An Investigation into Mobile Based Approach for Healthcare Activites Occupational Therapy System

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***Abstract* — This research is to design and optimize the high quality of mobile apps, especially for iOS. The objective of this research is to develop a mobile system for Occupational therapy specialists to access and retrieval information. The investigation identifies the key points of using mobile-D agile methodology in mobile application development. It considers current applications within a different platform. It achieves new apps (OTS) for the health care activities.**

Keywords-component; Mobile Apps; Health care; Agile Methodology; Mobile-D; Design; Optimzation; Testing.

I. INTRODUCTION

Mobile application development has progressed rapidly in the recent years to provide a better performance for the users. Mobile technology has developed in terms of technology 'Data communication' and real world apps 'Mobile apps'. Mobile apps have increased and improved in different aspects such as health sector. Having more demands on mobile apps from the users and organizational needs made the numbers of different platforms and tools to increase significantly in order to improve mobile applications for various purposes [16]. Mobile computing is a 'computing that allows continuous access to remote resources, even to small computing devices such as laptops and digital cell phones' [6: p.2]. Then, Occupational Therapy (OT) enables 'people to achieve health well-being and life satisfaction through participation in occupation' [20: p.761].

II. AIMS AND OBJECTIVES

This research is to deploy an advanced methodology in mobile apps. It is aimed to develop Occupational Therapy System (OTS) mobile application for the heath sector, which establishes the communication channel between the patients and therapists. To access of the resources, information and healthcare service delivery through wireless technology [22]. Improving patient safety and reducing costs are increasingly recognized and emphasized [22]. Design of the application within this research is based on using mobile computing and software development. It is a multi-tire iOS mobile application to improve some issues within the health sector. It consists of the two main sections which are server side and client side (user interface). Furthermore, the vision behind this application is to provide core functionalities to the patients and then improving the health sector through identifying different functionalities.

Usability, recovery error (robust), clear navigation and minimum number of views are the main fundamental functionalities within the application. Other functionalities are delivery services in short time and secure process (Authentication). Moreover, Data storage on the server side (cloud) is one of the essential functionality, which leads to increasing the performance of the application. Furthermore, significant differences in mobile applications especially within OTS are a design and optimization. This research concentrates on the design and optimization within the application to improve the usability and user interface design. There are some specifications that identify what OTS mobile application exactly does:

- The OTS application consists of three essential sections as a tab bar style. It includes login, registration and support for the patients and therapists.
- Only registered users (patients or therapists) can access to the main view of the OTS application.
- The main view includes different services such as create assessment, view assessment and access to therapist feedback.

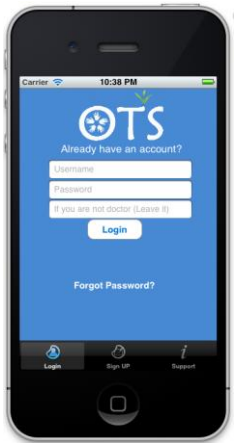

Figure 1 OTS Mobile Application

Besides, OTS has been designed based on some of the issues within mobile applications design.

III. BACKGROUND

The background of this research is categorized into some crucial sections which are Employed Method, Mobile Apps Design, Implementation and Testing.

A. Employed Method 'Mobile-D Agile Methodology'

Methodology is defined as a sequence process or 'road map to execute the processes to achieve the result' [9: p.27]. The agile methodologies are designed based on reduction and customization within the development process and being more flexible [15]. Another definition for agile development

methodology is 'incremental (multiple releases), cooperative (a strong cooperation between developer and client), straightforward (easy to understand and modify) and adaptive (allowing for frequent changes)' [1: p.17].

'4-DAT' is an analytical framework which is based on the four elements to analyse the agility of methodology for instance, method scope, agility characterization, agile values characterization and Software Process Characterization [13]. The core functionality and fundamental elements in agile methodology for developing mobile application consist of the 'simple design principles, a large number of releases in a short time frame, extensive use of refactoring, pair programming, test-driven development' [12: p.2].

Mobile-D is defined as 'the method is based on agile practices, drawing elements from well established agile methods such as Extreme Programming and Crystal Methodologies [2: p.4]. Meanwhile, the mobile-D is adopted from the different methodologies such as XP practices, scrum and RUP phases [12]. Test-Driven Development (TDD) is defined as XP method for developing an application based on reducing the iterations [17]. It is one of the techniques or approaches to develop software which is based on writing test code (Unit test) before beginning to write coding for the application (program) [3][11].

