficiency in the education process and gather requirements for more development.

2.4 Contribution of This Study

Course advising in higher educational institutions is an important factor for the student academic retention and performance [7-9]. Course advising is considered as a challenging task due to: (1) the intensive human effort required from advisors; (2) the advisors lack of knowledge such as a new faculty member assigned to advise students; (3) the time-consuming nature of this task especially when dealing with large number of students; (4) the unavailability of related information on academic curriculum to the advisors such as changes that might applied on the prerequisite structure for the department's courses where advisors might not be aware of them; (5) the unavailability of knowledgeable and committed advisors due to other academic commitments; and (6) advisors have obstacles getting precise and detailed academic information on students in order to look at their status [7, 9, 11-13].

The literature shows that the use of mobile technologies in higher education has positive outcomes for most students. Accordingly, introducing a course advising mobile application that can be used to overcome the above limitations during the course advising process at the beginning of each academic semester is our contribution in this paper. The proposed application shall be very significant in making the course advising process much easier, efficient and intelligent for university students. Additionally, to the authors' best of knowledge, there is no mobile application which has been implemented yet to support the university course advising process.

However, the m-advisor application was not proposed to eliminate the role of academic advisors, rather it reduces the course advising burden on the academic advisors and enables them to concentrate on real issues such as spend more time on students' support, planning students' education roadmap, career counseling, and goal clarification.

3 m-Advisor Design and Implementation

3.1 Design

As shown on Figure 1, the architecture of the m-advisor is composed of two major components: university system, and m-advisor application.

University System: This component is not controlled by our application, it contains all university databases (student, employee …etc.) manipulated by different university services. This component, via the internet and throughout the university's website, is used as a main source of student information.

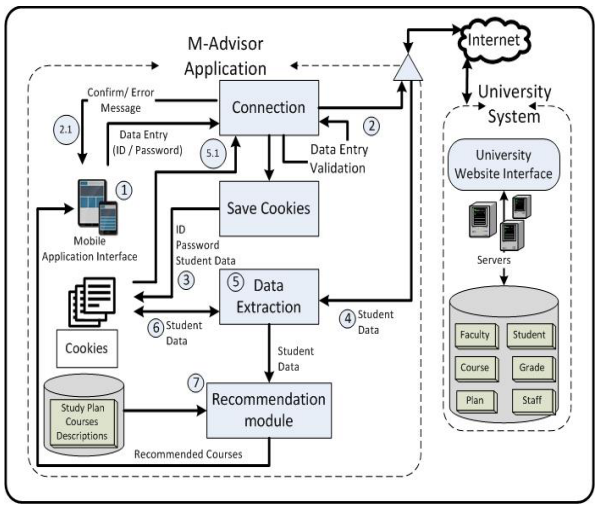

Figure 1. The architecture of m-advisor

3.1.2 M-advisor Application

The structure of this component is explained in seven steps:

Step 1. Receive the StudentID and Password from the login interface of the m-advisor application.

Step 2. Firstly, a two-level data validation process is applied on StudentID, and Password for each connection. The first level of data validation is done at the application level (i.e., checking the StudentID to make sure it is formatted correctly). The second level of data validation is done at the university login page in which the university server verifies the legitimacy of the login student. After validation, a new connection is established for each student to the university server via the URL of the university Login web page, StudentID, and Password.

2.1. In case an error occurs in Step 2, an Error message is returned to the student.

Step 3. If the login attempt was successful, an authorized session cookie is created to maintain the session and to be used later on when it is needed.

Step 4. The Document Object Model (DOM) parser is applied to find, extract and manipulate the required student data such as: First and last name of a student, Student specialty, Number of plan hours, Number of passed hours, Accumulated average, Semester average,

List of categories of academic program requirements, and Credit hours per category passed by a student. Before parsing, it is essential to examine the structure of an HTML page and determine the location of the required data to be extracted. The DOM parser has been used in parsing among others due to the requirements of our application and its features which are [30] : (1) It loads the HTML document into tree-like structure in which each element representing tree branches; (2) By loading the whole tree representation of the document in memory, the stored data can be flexible and easily manipulated; and (3) It is easy and convenient for the developers to implement.

