

# Studying User Interface and Usability for Mobile Application

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**Abstract:** *People are currently using mobile and smart devices to make use of online services. Many of them find major challenges to interact with the interface of these mobile devices. This is because of the complicated design of interface elements which doesn't meet the potential users' needs, ages, skills and capabilities. Therefore, it is important to develop a friendly interface which provide simplicity to users so that they can use mobile effectively. The interface should be designed in conformity with findings from ethnographic research, open standards, usability testing, customers' involvement and experts' reviews. An e-Clinic management application is proposed and implemented for an iOS-based platform. This important application is used to improve the interaction between patients and their doctors, especially for lately years while mobile communication technology is developing rapidly. The advantage of the proposed application consists of giving patients the ability to be connected with e-Health providers for fast medical follow-up. It allows patients to book appointments quickly with the possibility of selecting the best time and date. All this process can be completed within two minutes without the need to call or visit the clinic reception.*

**Keywords:** *e-Clinic; Usability; Mobile; Medical Service.*

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## 1. Introduction

Nowadays, a large number of people are complaining about the bad or unclear interaction design of mobile devices. It is important to investigate that whether this problem is caused by the bad design of mobile application or different age group users. User interface (UI) is the point when users and computer interact, including both software and hardware. The meaning of Interaction design is designing interactive mobile application to support people in their daily usage. The primary key question for interaction design here is: how do designers optimize the users' interactions with the interactive mobile application to identify user's needs and their activities. In order to design usable, useful, and enjoyable mobile application, interface designers and technical practitioners should always take into account the people who are going to use this mobile application.

User Interface is a very important concept to introduce which enhances user experience, in general with the systems especially the ones like health application. Additionally, Human-computer interaction (HCI) is the study of the interaction between people and computers. Designs in human-computer interaction (HCI) aim to create interactive mobile application that are easy and enjoyable to use. It also makes an attempt to

investigate the principles for designing mobile interfaces that results in effectiveness of user acceptance and find out possible solutions to the problems with mobile device interaction design. HCI and user experience (UX) research are significantly different. Research in different domains such as academia or industry often seem to deal with fundamentally similar objects: the understanding and design of interactive digital systems and their human users. Both domains are follow user-centered design processes and are advocates for making the understanding of human values.

Mobile devices play an important role in our daily life. They are being used by people of all age group for various purposes. They can be found in the fields of education, health, entertainment, communication service, and so on. Designing user interfaces for mobile devices poses several interaction challenges. Furthermore, interaction designers have placed their attention on user goals and experience and evaluate designs in terms of usability. Furthermore, good interaction design is user-centric; its goal is to reduce disappointment or misunderstanding and increase user satisfaction and productivity. It is the user that makes actual use of a mobile application. Therefore, only by involving real users, interaction designer can become able to properly tailor and maximize

usability. Also through the use of mobile application, designers gain the ability to better understand user experiences.

The most important point of using mobile technologies is to improve health and health care delivery. e-Health mobile applications could help people manage their own health and wellness especially older or young people. For young people, these kind of applications will educate them more about new articles as well as it will educate them more about different diseases, various kinds of infectious diseases and their causes. For older people, the mobile technologies will help them to get more education about their health problem and remind them of next appointment or their medicines. To developing E-health mobile application, it's important to understand that what types of applications can be designed across UX and UI principle.

## 2. Literature Review

The literature on “Studying User Interface, User Experience and Usability for Mobile Application” can be subdivided as follows:

### 2.1. Mobile application that developed for clinics

There a lot of applications that are developed for improving doctor-patient interaction system based on different platform such as iOS and Android. e-Health applications are needed to make life style easier. Its excellent performance on mobile terminals makes it possible that patients are able to access his/her medical report, request an appointment and share some articles and stories. Additionally, some applications give doctors opportunity to track and monitoring patient situation.

For example, Mayo 1 clinic application which is developed based on iOS and android platform. The aim of this application is to put patient’s medical record into his/her account. The advantage is that patient can follow and track his/her situation at any time and also ask care team without visiting Mayo clinic. Moreover, the patient can receive health information delivered every day such as lab result, radiology result and pathology report. This app has a similar and basic function which mainly include request appointment, reminder, contact us and map and location.