There are some of the advantages of Mobile-D agile methodology for mobile application development, for instance 'increased progress visibility, earlier discovery and repair of technical issues, low defect density in the final product, and a constant progress in development' [2: p.175].

Having more advantages of using agile methodology are crucial to identify the way how to manage and create a plan during the development processes of the application. However, having more complexity during the combination of different plans and lacking 'scientific validation' are some of the arguments against agile methodologies generally [16].

Adaptability of mobile development and each of the Mobile-D phases have been identified clearly in detail to simplify the whole processes during the development. In addition, Mobile-D is providing the software documentation completely [16]. Then, short iterations support changing user requirements frequently which makes more agility rather than to be fixed with the requirements. Having more efficiency because of pair programming which allows the maintenance and development easily. Stability is one of the vital advantages between the stakeholder requirements and developers [16].

On the other hand, Mobile-D is not perfect for the complex or large system. Then, it has other weak points in terms of testing an application. For that reason, mobile-D should be adjusted with TDD to test different sections within the project [16][17].

B. Mobile Apps Design

The backbone of mobile and software applications is based on having a good design [10]. There are some of the basic principles to design mobile application, for instance readability, navigation, hotspots, pagination, button and call to action [5]. Useful, desirable, accessible, credible, findable and usable are different aspects that increase the value of mobile applications [5]. Furthermore, user interface design is a set of command or key navigation which can be used by users to use the application [4][19]. Pettini (2007) indicates that context is the main concept to design the application which is divided into three elements which are context of use (analyse requirements), context of medium (deign) and context of evaluation (testing /evaluation) [4].

The rationale behind using MVC is critical to decrease the limitation and expand the advantages of mobile application by providing full functionality on the server to be accessed by the clients [7]. For that reason, model, view and controller might be reused repeatedly which leads to produce another application [8].

One of the advantages of using MVC is to minimize or optimise the architecture of mobile applications [8]. Then, it is to provide a better maintenance for the functionalities of an application separately. Moreover, reusability is another advantage of MVC in terms of writing less programming code.

However, some of the most important classes which are absent within iOS to develop dual-platform mobile applications [19]. That is why it is one of the weak points of iOS to use MVC effectively because those classes are responsible of controlling data management and user interface design.

C. Implementation

Implementation of the OTS mobile application includes both sides of the OTS application, which are patients and therapists. Furthermore, it explains that how OTS mobile application has been implemented based on Model View Controller (MVC).

D. Testing

Testing mobile application is one of the essential parts within developing mobile applications [14]. Unlike software development, testing mobile application is difficult and more complex [14][18]. The life cycle of testing mobile application includes 'Testing Environment', 'Levels of Testing', 'Testing Techniques' and 'Scope of the Testing'.

White box testing and black box testing are fundamental classes to test applications [21]. White box testing (structural testing) is defined as 'testing that takes into account the internal mechanism of a system or component' [14: p.36]. Furthermore, it is called structural testing which includes Unit test. This type of test is inside the test level of the mobile application testing. Unit test is defined as a 'smallest testable piece of software that can be compiled, linked, loaded for example functions/procedures, classes, and interfaces' [14: p.1455].

However, Black box is defined testing as 'testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions' [21: p.36]. Furthermore, it is called functional testing which includes the test scope within the mobile application testing.

IV. EMPLOYED METHODO (CASE STUDY)

The research method employed based on comparisons between some of the agile methodologies and assessing them. The ability of continuous changes during the development, improving the quality of the product and customer satisfaction, reducing wasting time by completing the development in short periods and predictability are several key factors lead to increasing the practicality of using agile methodology from some organizations.Having different software development methodologies makes it difficult to indicate the appropriate methodology within the project.

Several agile methodologies are described and compared in terms of their strength as well as weakness based on key points, characteristics and limitations such as Extreme programming (XP), Crystal methodologies and Rational Unified Process (RUP). However, none of them are specified separately to develop and implement mobile applications. That is why a suitable agile methodology for mobile application development called Mobile-D which supports the agility of mobile application.

The Mobile-D agile methodology consists of the five main phases which are Explore, Initialize, Productionize, Stabilize, and System Test & Fix. Each phase includes different iterations which are identified in Figure 2.