Step 5. A getter method is applied to get the data inside elements extracted in Step5, it can be value, text or URL link.

5.1. In case more than one link exists in the same page, Steps from 3 to 5 will be applied on each link.

Step 6. All extracted data will be processed and saved on cookies in order to be used by the application.

Step 7. Some of extracted data will be used as inputs to the course recommendation module (See Table 1 for more details on the course recommendation algorithm). The output of this step is a list of recommended courses, for each category of academic program requirements, which will be displayed to the student.

Table 1. Course Recommendation Algorithm

```
[CategoryList, CreditHours] = ParsingMethod (URLs)
// [CategoryList, CreditHours] = Compulsory University
Requirements:12 credithours, Elective University
Requirements: 15 credithours, Compulsory Faculty
Requirements:22 credithours, Compulsory Department
Requirements 71 credithours, Elective Department
Requirements 12 credithours

For each Category in CategoryList {
  If CreditHours of Category isnotcompleted {
    For each Course in Category {
      // Course can has 1, 2 or 3 CreditHours
      If Course isnotpassed {
        X = listof PreRequisiteCourse(Course, StudyPlan)
      // See Figure 2 as an example for the Prerequisite
structure
        preBool = 0
        For each PreReqCourse in X
          If PreReqCourse isnotpassed {
                preBool = 1 }
        }
        If preBool = = 0 {
          RecommendedCourseList.add(Course) }
      }
    }
  }
}
Display  RecommendedCourseList for each Category
```

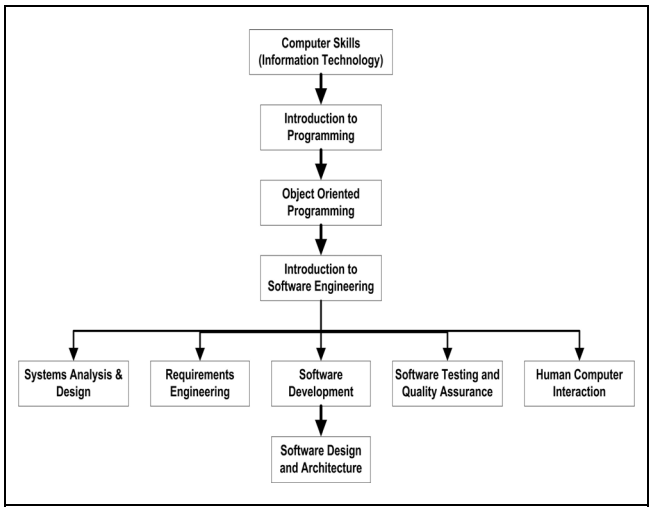

Figure 2. The Prerequisite structure of the compulsory department requirements (BSc degree in Software Engineering)

When the user logout from the application, all of the cookies will be deleted and the session will be closed. Note: the study plan and courses descriptions are saved on the application database.

3.2 Implementation

For implementing the Android-based m-advisor application, we used the Android Studio which is an Integrated Development Environment (IDE) based on the IntelliJ IDEA (the most Intelligent Java IDEA) [31]. For data storage purposes, we use the SQLite [32] database which is a lightweight SQL database supported by Android. SQLite has methods to create, execute, and delete data from database. In addition, we use the Adobe Photoshop software to produce the images of the application user interface. See the following snapshots (Figure 3 to Figure 8) of the developed m-advisor application.

