Objective Measurements Analysis for Usability Evaluation of Mobile Applications for Deaf People

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***Abstract*— Usability evaluation is an important element that will enable to identify performance of any system or application. Through identification of these issue, usefulness of a product can be improvised. Many usability models are available to evaluate the system usability. Usability data can be collected in two different method which is objective data and subjective data. This paper present objective data analysis of usability evaluation conducted with deaf people mobile application. The results show that the application evaluated having usability issue in term of performance which needs to be improvised by the developer to produce better functionality application for deaf people.**

***Index Terms*— Deaf people; Mobile application; Objective metrics; Usability evaluation model; Validation.**

I. INTRODUCTION

Usability evaluation is an important element to analyze usability issue in any system or applications. Usability issue are identified through evaluation conducted with users [1]. Literatures shows many usability models has been referred for conducting usability evaluation. Among the common usability evaluation model is Nelsen [2], QUIM [3], mGQM [4], Harrison [5] and ISO [6]. These are some of the usability evaluation model that has been in use for usability evaluation. However, when application is developed for specific targeted user, requirement of the user need to be incorporated into the application. Application will fail to satisfy the user if the requirement is absent and make it more difficult. This is common in application developed for disabled people. Different disability having different level of cognitive and mental strength [7, 8, 9] and application that developed to cater these people should consider these issues to ensure delivery of the application.

Deaf user is one of the highest number of mobile application user [7] among other disabled community. This shows importance for the mobile application developed for the deaf. Many mobile applications available in market are left unused by the community and not being used continuously [10]. This shows lacking usefulness which does not attract this community in continuously using the application.

This paper aimed in evaluating a mobile application that developed specifically for the deaf user social media to identify on the issue the application is having. The evaluation was conducted by examining seven tasks and collecting fifteen objective metrics. Objective metric is one of the important metric that commonly used in data collected during usability testing. Through objective metrics, data such as total task completed, total error rate, total time taken to complete and total action needed to complete task are being analyzed thoroughly during the evaluation. Through this, usability score can be identified for the application and issue related usability can be recognized.

Section two of the paper consist of application overview and implementation of the evaluation. Section three discuss the objective measures findings and paper is concluded in section four.

II. BACKGROUND OF STUDY

Usability evaluation for deaf mobile application has been ignored due to the fact the of the disability community that uses the mobile application. However, among the disabilities who uses mobile application, deaf community holds highest number [11, 12]. These mobile application are being used for many purpose such as communication, socializing and so on [12]. Deaf people are known as slow learners and application of mobile phones that keep changing constantly might influence their usage level. Such as, deaf people tend to give up on using mobile application continuously due to the reason the application might not be able to justify their usage with lot of features that deaf people unable to follow.

This makes mobile application developed for the deaf people left unused and many application are not being continuously used by the deaf people. Besides unable to provide service for the deaf people, the mobile application faces waste of energy of developer and cost involved in the development. Usefulness of this application are unable to justify the identification of usability issue in these abandon applications.

Many usability model available are focused on generalized application features whereas many mobile application meant for specific people are also needed to be ensure on the usefulness. Using generalized mobile application usability evaluation leads to unidentified usability issue in deaf mobile application. Besides that, usability model available unable to provide proper guideline in using for evaluation which leads to functions of mobile application are left unnoticed by the developers and practitioners. This is also one of the prominent issues relates whens usability of special people application in action.

Many studies have been conducted by researchers where usability evaluation dimensions evolved over time. Earlier [13] provides metrics for usability by developing usability models align that with ISO [6] standard which comprises of clear usability definition. ISO also strained that usability merely dependent on the user requirement about a product. [14] has elaborated usability as relying on human capability in using with easiness of a product.

Though many studies discuss on usability in general, few attempts have been made by researchers to study on mobile

usability. [15] have developed a framework by implementing eight requirements which eventually has the dimension of effectiveness, usefulness efficiency, consistency, compatibility as well as understand ability. While [16] believes that usability for mobile must consider problem on a product and human error, thus identifies dimension for usability for mobile using a hybrid technique which are learnability, satisfaction, intuitive, useful, error and understandable.

Usability models are conceptual view about the area to be focused and metrics that should be tested. These will help in the usability evaluation to be conducted on an application. Usability evaluation is about planning a task determining a method for evaluation and deciding the nature of data and rules in collecting it [6]. Thus, in measuring the interface usability plays a vital role to determine the effectiveness, accurateness and efficiency of an application to give a usage satisfactory to user as many usability model agrees.