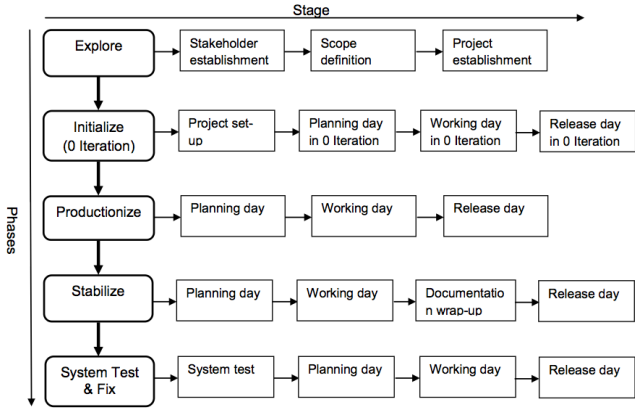

Figure 2 Mobile-D Agile Methodology Phases and Stages

A. *Explore*

Explore means to setup initial characteristics version of the project requirements and establishing the project plan. The main purpose of explore phase is to highlight the scopes and requirements within the project.

B. *Initialize (0 Iteration)*

When the initial requirements and plans of the project are well-organised and established, then, the Initialize phase begins which requires from the developer to build the first iteration within the project. Identifying the resources within the project technically and physically is one of the key points of this phase. Then, providing the communication channel between the developer and stakeholders is another important point during the application development.

C. *Productionize*

It means the implementation of functionalities that are collected within the Explore and Initialize phases of the project. In addition, it is divided into three stages. Firstly, the purpose of the planning day stage is to analyse the gathered requirements and prioritizing them to identify the core functionalities within the project. Then, it is providing iterations planning for implementation of the application development process which is called pre-established plan with compromising the test plan.

Secondly, working days step begins heading towards the pre-established plan which is provided to complete the core functionalities by using Test-Driven Development. Finally, when the testing process has been done perfectly release days step is the working version of the application which is produced successfully.

D. *Stabilize*

It means to collect and combine iterations together to finalise the product. To stabilise the application, one of the vital stages is to integrate all parts and putting them together as each system divided to different parts.

E. *System Test & Fix*

System Test & Fix is the final phase of Mobile-D agile methodology which based on the application testing frequently, fixing errors and finalises, complete the documentation of the application.

Having more characteristics and advantages of using agile methodology in terms of software development makes the agile methods more popular. Then, Mobile-D has been chosen because it is an agile methodology which is specified to develop mobile application.

V. SYSTEM DESIGN

To maximize the value of application, designers and developers should be concerned about different aspects and principles in mobile application development. In addition, it is important to make a comparison between some of the implemented user interfaces and then design the new interface with more efficiency.

This research consists of designing OTS architecture and diagrams based on using Model View Controller (MVC). Designing interface for the mobile application is about the achievements of the application and how it looks to produce the high quality interface design of an application. Usability and accessibility are two vital elements to obtain acceptable design. User experience which means utilizing the applications with features/services from users. Furthermore, Button sound (audible), standard fonts, zoom and alert vibration and background colours are some features in mobile applications.

Flowchart, wireframes and stylization/skinning are some of the essential ways to design the applications to create an intuitive application interface and to produce fixed overall design of the applications. User interface design is one of the challenges for mobile application.

High quality of user interface design of the applications can be achieved through making an attractive application user interface, usability which is simplicity of screen size, limitation which provides different keyboards based on the input information. Some functionality should be considered and applied in designing the applications such as user input format, use of context and present minimum information on the screen.

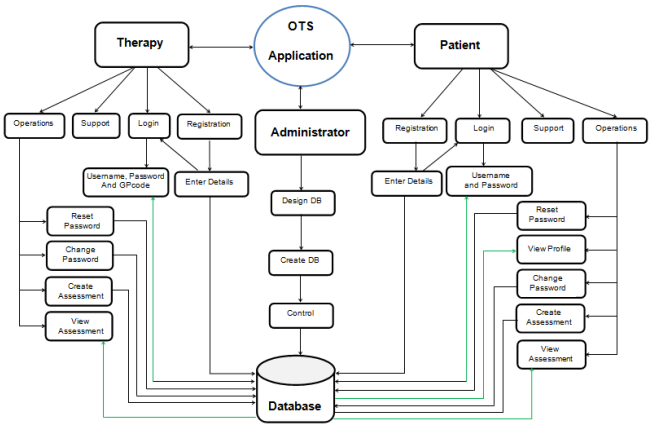

Figure 3 OTS Screen Design and User Interface

VI. IMPLEMENTATION

A. *Classes and Operations (Model)*

In this project, different operations are implemented to meet the OTS requirements and specifications. Each of the operations within the application consists of the two classes with the graphical user interface. Classes are implemented to store and manage the information within the application.