By adhering to the university rules and regulations, the m-advisor application maintains the student privacy and confidentiality by not exposing any sensitive information during the interaction process with the university servers. The m-advisor application does not allow the student to change any private data stored on university servers. To ensure that, we use a Java HyperText Markup Language (HTML) parser, the Jsoup [33], to extract the required data without the need to access the university database. Jsoup [33] is a Java library that manipulates HTML code. It is a very suitable API for extracting and controlling data using the best of jQuery, DOM and CSS -like methods. Jsoup implements the characteristics of HTML5 and analyzes the HTML code in a tree (DOM) as do modern browsers. Jsoup is an open source project distributed under the Massachusetts Institute of Technology license. The main characteristics of Jsoup are:

- Analyze HTML code from a web page URL, file or character string.
- **Find and retrieve data using the DOM tree and**

CSS -like methods.
- **Manipulate the elements and HTML text.**
- **Prevent XSS attacks by erasing the address of the user.**
- **Create a stored HTML code.**

4 Case Study

This section demonstrates a case study scenario to illustrate and test the features of the m-advisor application (The major tests summarized in Table 2). The m-advisor application is employed to assist undergraduate students of Software Engineering (SE) major in Al-Ahliyya Amman University (AAU) in selecting the suitable courses that can fit their needs in accordance with the requirements of the BSc degree in SE. In this scenario, Suzanne as a student is looking for a set of courses to register in the upcoming semester. First, Suzanne has to log into the m-advisor application, as shown in Figure 3.

Table 2. Testing of the major functions of the m-advisor application

Objectives	Expected result	Actual results
Student should successfully login and directed to his/her main page.	Student should be directed to his/her main page that has specific information about his/her academic status.	As expected (see Figure 4)
Student should successfully able to view his/her study plan.	Student should be able to view his/her complete study plan.	As expected (see Figure 5)
Student should successfully able to view recommended courses based on his/her study plan.	Student should be able to view recommended courses in each academic program requirements (e.g., University Requirements Obligatory, Department Requirements Obligatory, Department Requirements Elective..etc).	As expected (see Figure 6)
Student should successfully able to check the availability of his/her recommended courses in the upcoming semester.	Student should be able to check the availability of his/her recommended courses in the upcoming semester.	As expected (see Figures 6 and 7)
Student should successfully able to view the details of any course included in his/her study plan.	Student should be able to view the details of any course included in his/her study plan (e.g., course description, course prerequisites,.. etc).	As expected (see Figure 8)
Student should successfully logout from the application.	Student should be able to logout from the application.	As expected

Figure 3. Students login

After login, Suzanne can view her main page which allows her to access the main functionalities of the application, as depicted in Figure 4. The main page contains some useful information such as the name of a student, student specialty, number of plan total hours, number of passed hours, semester average, and the accumulated average.

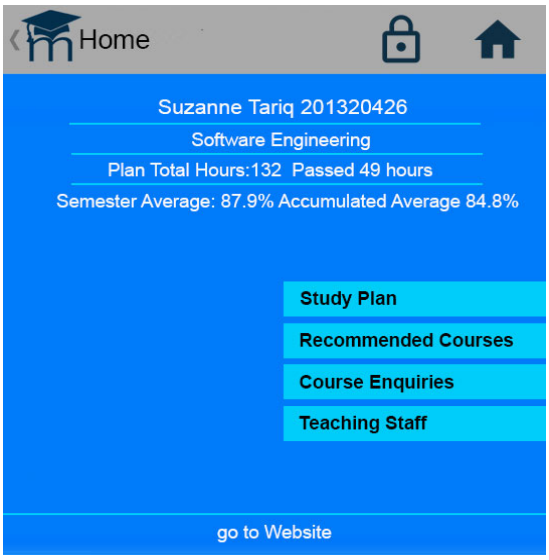

Figure 4. Main page of a student

In Figure 5, Suzanne views her complete study plan. The study plan contains the different categories of the academic program requirements (BSc degree in Software Engineering) and the required credit hours for each category. (e.g., Compulsory University Requirements: 12 credit hours, Elective University Requirements: 15 credit hours, Compulsory Faculty Requirements: 22 credit hours, Compulsory Department Requirements 71 credit hours, Elective Department Requirements 12 credit hours).