Normally two type of data will be collected from the usability evaluation which includes objective and subjective data. Objective data will be measuring on the data that can be measures such as time on task, number of errors and number of navigation. This data can analysed on the easiness of the usage of any system or application. Through time taken and number of error, how easy or difficult any application will be identified. While another type of data is the subjective data. Subjective data are more towards identifying the subjective emotions of user towards any system or application such as satisfactory level. This data normally collected through questionnaire or survey conducted with the user. As for this paper aim, objective data analysis will be discussed and results will be produced thorough usability evaluation conducted with actual deaf people as discussed in following section.

III. Implementation Of Usability Evaluation

Implementation of the usability evaluation taken place in few phases. Firstly, the application to be evaluated are identified then task to be conducted are developed. Once task and application are ready, participants are gathered and evaluation are conducted.

A. Application Overview

Before evaluation conducted, application to be tested need to be identified and ensure appropriate for evaluation usage. Since the aim of the paper is evaluation of deaf mobile application, thus mobile application related to deaf is a must. Thus, after analyzing the download store available on both GooglePlay and AppleStore, which are the two most used application stores in the world by Statista [8], researcher come across an application named DeafWorld. This application is free of cost and developed specifically for the deaf people. DeafWorld application is a social media platform that connect deaf from all over the world into one application to share and make friends. This application enable different countries deaf people are socializing through daily shares of videos and comments. However, number of download in both application store shows lesser than 10,000 which consider low compare with the population of deaf community around the world. This shows the application has been discontinued by the user for some reason and reviews received also shows dissatisfaction of the users toward the application. Thus, DeafWorld was chosen to be used as sample application for this paper.

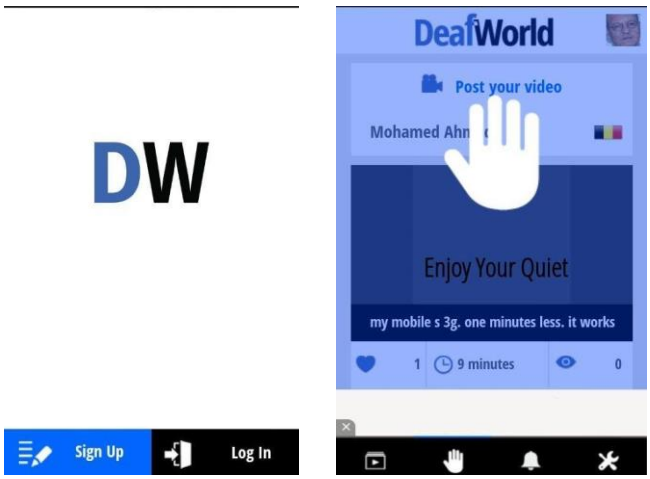

Figure 1: Interface of DeafWorld

After the application has been chosen, task to be conducted during the evaluation was identified. Total of 7 task were generated according to the application as per in Table 1.

Table 1
Task Descriptions

Task	Description
Task 1	Post video- user post any recorded video in the application
Task 2	Watch video and 'Like' – user watch any video and 'Like' the video
Task 3	Comment with emoji – user have to choose proper emoji to comment on any video
Task 4	Respond to any comment – user have to comment replying to any other user
Task 5	Search profile – user search for any other user profile
Task 6	Check notification – user have to check if there is any missed notification
Task 7	Logout- user logout from the application

B. Participant Gathering

After all the task has been identified, process of gathering participants are taken place. Convenience sampling were used in this process [9]. Participants are chosen in convenience form based on the availability of the participant and their willingness to participate in this evaluation. Many organization were approached for this attempt to identify potential participant however very few responses were received. Malaysia Federation for Deaf (MFD) is one of the organization which agreed in arrangement of the participants and time were fixed for the evaluation to be conducted.

Total of 20 participants were gathered from MFD age ranged between 18 to 30 years old due to availability. All these participants are deaf people working and studying at MFD. Among the participants are 8 male and 12 are female. All participants are user of mobile application more than 2 years. Participants are categorized as expert mobile application user and suitable for this evaluation.

C. Evaluation

Participants were gathered at MFD, Selangor for

evaluation to be conducted. Every session there will be 2 participant with one translator only. This is to ensure participants are focused and feel more comfortable rather sit in crowd of 20 people. Before evaluation started, participants were given brief introduction on the evaluation and process of what should be done throughout the evaluation. The instruction given to them through translator. Evaluation starts only after participants are clear on the evaluation and agreed the evaluation being recorded for research analysis purpose.

During the evaluation, all the possible data has been collected. Total of 15 objective metric data were collected during this evaluation. Objective data are important measure to identify system issue and any related issues on the usage of the application. Objective metrics listed have their own method of data collection as described in the Table 2 below.