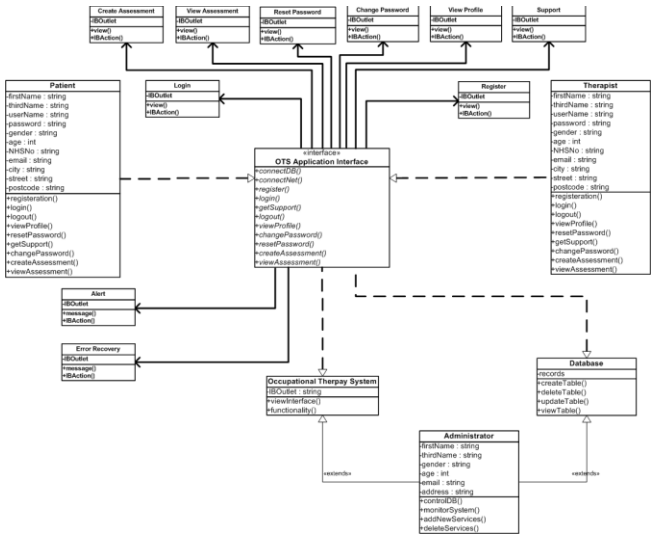

Figure 4 OTS Class Diagram

B. *Graphical User Interfae (View)*

It allows users to do various operations on the OTS application. The application user interfaces (views) are related to the View layer within the MVC. The OTS consists of tab bar navigation to switch between login; registration process and support as shown in Figure 1. Figure 2 illustrates the other views of the application.

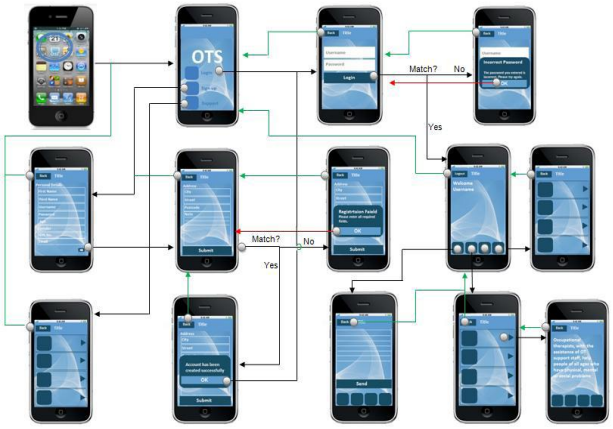

Figure 5 OTS Screen Design and User Interface

C. *Appication Control (Control)*

The final section within the MVC is a Control. The OTS application controls the connection between more views and models. The OTS database is uploaded to the indicated server, the connection is established through access and request to the files from the client side. Then, the query against client's requests executed within the server side.

VII. TESTING

Different techniques identified to measure the quality of mobile applications because testing plan requires appropriate strategies and techniques.

A. *The Application Testing in this Research*

The OTS application has been tested based on mobile application testing. It covers each sections of the life cycle of mobile application testing as shown in Figure 5.

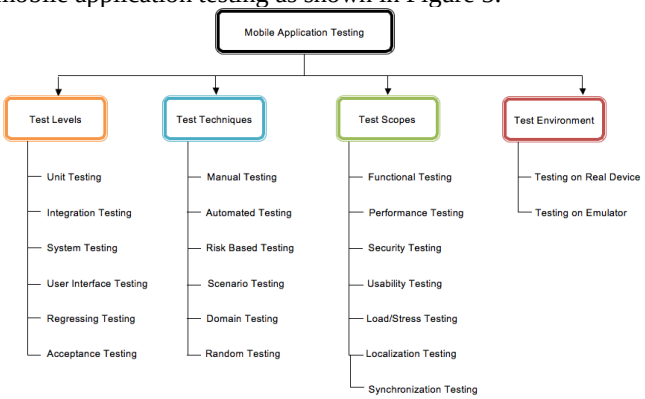

Figure 6 Life Cycle of Testing Mobile Application

In Testing Environment, during the development, the simulator used to test each actions and steps of the OTS application. In Levels of Testing, the application tested through White box testing (Unit testing). When the implementation phase of the application has been completed successfully, then unit testing begins by the developers. Then, the OTS application has been tested by a developer,

post graduated graduate student and the supervisor, which is an Acceptance testing.

In Testing Techniques, Automated testing used within the project, the automated test case allows unit testing performs within the iOS platform. In Scope of the Testing, the application has been tested through Black box testing which includes different areas such as Functional Testing, Security Testing and Usability Testing.