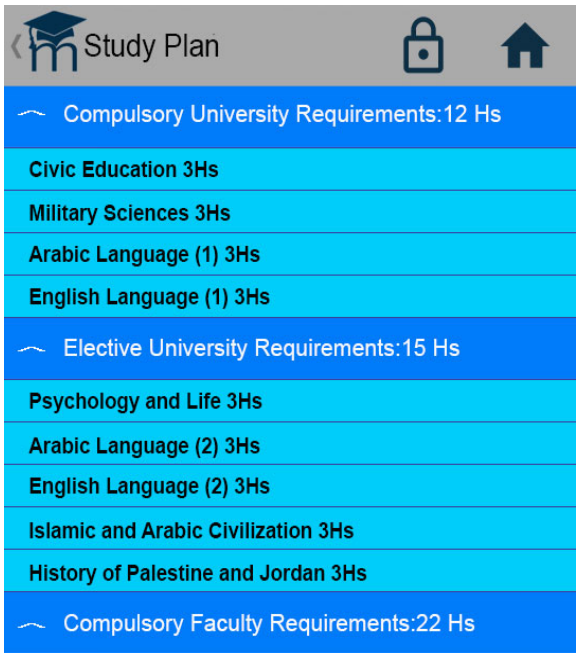

Figure 5. Study plan of a student

In Figure 6, Suzanne views the recommended courses for each category. For example, when she views the recommended courses which are under the Compulsory Department Requirements category, the application presents the "Introduction to Software Engineering" as the only recommended course. The reason is that Suzanne has just passed the object oriented programming course, and according to the prerequisite structure of the compulsory department requirements (See Figure 2), Suzanne has only one choice which is enrolling into the "Introduction to Software Engineering" course in the upcoming semester. At the bottom of the Figure 6, it can be seen that Suzanne cannot enroll into both of the graduation project and practical training courses as she didn't pass 90 credit hours of the total hours in the study plan (See Figure 4).

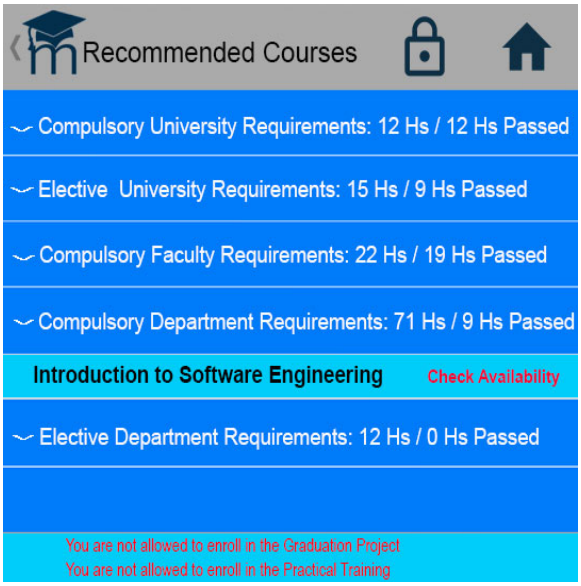

Figure 6. Recommended courses for a student

In Figure 7, Suzanne views the availability of the recommended course for each category. For example, the recommended course (See Figure 6) "Introduction to Software Engineering" is not offered in the upcoming semester (it was the summer semester when the application was tested), thus, the application presents a message states that the "Introduction to Software Engineering" is not available in the upcoming semester.

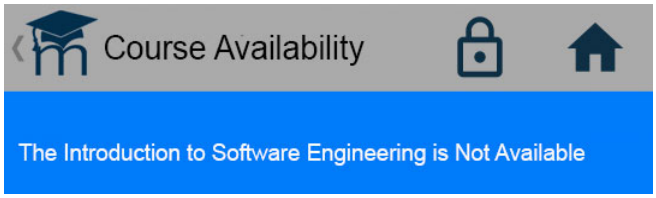

Figure 7. Checking the availability of a recommended course "Introduction to Software Engineering" in the upcoming semester

Furthermore, as seen in Figure 8, Suzanne can also view the details of any course in her study plan. Course details include the course description, the course prerequisites, and the courses that can be enroll into after passing the course.