Table 2
Objective Data Collection Method

Metric	Data Collection Method
Time taken to select a task	Time taken to select a task − start selection time
Time taken to complete a task	Time to finish the task – time start the task
Number of error (s) during navigation	Count how much time a participant made error when navigating in the task
Number of error (s) recognizing incoming alert in device	Count how much time a participant made error when identifying any alert received
Number of error (s) using text to sign language / translator in the application	Count how much time a participant made error when using text or translator
Number of click (s) to start the application	Count how much time a participant need to click in starting the application
Application loads in the device	Application loading time-time for main menu to appear.
Time taken to display page	Display page time-time for main menu to appear.
Time taken to key in information	Time a participant has to interact with the application during key-in
Time taken to learn using the application	Time a participant has to well versed in using the application
Number of interaction (s)	Time a participant has to interact with the application
Number of successful task (s)	Count successfully completed task by participant
Total number of error (s)	Count the errors made by a participant for each task.
Number of attempts to rectify error (s)	Count the number of time participant tried to rectify errors
Time taken to display output	Output display time − task finishing time.

Table 2 above shows all the 15 objectives data that was collected during the usability evaluation conducted. Data was analyzed through time taken with stop watches and also recording of video during the usability evaluation. All the objective data collected were then analyzed.

IV. FINDINGS

This section explains the results of the usability model validation conducted with the sample user who are deaf and an expert mobile application user. Statistical analysis conducted for the validation of the developed model.

Data collected for all the objective metric were analyzed using Statistical Package for Social Sciences (SPSS) and mean of each metric reported in Table 3. Mean data for objective metrics are calculated in seconds.

Table 3
Mean Score

Metrics	Mean
Time taken to select a task	0.011
Time taken to complete a task	0.665
Number of error (s) during navigation	1.540
Number of error (s) recognizing incoming alert in device	1.107
Number of error (s) using text to sign language / translator in the application	0
Number of click (s) to start the application	1.250
Application loads in the device	0.001
Time taken to display page	0.017
Time taken to key in information	0.173
Time taken to learn using the application	6.100
Number of interaction (s)	5.560
Number of successful task (s)	1.740
Total number of error (s)	3.700
Number of attempts to rectify error (s)	2.350
Time taken to display output	0.087

Table 3 above shows on the mean score for each measure on objective metrics for all participant in the usability evaluation. According to the table, task success level can be identified. In obtaining the usability issue, the data obtained for task success rate can be analysed with 4 (four) point scoring method to distinguish between different type of user experience [10]. The four-point scoring method used in this study as suggested by Albert and Tullis [10] are described as below:

Table 4
Score Descriptions

Score	Description
No problem	Participants successfully completed the task without any difficulty
Minor problem	Participants successfully completed the task but made slight mistakes but recovered quickly and successful.
Major problem	Participants successfully completed the task but took longer time to recover from mistakes and struggled before complete the task
Failure or give up	Participant gave up before completing the task or moved to the other task by skipping the task before completing.

Based on this scoring points, data obtained from the usability testing was identified the score through time taken to complete each task. The longer the time taken to finish the task, the more difficultly faced by participant in conducting the task.

Overall it shows that three (3) out of seven (7) task are having higher number of failure which shows usability issues are present in the application and needs more consideration. Although all the task recorded as completed however, the rate of problems encounters throughout completing the task will be invisible. Taking into consideration of [10], giving four scale rating score through user experience enable this issue to be identified clearly on the task that having many issue to complete and the easiest task to be completed as well.

This shows that the DeafWorld application are facing some major usability issue in using the application. The application are meant to serve the deaf people for socializing however tend to be discontinued in using it. This shows the issue in the application are clear and need to be identified in details and rectified in order to ensure the deaf people will be using it continuously. Figure 2 shows in the graphical of the task success level which has been identified earlier.

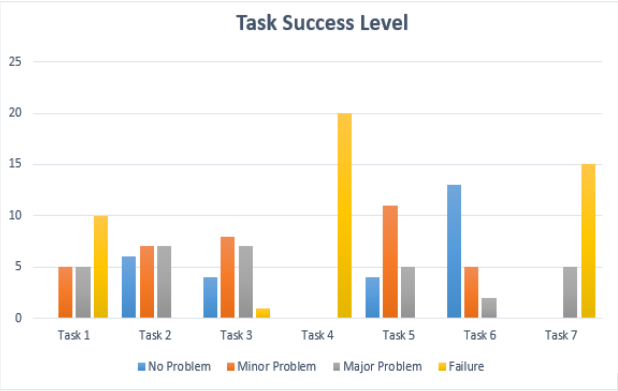

Figure 2: Task Success Level

V. CONCLUSION

Usability evaluation for the deaf are very crucial since their requirements for mobile application are different than for non-disabled people. This paper presents the objective metric data that has been collected and mean score has been reported. Besides that, task success level was also been reported and shown the application are having usability issue. Future studies can will focus on reporting on the subjective metrics.

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