Also, Cleveland2 Clinic has been developed based on iOS platform. The aim of this application is to provide access of medical record to patients. This app has a similar and basic function like our application which include request appointment, reminder, contact us and map and location. Moreover, this application will publish medical article daily to educate users and it can share through Facebook or twitter. Also, through this application, users will have their own pages to tell some stories related to health domain.

<sup>1</sup> <http://www.mayoclinic.org/apps/mayo-clinic>

<sup>2</sup> <http://my.clevelandclinic.org/mobile-apps/mychart-app>

### 2.2. Studying literature for User Interface, User Experience and Usability for Mobile Application

Our daily life is totally depending on different types of applications such as google map, ordering food, e-Clinic and learning application. All these different filed projects have to do testing after development cycle, however it depends on project type usability attribute that will help in making final choice. The main idea behind testing usability is to measure the most important attributes such as effectiveness, satisfaction and efficiency. User testing is deliberated as the most effective method to define user interface gaps and measure usability level.

In paper [2], group of researchers in Brazil have developed automated test application which is based on brain computer interface. The idea of this automated test is to collect amount of data such as number of errors during perform tasks. Furthermore, a group of researchers in paper [2] found a strong link between user behavior and learning. This strong link which can improve learning and increase usability attributes such as acceptance and efficiency. Understanding user behavior, emotions and mood are considered as affective state in designing user interface. The multimodal affective used different external and internal sensor to monitor user behavior and emotions. The authors found utility, level of accessibility and satisfaction as most usability attributes, which are important to be measured in learning application. In paper [3], the author has second opinion to define that which are critical components to have a successful leaning. The designer has to focus on factor of utilization which is made possible by adopting two important factors of user’s needs and usability. Such objective can be achieved by performing well defined tasks efficiently, effectively and with satisfaction. Moreover, focus on how to make application easier to use and ease to learn found that usability comprises five attributes (Nielsen’s usability model) [3]. Completing usability’s five characteristics is very important but most of researchers outlined efficiency and satisfaction as important attributes of usability [4].

#### 2.2.1 Mobile User Experience

The white paper titled “Creating an Effective Mobile User Experience” published by Adobe focuses on the significance and importance of developing a user interface that would give an intuitive experience to the users according to their specific needs and requirements. This objective can be achieved by using user-centered design approach with an integrated focus on ethnographic research. This design approach can be made more specific by ensuring iterative usability testing based on ethnographic requirements of the end users. The authors divided the user experience into three stages:

perception, interaction and reaction. Also, they mention that creating usable interface require a special team which mainly included technologist, graphic designer, usability specialist and ethnography specialist. Authors further explained that the ideal methodology for developing such an interface is by using open standards to create interoperability across platforms and simplified interface designs along with interactive development to ensure continuous process of improvement [5].

### 2.2.2 Usability Models

The author discusses two traditional usability models to produce another usability model which is helpful for addressing the needs of mobile application in order to create a more comprehensive model. The paper provided PACMAD (People At the Centre of Mobile Application Development) usability model which augments existing usability models within the context of mobile applications. Previously, researchers were in search of mobile usability models in different research papers and they found that usability is usually measured in terms of three attributes: Effectiveness, Efficiency and Satisfaction. Other attributes, such as Learnability, Memorability, Errors, and Cognitive load, are considered to be of less important. Usability attributes are likely to have an impact on the success or failure of an application. Therefore, one of existing models of usability is Nielsen which is identified five attributes of usability; Efficiency, Learnability, Memorability, Errors and Satisfaction. Unlike International Organization for Standardization (ISO) defined usability as the "Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". This definition identifies three factors that should be considered when evaluating usability: User, Goal and Context of use. The differences between these models is that ISO does not consider Learnability, Memorability and Errors to be attributes of a product's usability.

The PACMAD usability model incorporates the attributes of both the International Organization for Standardization (ISO standard (and Nielsen's model. Moreover, PACMAD consider attribute of cognitive load which is of particular importance to mobile applications. In PACMAD, the designer should consider three factors (User, Task and Context of use) to develop mobile applications. Each of these factors will impact the final design of the interface for the mobile application. Additionally, the author found that the task is the most dominant factor being researched than Context of use and the User.

