

Users' Perspective of Smartphone Platforms Usability: An Empirical Study

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Abstract – Smartphones are overwhelmingly considered as one of the most viral technological advancements in handheld and mobile computing. A wide array of companies are directly or indirectly incorporating new smartphone platforms and hence continually enhancing their features to wholly new levels. However, the incorporation on the most basic ‘ease of use for all’ front is still seriously lagging. Although new exciting features are innovated and developed on pace, yet there remains a huge gap for adequately supplementing the usability quotient of smartphones that is presently inferior in comparison to the desktop systems. Humans with variable ages, cognitive structures, experience based mental models and perceptions of reality eye smartphones differently. This inherent heterogeneity is one of the most burdening problems in smartphone adaptability and usability phenomenon. To target this critical and highly practical usability issue, a comparative investigation of the usability evaluation for the smartphone platforms (iOS & Android) considering the needs of older people is conducted. The main purpose is to investigate the difference of performance measure of older age groups (novice, intermediate, experienced).

Keywords _smartphone platforms, usability evaluation, older adults, swipe, tap, interaction gestures.

I. INTRODUCTION

Mobile phones have become really popular in modern age human communities. In all the modern societies the adoption of new technologies especially smartphones is increasing day by day. Due to this increasing sale of smartphones, the mobile phone companies are working on enhancing their ease of use and graphical user interface for all age groups. Usability and accessibility are the highly crucial determinant factors for increase in popularity and consequent purchase of any smartphone [1]. A sleek and neat design is one of the necessary factors for influencing sales. However, a smartphone that is not only attractive in looks but also has the adherent capability of reducing mental and physical stress, shortening the learning curve and aiding the user in device operability are important constituents for uplifting the overall product quality. The mobile phone

technologies have an impact on all age groups in our society. Studies illustrate that youth is amongst the most active users of mobile technologies [2] [[3]. Additionally, the elderly

People are also pretty keen to make use of the new mobile technologies but because of the inherent small size of smartphones leading to difficulties in text visibility, readability and functional complexity, they abstain from becoming active users of the associated technologies [4]. With rapid growth of elderly population in almost all of the economically developed countries it is noticed that elderly people take keen interest in games but have to abstain from becoming players of electronic games due to the associated user interface complexities [5]. In the mobile phones’ multi-touch technology, iPhone and Samsung Galaxy are the front runners in provision of advanced gesture based user interactions [6]. Figure 1 presents a comparative analysis of the quantified ranges of smartphone platforms’ coverage in world info graphics global markets

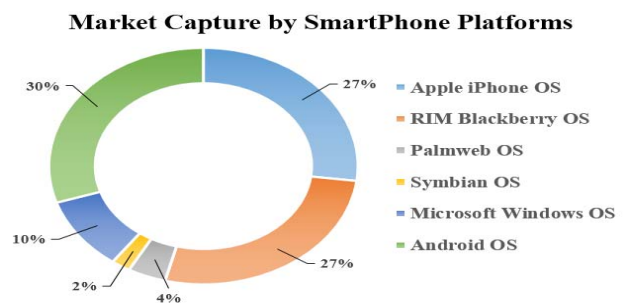


Figure 1: Smartphone Platforms

It is often considered that elderly people find it difficult to cope with new technology products such as the internet or mobile devices. The reason can be discussed from two different viewpoints:

1. Age-related problems: Physical and mental decline makes it difficult for them to adept with new evolving possibilities and products.

2. Software design: Designers do not often design the products considering older users' characteristics and limitations. A considerable proportion of software developers intend to make simple interface with big sized buttons and color combinations. However, this is a really limited view of problem and does not manifest realization of converting older people into effective users of latest smartphone technologies [7]

To investigate the above issues an empirical study is done so to study the factors which are inclined on the performance of older people to use technology. The main usability factors such as user satisfaction, learnability, efficiency and performance are thoroughly observed on two different types of smartphone platforms. This study results into the performance measure of older adults in different group levels (novice, intermediate and experienced). The rest of the paper is organized as follows. The paper reviews some interesting findings from extensive literature and field surveys from various perspectives. The possible implications from psychology, software engineering, design theory and marketing that may affect the hindrance in using smartphone for the elders are summarized in the paper. A proposed methodology framework is presented and discussed. Next, we present our research and methodology review. We conclude that to make smartphones easily usable for older adults we should consider the new design pattern having pictorial presentation of gestures which ensures less cognitive stress on old age memorability decline in older adults.

