myPDA: A Mobile Healthcare Application for Personal Diet Assisting

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Abstract— This paper aims at contributing to the global effort in tackling the obesity problem through introducing a mobile diet assistant application (myPDA) that improves the awareness of balanced diets, encourages following healthy plans and promotes increasing exercise levels. The assistant was developed as an Arabic Android application for mobile devices. The preliminary testing of the application, indicated promising results and we hope that myPDA can contribute to the preservation of public health by combating obesity.

Keywords-component; Healthcare; Diet; Android; Mobile Applications

I. INTRODUCTION

Year after year, the rate of obesity has increased across the world, dramatically enlarging the percentage of people suffering from health problems and chronological diseases. Based on a recent study in the US, the prevalence of overweight adolescents and children has nearly tripled during the last fifty years [1]. Therefore, many governments have declared obesity as a national economic problem. Indeed, losing weight and getting in shape nowadays is considered a governmental and social responsibility rather than a personal issue. Many studies have been done recently to identify ways to promote adopting a healthy diet to combat this obesity problem

On the other hand, mobile devices market is becoming the largest market with devices of reduced sizes and costs and increased functionalities. Using mobile phones for health applications is becoming visible in the market as they provide many opportunities to improve the quality of life through ubiquitous health applications [2]. Research has shown that it is technically feasible and possible to improve the management of chronic illness using mobile phones [3]. In [4] it was pointed that mobile nutritional support is effective for people with diabetes. A prototype for an educational fitness application on mobile devices has been presented in [5]. The application aims at helping combat the growing levels of obesity among adolescents 11 to 17.

Those efforts reveal that researchers have already begun to encourage healthy diet adoption through mobile devices. Additionally, surveying the mobile applications market shows that a number of m-diet applications have already emerged such as "DietPoint" [6] and "LoseIt" [7] for Android and Apple devices, as well as MyPersonalDiet, [8] which supports most mobile device platforms, and many more. However, Arabic Applications are still lacking. For instance, our search failed to find any application for Android or Windows devices. The application "ميزان الرشاقة" [9] was among the very few m-diet applications found for Apple smart phones. It has very limited features when compared to English applications, as will be indicated in section II.

To bridge this gap, we have started a multi-phase project to develop an Arabic m-diet application for Android devices that we have called "حميتي", i.e. Personal Diet Assistant or simply myPDA. In this paper, we describe the first phases of the project, which are the analysis, design and implementation phases. The result of these phases is a fully-running application that will be evaluated further in the next study phase.

The paper describes the complete process beginning from the software requirements gathering in section II, system design and architecture in section III, implementation in section IV and ending with testing and evaluating the fully running application in section V. The summary and conclusions of the papers are presented in section VI.

II. ANALYSIS

In developing myPDA, we followed the waterfall model as it is maintainable and easy to use. Additionally, myPDA has a small to medium-size scope with very low risks and requirements are clear from the start; these are the appropriate features for applying the waterfall model.

A. RequirementsAnalysis

In collecting the software requirements, we have followed two approaches:

- Questionnaire: we developed a brief online Arabic questionnaire, shown in Figure 1, targeting users of previous experience with m-diet applications with an aim to know the most preferable one so we can use as a model for our design and understand the lacking features so we can include them in our application. A question about the operating environment was also added to know which one is the mostly used. However, we received very few responses due to scarcity of diet applications in Arabic language, lack of Arab users

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for these applications, as well as low level of awareness of obesity-associated problems.

Figure 1. Requirements Questionnaire

- Comparisons with related software: Surveying the area of m-diet applications based on users' responses to the questionnaire, three Android applications were considered :

"LoseIt": which is an English-based weight loss application shown in Figure 2, for both Apple and Android smart phones. Based on our search, it is the most comprehensive m-diet application. Its main aim is weight reduction through providing a huge database of diet plans and food information. It offers calories and exercise tracking facilities and allows sharing motivation and progress with friends. It also has an accompanying website with additional features.

Figure 2. LoseIt Application

"DietPoint": this is a simple English-based application, as shown in Figure 3, for both Apple and Android smart phones. It focuses on healthy diet adoption by motivating sharing diet information and experiences through a mobile weight-loss forum. It provides a collection of diet plans, each of which has its complete grocery shopping list. The application includes facilities to alert users of meal times and track consumed calories. An accompanying website for this application is available to offer additional features.

