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Influence of Design Elements in Mobile Applications on User Experience of Elderly People

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Abstract

Technology in the field of health care has taken a step forward for making health maintenance easy on a daily basis. With a gradual increase in the elderly population, it is important to provide them with facilities made accessible through technological innovations. But it is observed that the elderly show reluctance to the use of new technology such as mobile applications. In this paper, an effort is made to overcome this barrier with the study of both elderly user experiences and user interface design of an mHealth application and an analysis of the relation between them.

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1. INTRODUCTION

Usage of mobile technologies has become a trend and also a mandatory tool for today’s life. They are mostly used by populations of developed and underdeveloped countries. Various applications are being introduced in these mobile devices under different categories like entertainment, health, lifestyle etc. which make them useful for a multitude of different tasks. In recent years, mobile applications have become relatively more important as it is observed that usage of these applications is being suggested by the health care centers. Mobile phones, tablets, PDAs and iPad etc are the devices that form the main platform for the mHealth services. The mobile applications providing health services can be used to monitor patient’s health, providing information on different areas of medicine and promote health and fitness for healthy lifestyle. The success of any type of application depends on how well it is being used by the user i.e. the usability and how well it is suited to the user’s requirements based on their experience1. User experience encompasses elements such as the usefulness and usability of an application or technology2,3. Hence, it is visible that the concepts of usability and user experience are similar and partly overlapping. Therefore, to develop a mobile application with a higher degree of quality and functionality and to measure the effect of the service provided by the

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applications on the users, user experience is measured. This paper deals with the study of user interface design elements (text size, font, color etc.) of a mobile application that affects the user experience of the elderly population. The information gathered with the use of prototype version is analyzed and compared to the existing information made available after the use of Glucosio application. This comparison directs the author to conclude the effects of user interface design elements on the user experience of elderly people in using an mHealth application.

2. MOBILE HEALTH (M-HEALTH)

Mobile health has evolved in the form of more or less stand-alone applications for support of healthy life-style and self-management of chronic diseases. The rapid expansion of mobile information and communications (ICT) technologies within health service delivery and public health system has created a range of new opportunities to deliver new forms of interactive health services to patients, clinicians and caregivers. One of the leading technologies with which the interactions are made easy are the mHealth applications for healthy lifestyle and self-management of protracted diseases. Many such applications have been released in the market in relation to diabetes. Diabetes is one of such diseases which must be monitored regularly for balancing the blood glucose levels in the body. Today’s mobile applications focus on being trendy with fast responding abilities. This increases the usability of the application by the youth of the society who are the majority population. But it is known that diabetes is common in the elderly population. Therefore, the design of these applications should be favourable for this category of the population as well.

2.1 Tools Related to M-health

In the present situation, the tools to measure user experience in mHealth applications are through a survey or QoE probe. According to Martinez-Perez.et.al., a survey is one of the tools to measure users Quality of experience (QoE)7. The survey tool uses the Likert scale in a survey questionnaire that involves different types of aspects related to content quality, availability, performance, appearance etc. of the selected mobile application. The tool proposed by Farnaz Fortrousi for user experience is known as QoE probe. It is an application used in Android and iOS devices, integrated with selected mobile application through an API8. The purpose of this tool is to capture user experience by collecting feedback from the user. It helps us to monitor requirements in run-time and also collects usage logs and QoE from the users in the form of feedback.

2.2 User Interface Design Elements

Mobile applications for older adults need to be meaningful, engaging, easy to use, usable and motivate the adoption of technology. The elderly’s preferences in the design of user interface are often neglected, thus making it difficult for them to the mobile applications. It is demonstrated that “a mobile device or application, if carefully designed, can be used effectively by older people.” The base for the studies on elderly people is that “elderly people want to stay and live in their homes as independently and as long as possible.” Various design guidelines and design principles were discussed in the previous studies describing how the user interface design of the mobile application can be presented, for elderly people convenience. To frame a user interface, different aspects of the interface need to be considered. These aspects are termed as the user interface design elements. Mobile design guidelines, UU principles, mobile health guidelines, inclusive design guidelines, World wide web consortium guidelines in mobile context are referred to conclude the user interface design elements suitable for elderly users.

3. RESEARCH METHODOLOGY

The research methodology includes problem description and research design.

3.1 Problem Description

Currently, a large number of mobile applications are framed to assist the self management of people who have both type 1 and type 2 diabetes. People aged 50 or older suffer disproportionately from diabetes mellitus, particularly type 2 diabetes. From the Diabetes App Market report, very few patients of this target group utilize diabetes apps to support their treatment. The proper design of the user interface helps to reduce the reluctance in adopting the application usage. This study of user experience directs the application designers to understand the usability as well as the satisfaction levels of the users while using the application. One of the big hurdles for deploying ambient assisted living systems in the real world is technology acceptance by the older adults. The hurdle is also applicable for...
mHealth. The current study is motivated as a way to address and overcomes these problems (hurdles) in such a way that it is easier for elderly people to use these technologies independently and confidently without any assistance.