II. LITERATURE REVIEW

A. Usability Evaluation

Usability evaluation is a systematic process of collecting data for achieving a better understanding of the users and how user groups make use of the product to perform a particular task under specified conditions [8]. Zhang [9] defines three approaches of usability evaluation methods namely: testing (e.g. coaching method, performance measurement and thinking aloud protocol), inspection (e.g. heuristic evaluation) and inquiry (e.g. interviews, field observations and questionnaires). In the usability testing approach, users perform specific tasks using the system or prototype. Usability evaluator examines users' performance on different tasks. The usability inspection approach involves the usability experts or professionals to examine whether the system, wholly or partially, follows usability principles. Lastly, in the usability inquiry approach, evaluator collects information regarding users' perceptions and understanding of the system through interviews, surveys and verbal discussions [10].

B. Touchscreen and Smartphone

Touch screen user interfaces are a really attractive part of electronic devices. There are two types of touch screens: resistive and capacitive. Resistive touch screens are made up of a number of metallic and electronic conductive layers, separated with a small gap. When a user taps on the touching surface, both layers connect and become a cause of electric current that activates the touching event. Capacitive touch screens work by sensing the conductive object e.g. finger. They allow multi-touch functionality that can be performed by using multiple bare fingers. The touch screen input method is increasingly becoming popular in the smart-phones and other mobiles devices such as Personal Data Assistant (PDAs) and tablet laptops [11].

C. Older Adults & Smartphone Gestures

This is well established in literature that older adults generally have more difficulty than younger ones in learning new skills, particularly in learning to use new technology [12]. In Pakistan there are nearly 11.6 million people aged 50-65 and over half of them use mobile phone [13]. Researchers have attributed older adults' difficulty of learning to use technology to a number of user characteristics, including decline in spatial working memory, slower information processing, lack of relevant technology experience, and a higher negative reaction to errors [14]. As stated in [13], the International Usability Partners have conducted a study to evaluate cultural differences and similarities in the definition of gestures for small, handheld touchscreen devices. In another similar study [15], participants were shown the effect/outcome of a gesture and asked to perform its cause, although in this study low fidelity paper prototypes were used instead of a touchscreen. The participants were asked to perform gestures for 28 common tasks such as *zoom*, *copy* and *multi-select*. From literature review of these papers [13] [14] [15], it is evident that touch screen based interaction gestures need to be modified according to the requirements of older adults. Older adults are more comfortable with icon based gestures rather than the text or video help.

III. PROPOSED RESEARCH FRAMEWORK

Both quantitative and qualitative approaches are commonly used for research studies [16]. In order to investigate usability evaluation of smartphone platforms, a mixed qualitative and quantitative approach is followed the quantitative research approach is used to perform the experiment and the qualitative research approach is used to analyze the open ended questions and participants comments [17]. This research study is carried out in multiple steps such as the literature review, survey design,

experiment design, pilot tests studies, experiment execution, selection of suitable evaluation methods, and finally the analysis of gathered data. The research is conducted as shown in Figure 2. Explanation for the set of steps and related activities is described below:

A. Survey Design

To find usability issues, survey technique is used. The objectives of the survey are:

1. To validate issues regarding the usability of smartphone platforms according to older adults.
2. To get input for the experimental design.
3. To find out the users' view points.

In order to collect feedback from the users regarding the smartphone platforms, a survey is categorized into demographics, systems (Iphone & Galaxy) information, applications information; touch screen features (especially swipe and tap gestures) and accessibility functionality.