The PACMAD usability model identifies 7 attributes which reflect the usability of an application: Effectiveness, Efficiency, Satisfaction, Learnability, Memorability, Errors and Cognitive load. Each of these attributes has an impact on the overall usability of the application and as such can be used to help assess the usability of the application.

To evaluate the PACMAD usability model; it is important to know what are the most common attributes to measure usability for mobile applications, Effectiveness, Efficiency and Satisfaction. All of these attributes correspond to the attributes identified by the ISO's standard for usability and also relatively easy to measure. Moreover, usability model for mobile applications could be evaluated by determine how users would use a technology outside of a controlled setting [6].

The limitation of usability is to develop application with screen size, poor connectivity and limited input modalities that have an effect on the usability of mobile applications. However, one of the biggest limitations to mobile devices is the limited input modalities according to small screen size.

User Interface:

Many seniors face difficulties in making comfortable use of computers and the survival of physical and mental activity. This problem was discovered by the American Association of Retired Persons interview. To resolve this issue, a strategy has been developed for the trivia game. The aim of the game is to make users more comfortable on the Internet, motivate them to learn computer, to increase efficiency and to enhance lifestyle. The game contains seven different pages. These pages include login (Start page), information about the game, registration to the game, a reminder when you forget the password, welcome screen, puzzle, hint to solve puzzle and prize claim. It has been developed the game and design of two models and do survey. Based on the user feedback and usability testing, it has been holding additional modifications in the design to suit the elderly. The biggest challenge in the design of new improvements to the interface is easy to use and navigate between pages easier. Due to the lack of a database (to save and store the data of people), the American Association of Retired Persons can't communicate to interview the winner, and the user will not receive e-mail notification about where the prize. There are still many of the additions that must be done before it becomes a fully functional game product. The most important addition is the database on the Internet. To create a fully functioning system, the database you need online to be linked and integrated with the user interface [7].

This paper focuses on the experiment for usability testing using a Tablet (iPad 4th generation) to application Sale Force Automation (SFA). It has worked the experience in the "Laboratory of Movement Analysis and Interface Ergonomics, Institute of Computer Science, Lublin University of Technology in November 2014" [8]. It made use of special glasses to eye tracking because it gives more accurate information about the participants interact with the application interface. Detection of a group of problems hinder the usability. Also, such system help the work of sales representatives working away from headquarters and offices. The application has tested by beginner and not trained users. The overall

experience of testers was bad with the iPad device because it is not a widespread mobile device in Poland. It also helps in detecting a problem when using the interface. Finally, to usability testing, survey was carried out to measure satisfaction with the application through a questionnaire. The majority of the participants, 85% rated positively. Disadvantages of this experiment to study usability with four scenarios for 14 days, a period of long, costly and arduous [8].

### 3. Methodology

This study aims to evaluate the usability of health care mobile application prototype design. The goal is to examine usability and user experience as well as to achieve a system functionality. In this research, we applied an experiment on male and female participant with age range of 16 to 60 years old. The experiment was carried out with e-Clinic app, which is management software for healthcare specifically designed for patient. It allows patients to make appointment and remind upcoming appointment. It also helps in collecting requirement with help of volunteer by using the prototype version. After finishing with the low fidelity prototype, we prepared a dummy e-Clinic app using computers in the form of iPhone design. As we planned the e-Clinic app should be implemented in an iPhone operating system. But for this stage, the prototype is implemented using online moqups<sup>3</sup> tool. Therefore, we can observe the participant interaction and we can understand their needs as well. With the help of the team members' families, we could apply the experiment and collect the feedback from the participant regarding the e-Clinic app with answering the questionnaire form. After the experiment, we could find the gaps that should be developed in the next stage.

### 4. Experimental Design

This research is targeting mainly the participants, including male and female participants from age range of 16 to 60 years old in Saudi Arabia who can participate via a mobile application prototype. After the first experiment using low fidelity prototype, we tried to apply higher fidelity prototype on different participant's age and skills level, so it will be their first attempt. We have collected data from 6 participant within age 16 to 60 years old, three males and three females. The participants are from different backgrounds, skills level and demographics. They are in their normal mood.

For expert participants (EP), we had two experts to do the cognitive walk-through evaluation. EP1 is Master of software engineering students and EP2 is Doctor of Philosophy (PHD) of software engineering who have a good experience on Information technology (IT) field.