3.2 Research Design

The research design chosen is the quasi-experiment design. “Quasi experimental designs are generally used to establish the causality in situations where researchers are not able to randomly assign the subjects to groups for various reasons.”

In this paper, to study the UX the population is the elderly people aging 50 years or above, suffering from type 2 diabetes. The sampling technique selected is the convenience sampling of the non-probabilistic sampling. The total sample size is 6 participants; 3 in each group wherein one group is the control group i.e. the user experience is evaluated with the original Glucosio application and the other group is the experimental group wherein user experience is evaluated with the prototype version of the Glucosio application. The data required are the answers given by the sample to the post questionnaire after using the Glucosio application. The elderly people are interviewed by the authors. A user experience test which is similar to the usability test is conducted and the usability along with the user experience is measured. The user-experience test includes 10 tasks and each task is followed by a certain set of questions. By the observations made while performing the tasks and knowing the opinion of the user through the framed questionnaire, the user interface usability and functionality attributes of UX are measured. The test is followed by an interview of 20 questions related to the measurement of different aspects of user experience. Some of the questions to measure the above mentioned attributes are referred from System Usability Scale (SUS), AttrakDiff tool, W3C-WAI guidelines related to mobile, QUIS (Questionnaire for user interface satisfaction) and questionnaire from.

4. EXPERIMENT DESIGN

This section includes a description of the dataset construction, data analysis, experimental setup and experimental environment.

4.1 Data-Set Construction

The data collection is done by conducting interviews. The initial step to perform the interviews was to find the participants using convenient sampling methods. The sources approached to find the participants include Blekinge Institute of Technology (BTH), Blekinge Diabetesförening, Health centres (Vårdcentrals) and Retirement homes.

4.2 Data Analysis

Quantitative data and qualitative data obtained from the interviews are analyzed using descriptive statistics and narrative analysis respectively. The analysis is as follows:

Initially, the participants were given an introduction to the topic and the purpose of the UX test for the research. They were also briefed about the test procedure. The authors then provided the Glucosio application to the participant and allowed a period of 5 minutes to explore the mechanics of the application. Later, the user is subjected to perform 10 tasks to measure the user interface usability and functionality attributes of user experience. The questionnaire is framed such that the responses are ratings from 1 to 5 of the Likert scale. The analysis for this rating is also a descriptive statistical analysis measuring the attributes of the user experience. Since the interview questions are an open-ended questionnaire, they allow the user speak about his or her viewpoint on the application interface and its functionality.

4.3 Experimental Setup

In this experiment, initially the sample is selected from the population with the help of a sampling technique. Further, a random assignment is done to classify the sample under the control group and the experimental group. Here, the control group is tested for UX with the existing Glucosio application. The data obtained from the analysis of the UX test is used to perform a comparison. For this experiment, prototype of the Glucosio application is developed. Thus implementing the condition for the experimental group. The experimental group is tested for UX with the prototype of Glucosio application. A comparison between these values is statistically measured. Conclusions are made with the discussion on the observed results, further leading to the generalization of the concept to the population.
4.4 Experimental Environment

The experimental environment includes the designing of the prototype based on the alterations made. The prototype was designed using the tool named Balsamiq. It is a tool for designing interfaces or mobile applications in a smarter and easier way. The Glucosio application code is available in Java for which the QoE Probe code is integrated such that the Glucosio application calls the QoE Probe Questionnaire. The QoE probe is integrated such that the questionnaire is popped up in the Glucosio application only after the necessary action is performed, thus measuring QoE of that particular feature. The integration is performed using Android Studio IDE - 2.1.1. This integration helps to study the quality of user-experience of the selected sample. While using the “Glucosio” application an emulator is necessary to run the code in the Android studio. An android mobile “HUAWEI CheL-L04 (Android 4.4.4, API 19)” acted as an emulator.

![Quality of Experience](image1.png)

Figure 1. QoE Probe Setup

5. RESULTS

In this experiment, a sample of 6 participants has participated to study the user experience. Interviews with the sample is conducted to obtain the data needed to perform the experiment.

5.1 Data While Using Glucosio Applications

Initially, the participants are asked to perform 10 tasks for which user experience is recorded in the database of the QoE probe application.