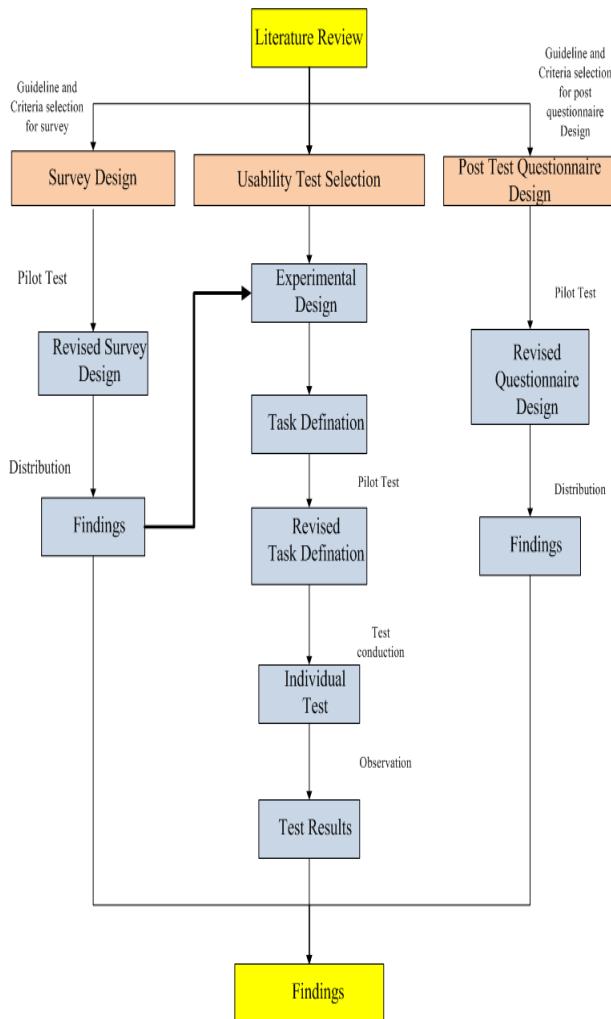


Figure 2: Proposed Research Framework

B. Experimental Design

Experimental design is the process of planning a study to meet already specified objectives. The following aspects are considered while performing experimental design on smartphone platforms:

1. Participant Selection
2. Hypotheses
3. Task Definition
4. Procedure
5. Experimental Material e.g. videos, paper, pencil etc.

C. Post test questionnaire

To know the participants' usability experience about the systems, a post-test questionnaire is designed. It contains both close ended as well as open ended questions. This study aims to reach an understanding of older adults and touch-based interaction on small handheld devices in a number of important ways:

- First, by evaluating the usability of current smartphone platforms' usability for older adults through the survey approach.
- Second, by experimental method to find the difference of performance measure for smartphone platforms targeted at various older adults' participant level.
- Third, by post evaluation method to investigate the overall issues and improvement of performance in smartphones for older people.

IV. USER STUDY EVALUATION AND RESULTS

In order to evaluate the practical results of different smartphone platforms, different version of iOS (iphone 3gs, 4s) and Android (Samsung Galaxy 2 and note2) smartphones are chosen for experimentation (Figure 3)



Figure 3: Iphone3gs, Iphone 4s, Samsung Galaxy2, note2

The data is gathered from 100 older participants categorizing them in three different groups (novice, intermediate & experienced) in the user study whose ages range from 55 to 75+ years old (64% male and 37% female). To investigate the usability, each participant was asked to perform ten different tasks (1) scroll to unlock smartphone, (2) panning screens, (3) change the location of an item, (4) select application, (5) use application, (6) zoom-in, (7) zoom-out, (8) make call, (9) make text message, and (10) close smartphone. After performing this task the participant gave their feedback on the questionnaire as attached to Annex A.

Different performance measure aspects such as user satisfaction, accuracy, efficiency and overall user performance are analyzed for each user group in comparison to smartphone platforms usability.

A. The Evaluation Of Accuracy

From the overall evaluation of the accuracy of users' group performing task such as selection of app, zooming and typing mistakes, familiarity with the platforms is investigated. The experiments are conducted on all the participants of older groups and for each older group their mistake rate according to each task are calculated as presented in Figure 4, 5, and 6.