#### A. Setting

##### The setting of the experiment

##### 1. Before the experiment

All of the experimental session is taking place in the participant's homes, so participants will be more comfortable and able to do all the tasks. There should be a mobile device; smart phone to apply all the tasks which is described in Usability Testing report. The app was introduced to the participant before starting the testing.

##### 2. During the experiment

For the recording session, a mobile Camera is included in the setting, so we will hold it and record while the participant is applying the tasks.

##### 3. After the experiment

A questionnaire is given to participant to take the feedback and evaluate mobile app.

##### 4. Expert experiment

The same app that was applied to the participant is given to the experts. A special questionnaire to take their feedback.

#### B. Materials

For the mobile application, we first worked to transform the low fidelity prototype (paper prototype) to a high fidelity prototype (interactive prototype running on the mobile or laptop). The examiners will use high fidelity prototype used by fluidui<sup>4</sup> tool of the mobile application. We first worked to transform the low fidelity prototype (paper prototype) to a high fidelity prototype (interactive prototype running on the iPhone). Furthermore, we used another tool to transform the low fidelity prototype to a high fidelity prototype to real app that ready to publish using AppMachine<sup>5</sup>.

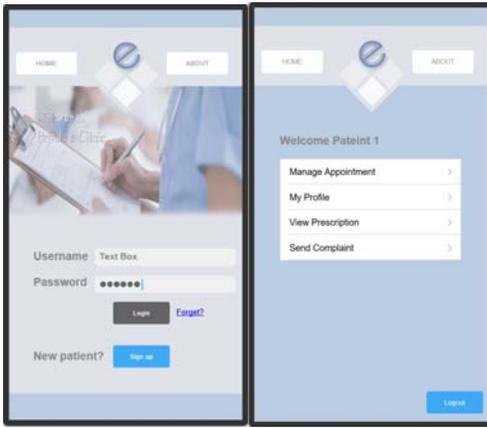
We designed the home page shown in figure 1.A. The home page interface contains login form allows a user to login into the e-Clinic system by providing it is user name and password. If a patient is using the system for the first time, he/she should click on "Sign up" to fill the registration form to create an account. The link "Forget your password?" would allow a user to recover his/her password.

Once the patient is logged into the system, his/her home page, shown by figure 1.B, will be displayed on the navigation his/her function: Manage Appointment, My Profile, View Prescription, Send Complaint and Logout.

<sup>3</sup> <https://moqups.com/>

<sup>4</sup> <https://www.fluidui.com/>

<sup>5</sup> <http://www.appmachine.com/>



**Figure 1.A.** e-Clinic Home page. **Figure 1.B.** patient home page

## C. Procedures

### 1. Participants: Persons

#### Pretest

In this study, the researchers began with explaining the experiment to the persons first. Then, they equipped the room with the experiment sittings: table, two chairs, laptop and camera phone. Before the examiner start explaining the experiment to the persons, they engaged in small conversations with them. Then, the examiners started to explain to the person how the system works and give them the instructions.

The instructions were:

1. Login into the e-Clinic system by providing it is user name and password.
  - 1.1 If a patient is using the system for the first time
    - 1.1.1 He or She should click on "Sign up" to fill the registration form to create an account.
2. Link "Forgot your password?" would allow a user to recover his/her password.

#### During the test

For the recording session, a mobile Camera is included in the setting for some of participants, so we will hold it and record while the participant is applying the tasks. For other participants, taking notes to capture error point.

The person started by choosing the management appointment page. Once the patient is in the system, his/her entry page, will be displayed on the navigation him/her job: recruitment management, my profile, show a prescription, sending a complaint and exit. After that, the interface is shown.

#### After the test

The examiner thanked the persons for their cooperation. Then, asked them to fill an evaluation form for the system.

### 2. Participants: Experts

#### Pretest

The examiner started with explaining the system to the expert in the same way they explain it to the persons and used the same instructions.

#### During the test

For the recording session, a mobile Camera is included in the setting for some of participants, so we will hold it and record while the participant is applying the tasks. For other participants, taking notes to capture error point.

#### After the test

The examiner thanked the expert for their cooperation and gave them the evaluation form to evaluate the system.