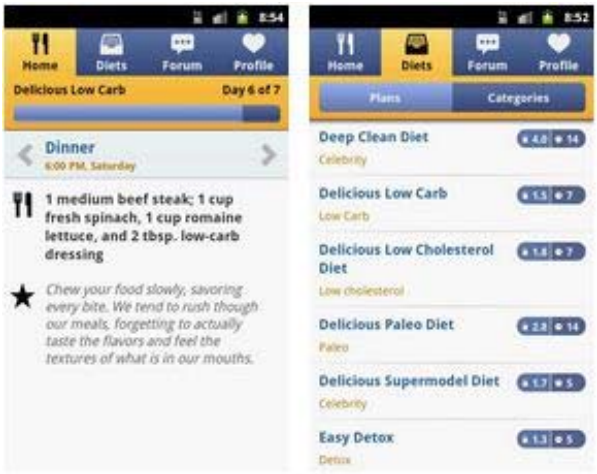

Figure 3. DietPoin Application

ميزان الرشاقة: This is the only Arabic m-diet application pointed to by our questionnaire respondents. It targets Apple smart phones and focuses on helping users lose weight by tracking their consumed daily calories. This application has a feature of monitoring water consumption, which is not available in the two applications mentioned above.

Figure 4. ميزان الرشاقة Application

It is worth pointing to other Arabic m-diet applications that we came across during our survey, such as "اخسر وزنك بطريقة تناسبك" and "الرجيم المتكامل في أربعة أسابيع". However, they are all for Apple devices and have very limited functionalities when compared with ميزان الرشاقة.

Table 1 provides a comparison between LoseIt, DietPoint and ميزان الرشاقة based on twelve features. These features are the commonly implemented by comprehensive m-diet

applications except the last one, find the nearest gym, which, to the best of our knowledge, is unique to myPDA.

TABLE I. COMPARISON BETWEEN LOSEIT, DIETPOINT AND ميزان الرشاقة APPLICATIONS

Feature	LoseIt	DietPoint	ميزان الرشاقة
1. Wight tracking	Yes	Yes	No
2. Collection of diet plans	Yes	Yes	Yes
3. Give information about diet plan	Yes	No	Yes
4. Share diet plan with friends	Yes	Yes	No
5. Print detailed reports directly from the phone	Yes	No	Yes
6. Share user profile with professionals	No	No	No
7. Alert the user when each meal started	No	Yes	No
8. Include software tutorial	No	Yes	No
9. Water consumption tracking	No	No	Yes
10. Work with\without connection	Yes	No	No
11. Has an accompanying website	Yes	Yes	No
12. Find the nearest gym	No	No	No

B. *Product Features*

The most important features of myPDA include:

- A user-friendly Arabic interface
- Supports Android devices.
- Allows tracking weight and body measures.
- A pool of healthy diet plans.
- Suggests a shopping list for each diet plan.
- Finds the nearest gym based on the user's current location.
- Alerts the user for meal times.
- Calculates the Body Mass Index (BMI), Basal Metabolic Rate (BMR) and the daily energy expenditure.
- Provides password-secured access to data and information.
- Supports touch screen devices.

The application can be used by anyone and does not require a certain age or gender but it does require basic knowledge of using smart phones. It also requires an understanding of Arabic Language. It is also important to stress that it is not recommended for people with diseases that require a doctor's consultation for diets and meals.

III. DESIGN

Basically, the system is composed of three software components: The mobile application with embedded database, the server and the execution environment. The deployment diagram in Figure 5 illustrates how the system with its main classes will be physically deployed in the hardware environment. It shows where different components of the system will run and how they will communicate with each other.

The data flow diagram (DFD) in Figure 6 shows the main system functions and information flow among them.