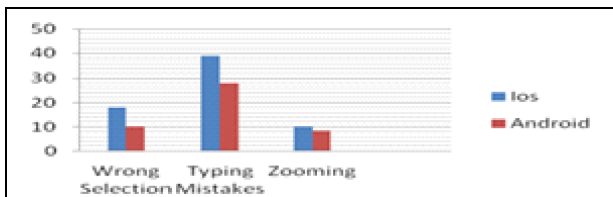


Figure 4: Novice User Mistakes Results Graph on the iOS and Android

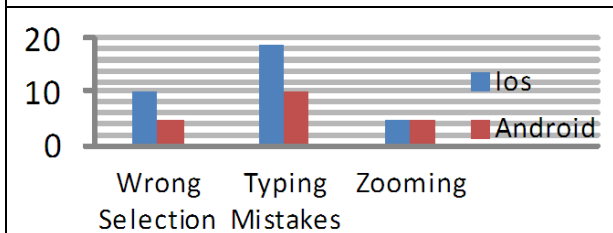


Figure 5: Intermediate User Mistakes Results Graph on the iOS and Android

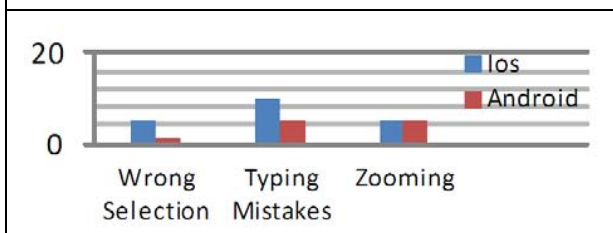


Figure 6: Experienced User Mistakes Results Graph on the iOS and Android

The accuracy rate of experienced user >intermediate user >novice in both the platforms i.e. Android and iOS as reflected from Fig 4, 5, 6.

B. The Evaluation Of Efficiency

In order to evaluate platforms efficiency in each user group, from task time comparison it is learnt that both of Android and iOSs efficiency differ for each user group (Figure 7). The novice users in both platforms take the longest time to complete a task correctly in comparison to other two groups. It is also observed that on Android their efficiency rate according to average mean time is much higher than iOS platform. It indicates that they perform the given task on Android in lesser time than on iOS.

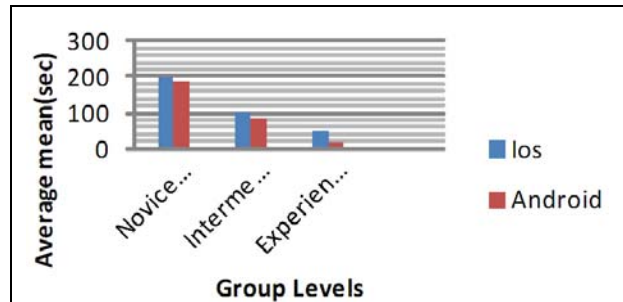


Figure 7: Platform Levels Comparison Graph of the efficiency to complete task of the Participant Group Levels

C. The Overall User Performance Measurement

From the overall evaluation of the user's satisfaction level about the performances of both systems, the post questionnaire technique is used. The Wilcoxon Matched Paired Signed Ranks test [18] is used to analyze the user's responses as shown in Figure 8 & Figure 9.

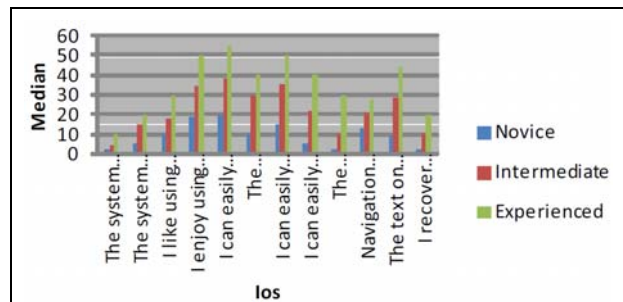


Figure 8: The Graph Presents the Median Comparison of the Degree of Agreement against Each Question by Three User Groups on the iOS

In both Figure 8 & 9, ten questions were asked and according to each platform. Again the novice user results reflect that they face more problems in using these platforms efficiently. Considering the performance of each user groups' experience of different systems, it is

observed that there is a difference of satisfaction, accuracy rate, efficiency and overall user performance in different user group. The systems are not designed for all age groups and no specific help is available to these participant groups, thus there is a need of a new design interface in which the older people are provided specific help and guidance to use these smartphones to overcome their cognitive and usability problems.

