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ONLINE SHOPPING APPLICATION FOR ILLITERATE AND SEMI-LITERATE USERS AND ITS USABILITY EVALUATION

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Abstract

In the current age of ICT (Information and Communication Technology), online shopping has become a necessity. Almost all shopping websites are in textual form which is only beneficial for literate people. The basis of this research is to address the prevalent issue towards electronic shopping for illiterate and semi-literate people of KPK (Khyber Pakhtunkhwa), Pakistan. An ICT solution is proposed to reinforce the importance of alternatives (auditory, visual and tactile etc.) to text. Two similar applications are developed with and without audio support. We test the developed website on 31 participants (20 illiterates and 11 semi-literate) including female. The results show that the solution with audio support is better understood by illiterate and semi-literate as compared to without audio solution. There is a clear difference between illiterate and semi-literate users while using the website without audio support. This show that without audio assistance the ICT solution is non-usable for illiterate. Semi-literate complete their task rapidly as compare to the illiterate. Our research also confirms that the usability is not affected by age. Gender plays a role in presenting the different usage of the interface. Sketches proves to be useful for illiterate. Overall results show that the proposed solution is usable for both illiterate and semi-literates.

1. Introduction

Technology is affecting every field of life and has become an integral part of our lives [1, 2]. The birth of internet has revolutionized the whole scenario. It also affected the businesses which are fast converting from the traditional bricks and mortar to online presence. Presently a business can't survive properly without technology. For a common man and consumer, it brought unimaginable comfort and access to services. In developed world, young or old, poor or rich, literate or illiterate, is reaping the benefits of this new form of technology [3, 4]. For the businesses and producers, it provides a simple and efficient avenue to extend their services and market their products.

However, this is not the case in many developing countries. Along with many other factors in technology usage, the major factor in many developing countries is illiteracy [5]. About 774 million of the world's inhabitants still can't read or write [6, 7]. The literacy rate in Pakistan is about 59.5% (with 69.5% male and 45.8% female) according to the World FactBook [8]. Majority of the illiterate populace live in the developing world. Developing countries are deprived of the benefits of Information and Communication Technologies (ICT).

Fortunately, the technology has advanced to the point where we can make it convenient even for the illiterate. We have alternative to text that can be rendered through other sensory modalities such as auditory, visual and tactile etc. Work has also been done in the field of interfaces for illiterate people which is mostly geared towards illiterate in the advanced countries, who have different perception level [9, 10]. That work can't be applied directly to our country as socio economic factors significantly differs from those of the developed countries. Therefore, there is a need for localized research in the area that targets the illiterate people.

The objective of this work is to develop an interface of online shopping for illiterate. Illiterate people always need some assistance in doing different kinds of activities e.g. online shopping. Through our application we surmount these hurdles to greater extent by using audio assistance with the graphic support. Results showed the effectiveness of our approach.

The rest of the paper is organized as follows: Section II describes the motivation and contributions of our research work. Section III presents the relevant literature of interfaces for illiterate. Section IV demonstrates the developed user interface for our research. The experimental work of this research is explained in Section V. Results are presented and discussed in Section VI. Section VII shows the contribution of our work, its conclusion, limitation and the direction for future work.

2. MOTIVATION AND CONTRIBUTIONS

E-shopping has become the most popular and preferred way of shopping throughout the world [11]. In recent years it has grown considerably but still it is not a major contributor to economy as only a fraction of population uses it. There are many factors. Major factors in our opinion are security risks, fraud, psychological issues and high illiteracy rate. However, being the root cause of many other problems, we suffer from the illiteracy factor. Lack of interest of illiterate people in e-shopping can itself be because of many reasons. It is a common observation that even rich illiterate people shy away from using technology and that is mainly because of the interfaces which are designed for literate people only. This motivated us to carry out this research work so as to make computer technology accessible to illiterate. The objective of this research is to evaluate such user interface of online shopping for illiterate users which will be more responsive. The main contributions of this work include i) analysis of the illiterate and semi-illiterate users' requirements, ii) design of the web-based shopping application based on the users' requirements analysis, iii) data gathering for SUS test, iv) analysis of the data for extraction of useful information.

3. LITERATURE REVIEW

The problem of illiteracy is more common in the developing world where the majority of the population is illiterate [12]. This group of people were also called the information poor by the Goetze and Strothotte [13]. Rich multimedia and voice based interfaces were proved more amiable to the illiterate. [3]. Different strategies were used to make interfaces more user friendly by introducing graphics and audio [14-16]. In [12, 17] it was noticed that the sketch based photographs were more user-friendly as compared to the real photographs. Real photographs has additional information which perplexed the illiterate users[12]. Similarly, the research [18]

showed that hand-drawn sketches were more understandable by illiterate rather than using icons and photographs. The interfaces which include graphics and audio also produced favorable outcomes [3]. Other forms of technology e.g. having input through microphones, touch screens, non-linguistic graphics, usage of speech and dialogue interaction were comparatively more satisfactory for illiterate people [10]. The involvement of users in the designing of interfaces not only strengthen the design but also expose the shortcomings [19]. User-centered design process helps in progressively testing the prototypes which result in the developed application against the demands, needs and desires of the end users [20].

Automated teller machines (ATMs) are playing vital role in the e-commerce. Almost all ATMs are text based and have no graphically interfaces. Therefore, this is nearly not possible for illiterate to use them. For blind people some talking ATMs were introduced in USA, Canada, Australia and Netherland [21]. However, there are considerable socio-political differences between the developed and developing countries. These differences made it difficult to transfer the technology from developed to developing countries without a proper research.