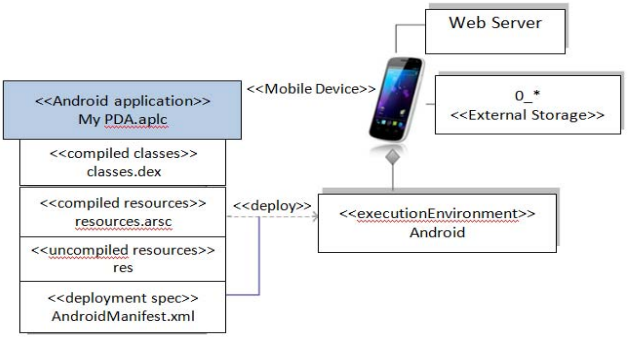

Figure 5. Deployment Diagram

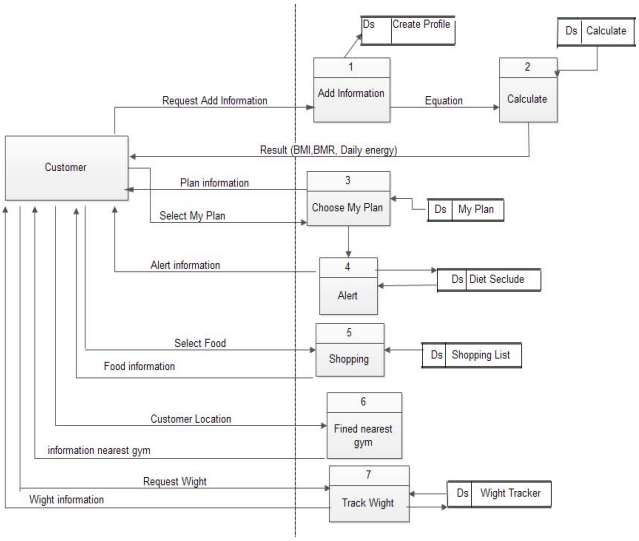

Figure 6. Data Flow Diagram

IV. IMPLEMENTATION

A. *Implementation and Execution Environments*

Hardware Specification:

- Smart phones: an Android smart phone is required to run the application after development.
- Computers: personal computers or laptops are required during development.

Software Specification:

Several software tools were required to develop the application with its embedded database:

- Emulator (SDK).
- Eclipse-Java to compile the code.
- Android platform 2.2 (Google API 8).
- Arabic libraries.

For Smartphones we needed:

- Network communication: full Internet access for Share-diet and Find-nearest-gym functions.
- Version 2.2 gingerbread to version 4.0 ice-cream sandwich for Android systems.

B. *Database Implementation*

We used the SQLite Database which is a relational database management system. It is included in a library programmed in C with approximately 500 kilobytes. The library of SQLite is integrated within the program that uses it. Figure 7 shows the six main classes that were imported for myPDA database which was implemented as an SQLite class in java. Figure 8 and Figure 9 show snapshots from the code for creating the myPDA database with its tables and columns in the User Table, respectively.

```
import android.content.ContentValues;
import android.content.Context;
import android.database.Cursor;
import android.database.sqlite.SQLiteDatabase;
import android.database.sqlite.SQLiteOpenHelper;
```

Figure 7. Class of SQLite Database

```
private final static String DatabaseName = "DietApplicationDB.db";

public final static String str_Tb_User = "User";
public final static String str_Tb_Plan = "Plan";
public final static String str_Tb_Plan_Details = "Plan_Details";
public final static String str_Tb_Plan_Days = "Plan_Days";
public final static String str_Tb_Diet_Schedule = "Diet_Schedule";
public final static String str_Tb_Shopping_List = "Shopping_List";
public final static String str_Tb_Weight_Tracker = "Weight_Tracker";
public final static String str_Tb_User_Profile = "User_Profile";
```

Figure 8. Creation of Database and Tables

```
public final static String str_CL_USER_USERNAME = "username";
public final static String str_CL_USER_PASSWORD = "password";
public final static String str_CL_USER_REMEMBERPASS = "remember_password";
public final static String str_CL_USER_SELECTED_PLAN_ID = "selected_plan_id";
public final static String str_CL_USER_LOGIN_STATUS = "login_status";
public final static String str_CL_USER_LAST_LOGIN = "last_login";
public final static String str_CL_USER_PROFILE_UID = "user_id";
public final static String str_CL_USER_PROFILE_AGE = "age";
public final static String str_CL_USER_PROFILE_HEIGHT = "height";
public final static String str_CL_USER_PROFILE_WEIGHT = "weight";
public final static String str_CL_USER_PROFILE_GENDER = "gender";
public final static String str_CL_USER_PROFILE_ACTIVITY = "activity";
```

Figure 9. Creation of Columns in User Table

C. *User Interface and Mobile Application*

We consider the most challenging part of our project to be creating a mobile interface that is user-friendly, while offering all functions expected by end users. Figure 10 illustrates the structure of the user interface that we have implemented showing all pages and dialogs.

The first page is the Logo Page. The application logo is displayed at the center of the page as shown in Figure 11 for a second and then the control moves to the second page.