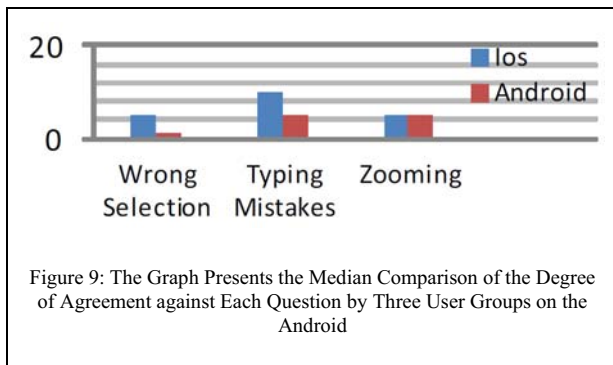


Figure 9: The Graph Presents the Median Comparison of the Degree of Agreement against Each Question by Three User Groups on the Android

V. CONCLUSION & FUTURE WORK

This research study discusses a comparative investigation of smartphones' interface according to older age people. Several key factors are analyzed and usability issues are perceived. On the basis of evaluation it is concluded that there is a need to provide a new design framework in which these commercial smartphone platforms interface overcome the gap of adaptability quotient of older adults. In short, a new user interface that should be established on a new design framework will bring new customer retention to these platforms which are different from past and worthy for the designer to make further study and practice.

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ANNEX: A

Survey Questionnaire for Evaluating the Usability of the Smartphones according to older adults

Participant Number: (Android/iOS Platform)

The purpose of this questionnaire is to take the feedback regarding the issues that older people experience while using any Smartphone currently in market. This is specifically for the research purpose to improve the usability of gestures for senior people. This information will not be shared with any other person or organization.

SECTION I: Personal Information

1. In what age group are you?
 55-59
 60-64
 65-69
 70-74
 74+

2. Gender:
 Male
 Female

3. What is your highest level of education achieved?
 No formal education
 Less than high school graduate
 High school graduate
 Bachelor's degree (BA, BS)
 Master's degree (or other post-graduate training)
 Doctoral degree (PhD)

4. Your mobile phone experience since?
 Novice 1-2 year 2-3 year More than 3 year

5. Have you use Smartphone yet?
 Yes No

6. What is your dominant hand while using mobile phone?
 Right Left

7. Do you have any difficulty regarding vision/hearing?
 Vision Hearing Nothing like that

SECTION II: Usability Evaluation: To as great degree as possible, consider all the tasks that you have been performing with the phone while you answer these questions. Please read each statement and indicate how strongly you disagree or agree with the statement by marking (X) in the circle. If a statement does not apply to you, leave it empty or use the word (N/A) at the comments line. Please write comments to elaborate on your answers

Phone ("Overall Satisfaction")

1. Do you think that you can easily unlock phone?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

2. Do you think that you can easily lock phone?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

3. Do you think that the layout of the applications on the phone screen is clear?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

4. Do you think the graphics of the phone is appealing for your age group?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

5. Do you think that the phone is designed for all age groups?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comment:

6. Do you think that the phone has all the functions and capabilities you expect it to have?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comment:

Gestures: ("Memorability and Learnability")

7. Do you think that gestures in Smartphone device are easy to use?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

8. Which gesture was harder to do?
 Tapping the screen Dragging your finger along the screen
 Comments:

9. Do you easily use the text zoom in and zoom out gesture?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

10. Do you like the gestures for selecting and zooming the application?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

11. Do you think the gestures are easy to learn?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

12. Do you think the gestures are easy to remember?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

Navigation: ("Overall performance")

24. Do you think navigation on the applications is simple?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

25. Do you think navigation labels are clear and concise?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

26. Do you think navigation on the applications is similar?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

27. Do you think text on the applications is easy to read?
 Agree Strongly Agree Neutral Disagree Strongly Disagree
 Comments:

28. Do you think it is easy to find the information (help, pop up messages)?
 Agree Strongly Agree Neutral Disagree Strongly Disagree