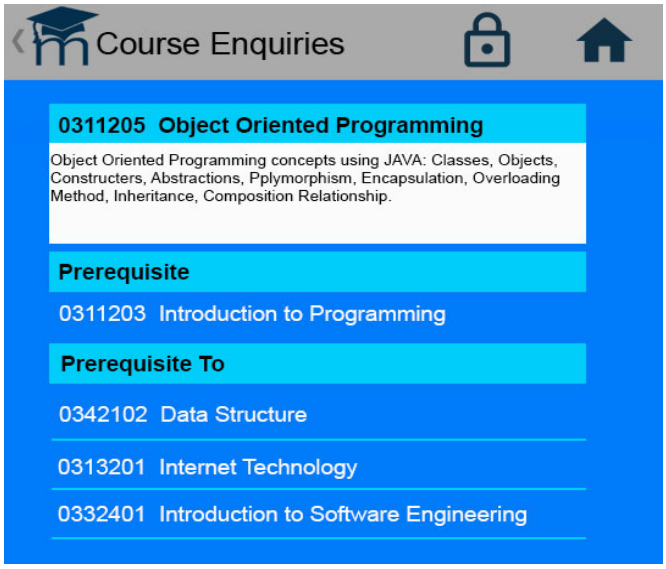

Figure 8. Details view of the "Object Oriented Programming" course

5 Evaluation of m-Advisor

A usability evaluation of the m-advisor application was conducted using a modified version of the original questionnaire proposed by Cafferella [34]. Early studies in literature acknowledge the assumption that 5 to 10 test users are a sufficient sample for a usability test in an iterative development process [35-37]. Conforming to this assumption, our evaluators were a group of 10 students that benefit from the m-advisor application to answer the questionnaire which determines the level of their satisfaction on using the

application. The questions were rated from 1 to 5, with 1 indicating strongly disagree and 5 indicating strongly agree. The questionnaire results summarized in the following six parts.

App content. This part evaluates the m-advisor application content in terms of both accuracy and presentation. The students' average rating was 4.35 (87%).

Advising strategies. This part measures the m-advisor application's appropriateness for course advising. The students' average rating was 3.97 (79.33%).

App design. This part involved questions regarding the interfaces of the m-advisor application, user friendliness, and level of difficulty for the app users. The students had an average rating of 3.70 (74%). We also received helpful feedback with regard to improvements to the design of the application interfaces.

Appropriate use of mobile technologies. In this part, questions were asked to review, based on the m-advisor application as a case study, the suitability of using the mobile technologies in higher education in general. The students' average rating was 4.00 (80%).

Cost/benefits analysis. This part involved questions regarding the benefits of using the m-advisor application. The students gave an average rating of 4.33 (86.67%) when asked to rate the statements: "The students and advisors will benefit from this app through reducing the time and effort involved during the course advising process" and "The app is worth using and will improve course advising in general".

Overall evaluation. An overall evaluation of the app was obtained from each student in this part. The students' average rating was 4.35 (87%).

In general, the mean rating (mean satisfaction level) of all respondents on all sections was 4.12, which indicates a 82.33% percentage of satisfaction level of the students on the services provided by the m-advisor application.

6 Conclusion

The paper presented the design and implementation of a novel mobile application for university course advising, called m-advisor. The m-advisor application plays an important part in a student's academic life in which it reduces the time and effort for both the students and advisors during the course advising process by providing students with informative advices on which courses they should register in the upcoming semester. The m-advisor application eases the advising process by: accessing students' academic record, retrieving passed courses, identifying the recommended courses that can fit students' needs in accordance with the prerequisite requirements, and checking the availability of the recommended courses in the upcoming semester.

Our future work will focus on further expanding the functionality of the m-advisor application by helping the academic staff in planning ahead the courses and the number of sections for each course to be offered in the upcoming semesters based on the students' needs so they can keep on the right study path and graduate at the scheduled time.

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