The second page is the Login Page, shown in Figure 12. This page contains two fields: one for the username and the other for the password. A check-box for remembering login information is provided for direct login if the user already has an account.

In the Home Page, shown in Figure 13, the key functions of the application are displayed as icons. At the bottom there is a tutorial button which transfers users to the Tutorial Page, shown in Figure 14, which explains how to deal with the application and the key steps of each function.

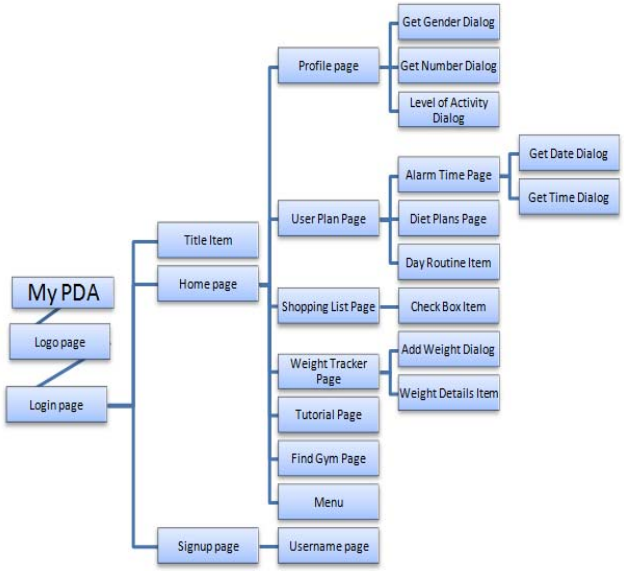

Figure 10. Interface Structure

The Profile Page, shown in Figure 15, contains the goal weight, age, height, weight, gender and activity as buttons so the user can create or update his profile. At the bottom of the page, the BMI, BMR and energy of the user are displayed after being calculated automatically by the system.

In the Weight Tracker Page shown in Figure 16, the user can track his weight by entering his current weight and the system will compare it with the previous and goal weights. It will also recalculate the BMI, BMR and energy accordingly.

My Plan Page consists of plan names displayed as buttons. Users select the plan they seek and the detailed plan will be displayed in response, as shown in Figure 17.

In the Diet Schedule Page, shown in Figure 18, the user can choose a starting date for his diet and the alarm time of each meal.

In the Shopping List Page, shown in Figure 19, a list of foods that corresponds to the diet plan selected by the user is displayed with a check-box next to each item to indicate whether this item has been purchased or not.

The user can choose to share his plan or profile with his doctor or anybody else using one of the social networking applications available in his phone, as shown in Figure 20.

In the Find Nearest Gym Page, the application connects with Google Maps to find the location of the nearest gym based on the user's current location, as shown in Figure 21. We believe that this function is a distinguishing function for myPDA as our m-diet application survey has not found any m-diet application providing the same function, except via its website. Implementing this function was among the most difficult problems we faced in this project. It was challenging to link Google Maps with the application and then to search for the nearest gym. Defining the word 'gym' in the code to be recognizable by the search engine was not an easy task. Moreover, the issue of narrowing down the search to a particular range was also difficult to resolve, but had to be done, because a wide search range would require a powerful memory.

V. TESTING AND EVALUATION

We set a general work plan to test myPDA in a continuous manner, so we started by testing each unit separately, then we tested for correct integration between units and finally we tested the functionality of the whole system.

The unit testing went smoothly except for one problem related to Platform 2.2, which does not support the Arabic language, so Arabic letters were displayed intermittently. We finally tackled this problem by adding three classes to define the Arabic language and connect the letters together.

In integration testing, we insured that all application pages with links have correctly-working links. For each application page connecting to the database, we insured that the connection is functioning and that the returned results are correct. This integration testing was also among the most difficult jobs we have gone through in this project. As sometimes a database table was working correctly and a page is also functioning perfectly, however when we try connecting the two, a problem occurred. For instance, we needed to link each food plan with a certain shopping list and we faced many problems in implementing these links.

After successfully solving all the integration problems, we were able to test the entire system. We examined the overall functionality of the application, ensuring that high priority requirements of the application are implemented. Testing the myPDA system was by first converting the code to .APK file, and downloading it on three Samsung Galaxy S™ II Android Smartphoneto find disparities between implementation and specifications.