## D. Data Analysis

The variables in this study is; the usability. In addition to that we examined the success rate, and the conducted time and user satisfaction mercies.

The satisfaction is based on the ratings the users gave to each one of the variables. On a scale from 1 to 5, 5 is the best and 1 the worst. A quantities analysis of the ratings was conducted to determine the level of satisfaction and for the preferences of the persons regarding each variable.

In our research, we have two variables based on the sex, we did our testing on 6 participant, 3 of them were females, and 3 of them were males.

Age ranges:

- From 16-24 years old
- From 25-34 years old
- From 35-44 years old
- From 45-55 years old
- over 55 years old

The testing was basically by recording video, taking a note and write up a short summary of correct and error points while using the prototype, and letting them express with their own words what they think about this application, and before starting observing participant session, we have interviewed the participant on the subject related to our application. Therefore, we will evaluate the prototype with a group of potential users, which are 4 people, such as 2 people experts via heuristic/cognitive walk-through evaluation and 5 users via usability testing, and get some feedbacks. The feedback from the users will be used as the future works for the prototype system.

We can conclude from the previous paragraph, that we have two main variables: sex people, and the age range.

We did our testing on them as follows:

1. We took each participant individually; each participant took approximately from 3 to 5 minutes to applying all required tasks. After that, we were planning to give them the questionnaire to find gap and mistakes point in our design.
2. Evaluate the prototype with a group of potential users, which are 6 people:
  - A. 2 people experts via heuristic/cognitive walk-through evaluation.

**Table1:** Experiment setting

ID#	participant Name	Gender	Age	Experiment place	Experiment Environment	Testing Medium
P1	Rasha	Girl	28	Home	Closed-room	Paper
P2	Layan	Girl	18	work	Closed-room	Paper
P3	Lama	Girl	49	Home	Closed-room	Paper
P4	Saad	Boy	60	Work	Open-outdoor	Paper
P5	Fisal	Boy	35	Home	Closed-room	Paper
P6	Ahmad	Boy	51	Home	Open-outdoor	Paper

B. 4 users via usability testing.

3. Finally, we get the feedbacks from the potential users.

## 5. Result

The results of the experiment were as the following:

- P1 → this participant has liked design of our application and find that the color was comfortable for eyes. Also, loved how she can have control on making appointing and track upcoming appointment, this participant gave us a sweet smile at the end of the experiment.
- P2 → this participant found the application was designed clear and perfect. Also she found all the functionality correctly.
- P3 → this participant has liked design of our application and find that the color was comfortable for eyes. Also, loved the color and the logo, but unfortunately, participant faced problem in two tasks, to view upcoming appointment and find phone number and location.
- P4 → this participant has liked design of our application and find that the color was comfortable for eyes. Also, loved the color and the logo, but unfortunately, participant faced problem in two tasks, to view upcoming appointment and find phone number and location.
- P5 → this participant has liked design of our application and find that the color was comfortable for eyes. But unfortunately, participant faced a problem on Task2 and Task 2, Task 2 after she registered, she does not know how to log out to log in again. Moreover, on Task 4 she cannot probably make new appointment, she found the calendar not clear enough to select suitable date.
- P6 → this participant found the application was designed clear and perfect. But unfortunately, participant faced a problem on Task4, Task5 and Task 6, Task 4 she cannot probably make new appointment, she found the doctor list not clear enough to select and

find phone number of clinic, participant faced to view upcoming appointment.

The Experiment Settings

- Location (home, work):
- Environment (closed/open): by closed we mean the environment is done in a closed controlled room with no outside interference. Open means it was conducted in a public/simi-public place where the room was not closed nor controlled.
- Testing Medium (iPhone/ Laptop), as shown in the table below:

## 6. Conclusion and Future Work

Mobile devices play an important role in society now. They are used by people for the purposes of different areas. Our system was specifically designed and implemented for a private clinic. The software will be specifically designed and implemented for patients to register in the system and book appointments. The main objective of this experiments is ensuring the satisfaction of User Interface, User Experience and Usability of the system by the end users. We developed high-fidelity prototype which is close enough to a final product. Also we tested the high-fidelity prototype and usability test was performed to determine the ability for the user to complete routine tasks for application interface. However, our application assumed easy to use, usable and attractive and we ensure that by analyzing the test results.

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