![User interface usability & Functionality](image2.png)

Figure 2. Rating for the tasks by Control Group

Fig. 2. gives the graphical representation for measuring the scales given by each participant for the 10 tasks. It indicates only the user interface usability and accessibility attributes of UX because the tasks are framed such that they measure only these attributes. With the task performance, participants were asked to answer the set of questions framed to measure the different attributes of UX i.e. effectiveness, efficiency, learnability, usefulness, ease of use, attractiveness and accessibility individually. The individual means and the standard deviation (S.D.) for the attributes of UX are calculated and are graphically represented in Fig. 3.
Certain observations were made while conducting the test to measure user experience. Participants have recommended certain improvements in the user interface of the Glucosio applications. Description of these discussions are analyzed using narrative analysis and the conclusions are made. With the narrative analysis, a great deal of information is gathered about what user interface design elements of the Glucosio application can be modified for an improvement in the user experience and usability. Usability of the application can also be measured by considering the usability metrics such as success rate of the tasks or the time taken to perform the tasks. A strict success rate is measured considering whether the participant successfully completed the task or not. There are no partial considerations. The tasks that are completed and not completed are numerically indicated as 1 and 0 respectively. This scale allows for a statistical analysis.

From Fig. 4, it is observed that the participants A, B and C have performed 6, 8 and 4 tasks completely. The success rate of each participant is 60%, 80% and 40%, therefore, the average success rate of participants while using the Glucosio application is 60%.

5.2 Data While Using Glucosio Applications (Prototype Version)

Here the steps performed are the same as performed with the control group but the participants are from the experimental group. Fig. 5, representing the individuals rating for the tasks. The 10 tasks performed by each participant of the experimental group using the prototype of the Glucosio application. The mean for the tasks is calculated for easy understanding of the user interface usability and functionality.
To demonstrate the number of questions posed to the experimental group based on their experience with the prototype. The individual scores are given followed by means and standard deviations of each attribute of UX. The overall means and standard deviations for each attribute are calculated. The graphical representation of the means of the individual UX attributes of the experimental group are represented in Fig. 6.

As a conclusion to the experiment, the results obtained with the control group and experimental group are compared in order to analyze the user experience when a change in the user interface design elements is made. Further, the participants of the experimental group have provided their suggestions for the betterment of the prototype.

5.1 Comparison of the results

The UX of both the control group participants and the experimental group participants are compared graphically.

From Fig. 7, it is observed that all the attributes of the UX have shown an improvement in the experimental group when compared with the control group. This might be due to the excitement elders felt when they were able to perform the tasks by their own. The reason for the improvement in almost all the attributes of UX may be due to two of the participants of the experimental group who are completely unaware of the mobile technology and were extremely excited to experience the use of application during the task performance, the changes made within the application. The elderly people were more interested in using the application that contains only one button to view their readings, rather than navigating among different menu options. Considering this as the key point, the prototype was designed resulting in greater UX. The Glucosio application included assistance directing to certain functionalities as a short-cut option. But most of the elderly did not even choose to use it. Most of the elderly were interested in using the mobile applications only after they were assisted by another person on how to easily use the application. This point is implemented by introducing a video within the Glucosio which shows the functionalities of the application and its usage. It is made sure that all the representations are clear. This shows that the improvements made in the user interface design elements of an mHealth application result in an improvement in the user experience of the elderly users.
checks for the usability metric are made to compare if there is any improvement in usability.

The UX is defined as the combined study of the attributes, the overall UX is measured by adding all the scores of the attributes. Box plots are built as shown in Fig. 8. and compared between the control and experimental groups considering the obtained UX scores of each participant. The box plot of the experimental group has larger interquartile range-IQR (spread)\(^\text{19}\) than that of control box plot which means that the UX of the control group participants is observed to be almost same while is a difference in the overall UX of the participants of the Experimental group. From these comparisons it can be concluded that a little focus on the user interface can lead to the increase in the elderly’s usage of the application.

6. CONCLUSION AND FUTURE WORK

The primary focus of this research is to increase the use of mHealth technology by elderly population of the society. To implement such a thought, an understanding of the elderly people opinion about the growing technology is necessary. A hypothesis is framed to study the influence of user interface design elements on the user experience of the elderly people. This is tested by conducting a quasi-experiment wherein a sample for the experiment is selected with the criteria that people (sample) should be 50 years old or above. The participants from the control group were exposed to the Glucosio application integrated with QoE probe to study user experience and experimental group was exposed to the prototype of Glucosio to measure UX. It is observed that much of the difference in the user experience of the elderly people can be seen after they use the application. This study doesn’t focus on certain design elements such as audio preferences, notifications etc. as these elements were not part of the original Glucosio application. So, a similar study can be conducted with another mHealth application that is most popularly used by the elderly. This might result in conclusion with greater scope and such application should be implemented after iterative prototype testing.

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This study doesn't focus on the usability of mHealth applications for elderly people can be seen after they use the application. The primary focus of this research is to increase the use of mHealth technology by elderly population of the society. To implement such a thought, an understanding of the elderly people opinion about the growing technology is necessary. This is tested by conducting a quasi experiment wherein a sample for the experiment is selected as these elements such as audio preferences, not certain design elements such as audio preferences, not. From his might result in conclusion with greater scope and such these comparisons it can be concluded that a certain range of mHealth application, but when considering the obtained UX scores of mHealth application, but when considering the obtained UX scores.

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