After finishing the entire testing process, we prepared a short questionnaire for users as a part of the preliminary evaluation process to get their feedback about the application user-friendliness and learnability. As indicated in section II, scarcity of diet applications in Arabic language and the lack of Arab users for these applications, as well as low level of awareness of obesity-associated problems made it difficult for us to collect enough information. However, the thirty responses we received were all positive. The only negative feedback was related to the font size in some screens, specifically the Home Page and the first screen of the Diet Plan Page.

To evaluate the usability and effectiveness of myPDA, several issues should be considered as previous studies stated that there are several critical issues related to evaluating obesity tackling programs [2]. For instance, ‘what outcomes need to be measured?’, ’Which population should be studied?’, ‘How long should the study last?’ and ‘How many times should the study be repeated?’ just to name a few. Additionally, using ordinary quantitative tests is difficult in assisting the improvement level in long-term characteristics such as the compulsive eating habit characterizing many obese people. Furthermore, even when a participant loses weight successfully, it is difficult to attribute that to the software.

Even though the evaluation of such application is difficult, it is planned to be carried out as a next phase for this project. A scientific group including programmers, dietitians and nutritionists would carry out a detailed evaluation of the content in a form of a cognitive walkthrough. Furthermore, a pilot study on randomized samples would be carried out by a specialized research team with measurements taken pre- and post-intervention. We are preparing to apply for approval to conduct such a study.

VI. CONCLUSION

Year after year, the rate of obesity has increased across the world, alarming of many heart and chronological diseases. Use of mobile phones for health applications has been visible in the market and has provided many opportunities to improve the quality of life at reduced costs and efforts.

This paper presents the complete process of developing an Arabic Android application called myPDA, which utilizes and integrates many tools and technologies to help in tackling the obesity problem. The process included many phases beginning from the software requirements gathering and ending with the testing and evaluating of a fully running application.

The application offers the user many functions such as creating a profile and sharing it with friends or dietitians, tracking weight, choosing a diet plan, displaying a shopping list, alerting of meal times and finding the nearest gym.

There are several near future tasks that would complement this work. We need to add more diet plans and food nutrition information. Also, we need to add more functions to promote exercising. We intend to create a supporting website for the application with additional features and functionalities. Additionally, we are preparing to conduct a systematic evaluation of the application in a form of a cognitive walkthrough and a pilot study with a specialized research team. It is our hope, through conducting this work, to have myPDA contributing to the preservation of public health.

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Figure 11. Logo page

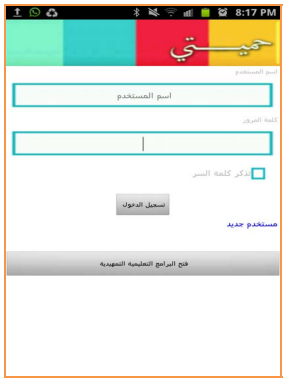

Figure 12. Login Page

Figure 13. Home Page

Figure 14. Tutorial Page

Figure 15. Profile Page

Figure 16. Weight Tracker

Figure 17. Diet Plan Page

Figure 18. Diet Schedule Dialog

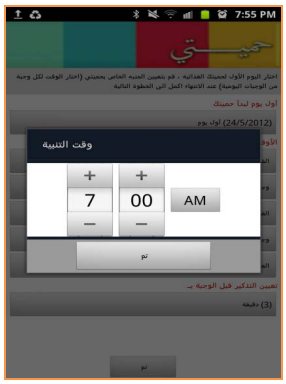

Figure 19. Shopping List

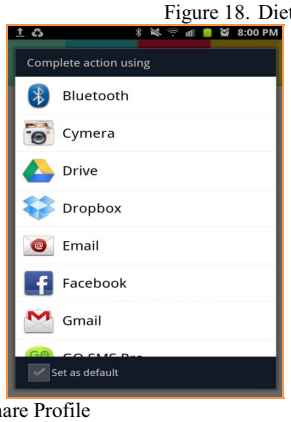

Figure 20. Share Profile

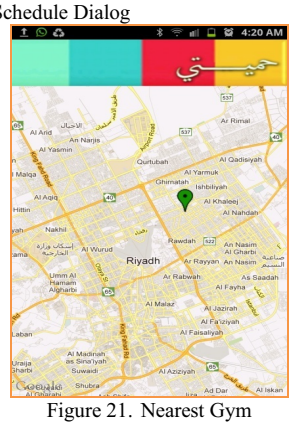

Figure 21. Nearest Gym