Rational behind testing mobile application is that developers focus on and concern about the functionalities of the applications rather than testing applications on the real device. Moreover, lack of specific software to test mobile applications. Different types, techniques and tool of testing are given in order to improve the design of OTS application, to provide run able application. There are some crucial points behind testing application. Firstly, it is to verify that the source codes works perfectly. Then, it is to ensure that the application is stabilised and ready to use.

VIII. Results

It seems that there are some mobile applications which are designed for the purpose of a healthy life. Different tools and languages used within this project to create OTS mobile application for iOS platform. In this research, NHS direct and Epocrates iPhone applications are disciplined and analysed based on the principles of mobile application design. Lists of current issues in the health sector are identified. Furthermore, new designs of the mobile application achieved which minimizing some issues within those applications, OTS mobile application obtained which works on the iOS platform.

It is a multi-tire mobile application (client and server sides) which will be used within the health sector. The communication channel obtained through the application between the patients and therapists. In addition, the application optimized and minimized the number of views for different purposes such as easy to use, more user friendly and clear navigation.

IX. Evaluation and Analysis

This research is to create a mobile application for iOS platform. The aim was to organise, obtain and collect valuable resources within this research. Document design is one of the crucial steps before applications development begins. For that reason, the appropriate methodology (MVC) to design the OTS application was given. Then, functionalities of the application had been identified.

Furthermore, the OTS application had been designed technically such as architecture of user interface and server side, UML diagrams for the functionalities and screen designs. Theoretically, designing document consisted of the outlines of the application which include different sections on the application identification in detail. Moreover, designing document provided the initial document to clarify goals and overall ideas about the application. After that, it is possible to restructure or modify the outlines within the application. One of the views was well structure planning at the beginning of the project. Furthermore, analysing requirements specification, establishing communication channels and designing functionalities within the project are other successful aspects.

The connection between the background of this research and the OTS project is based on different views such as user interface design, usability and functionality. Furthermore, NHS Direct, Epocrates applications have been chosen because of compatibility with OTS project. Both of applications had been used for the purposes that they are related to the health sector. OTS application comes out based on those existed applications and other systems, which operated on different platforms. Furthermore, OTS application is reviewed and strengthened in terms of readability, navigation, pagination, hotspots, buttons, and call to action.

This project was managed through using agile methodology to develop mobile application. Furthermore, it considered choosing specific methods for mobile application development, which is Mobile-D agile methodology. Mobile-D is a combination of different agile methodologies in software development such as XP, Crystal and RUP. Mobile-D phases and stages had been applied within OTS project.

Despite efforts to identify Mobile-D advantages and disadvantages, there are some points require to be extended to improve of the Mobile-D methodology in mobile application development. One of the Mobile-D weak points is testing. Besides, to minimize disadvantages of Mobile-D methodology, different approaches to test the application are given.

If you take the advantages of Mobile-D methodology through iterations or reviews, Iterations in each phase of the Mobile-D made the application more robust (error free), reliable in terms of functionality. In terms of usability, it made the OTS application easy to use and simple. Those positive observations had been achieved through the OTS application. Solving the issues technically and efficiently extended the advantages of Mobile-D methodology within the mobile application development.

X. Conclusion and Future Work

To sum up, this research proposed to use appropriate methodology for OTS mobile application. In the research method, it disciplined agile methodologies such as XP, Crystal and RUP. Mobile-D agile methodology had been chosen because it is a combination of those declared methodologies. Furthermore, all phases of the Mobile-D are explained with Mobile-D advantages and disadvantages in mobile application development. The research conduct explains how different phases of Mobile-D are applied within this research.

Some applications and existing systems for iOS platform had been taken into account. Different tools and software are discussed in terms of mobile application for iOS platform. The fundamental features of usability are stated in OTS application such as effectiveness, efficiency and satisfaction.

In the design section, this research explained a brief background and some principles of design mobile

applications. It presented each layers of Model View Controller (MVC) with advantages and disadvantages in mobile application development. The Architecture of the application outlined in design section such as functionality architecture and system architecture.

The implementation and testing of mobile application are organised in a different sections. Implementation part explains how OTS application is implemented. Furthermore, testing section includes a background of testing mobile application. It identified different types of testing mobile application such as Black box and White box testing. Both types of testing are applied within the OTS mobile application. In evaluation section, project evaluation, theoretical evaluation of the project and methodology evaluation had been analysed.

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