There are variety of ICT solutions for illiterate users. For example a solution that was text free interface but still required human assistance for using [22]. Another solution provide interface which was text free and didn't require human assistance[15]. For communication purpose a text-free interface for smart phone was designed in which an illiterate could receive and listen to the message and can write a message through icons rather than text [23]. Ali and Kumar [24] conducted a study for Indian farmers which helped them in improving their income. A visual phonebook application[25] was developed for illiterate to provide them fast access to their contacts. In this solution colors, icons and numbers cues were used to distinguish the contacts. It was reported by the author that on the visual phonebook the average time taken was significantly reduced as compared to the traditional text based. Video email facility was designed for illiterate people for the communication purpose [26]. This application was also text free with the inclusion of audio assistance, images and animations. This idea was based on the concept of pictorial identity which was first proposed by Katre [27].

An e-government portal application was designed by Taoufik et al.[22] to make the portal accessible to the illiterate. Text was used in this interface along with the audio support and images. The participants showed interest in using and also give positive response to use it in the future. Touch screen devices were used in this study to increase the usability of the portal. It was reported by the author that human assistance was required for using that portal. Electronic voting system was developed by Alam et al. [28] to make the illiterate people to vote electronically. Here in this system symbols were used to represent the candidate for electing.

Medhi et al [15] showed that hand-drawn sketches were better to understand by illiterate rather than using icons and photographs. Interfaces which include graphics and audio were comparatively more appropriate and generate good results [3]. Cartoon generation tool was used to create cartoon like images from photographs to exclude extra information from the photograph and to make it more understandable for the targeted user [4]. It was acknowledged that use of imagery was better than text and extensive use of graphics [2, 3, 15, 29-32]. Text free user interfaces were more preferred by the low literacy people rather than text based interfaces while in literate population standard text based interfaces were preferred [14, 33]. Voice recording also showed good results for information deliverance to illiterate [3, 34-36]. Richer user interfaces were not better overall because hand-drawn sketches were more understandable than realistic photographs [3, 15, 29, 31, 32].

From above all discussion, it was agreed graphical contents should be used instead of text. Graphical contents could be icons, digital photographs, and hand-drawn sketches with audio and video support. Rich interfaces lead to the complexity and confuse the users. It was noted from the above mentioned studies that most of the ICT solutions need human assistance. The study of Pappachan and Ziefle [37] showed that culture also effect the designing of interface. Culturally relevant context should be used in developing interfaces for illiterate. The ICT solution proposed in this paper considered all the above issues to address the concern problem.

4. DEVELOPING USER INTERFACE

The website is developed using two types of images (after ethnographic study), sketch based images and digital photographs. Touchscreen devices were used to avoid the load of training the users in computer initial usage like mouse and keyboard. The assistance of human was omitted by audio support in background. Users can also take printout to address the location.

4.1. Proposed Solution

Our proposed solution was to support shopping activity for illiterate and semi-literate users which consist of graphical contents e.g. hand-drawn sketches (representing menu) and digital photograph (representing actual shopping items) with background audio support. The background audio support was in local language of the users. For making the website culturally relevant, human centered design method was followed by the ethnographic study. The said study is presented in the following section. After the ethnographic study, graphical contents were selected and used in the interface.

4.2. Ethnographic Study

The relevant researches emphasized the usage of graphical contents [2, 3, 12, 15, 17, 29]. To remove the misperception that which contents should be used, we conducted an ethnographic study. Ethnographic study is a qualitative method where researchers observe and interact with participants in their real life environment. In this study we presented both kinds of images (hand-drawn sketches and digital photographs) to the targeted population. It was noticed that the actual shopping item cannot be represented by hand-drawn sketches. Hand-drawn sketches were not only easily comprehensible for the targeted community but also it helped to identify the difference between menu and real shopping material. Therefore, both types of graphical contents were used in our proposed solution.

Culturally relevant shopping items were put in the interface which includes three menus: clothes, foot wears and wristwatches. Each menu consists of four different shopping items, resulting in 12 items for male and 12 items for female. The website design is presented in following section. The background audio support was used to make the website more usable.

4.3. The Website

First step for the development of the website was the selection of shopping materials for visualization purpose. It was decided to keep the basic three items (clothes, foot wears, and wristwatches), as it is considered as the most prominent things for shopping in the considered culture.

First page, named as the main page is shown in Fig. 1. It includes the menu for male and female. The website was designed by using ethnographically verified hand-drawn sketches as it was more amiable for this community.

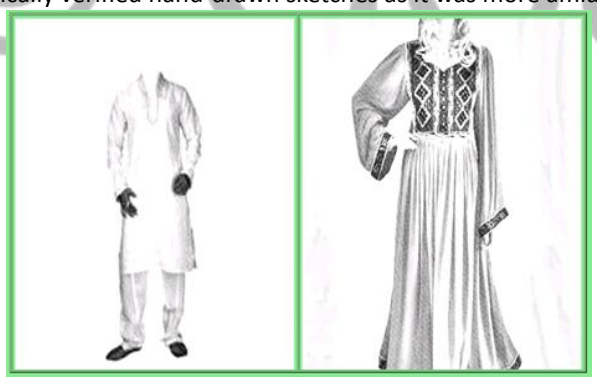

Fig. 1. The Main Page

Users were able to click on their own choice. If the choice was male side of the webpage, the following page was displayed which is shown in Fig. 2. Same was the case with the female page. In this page there was also audio support in the background. Users could go to the previous page by using the back button.

Fig. 2. The Male Page

In the male page there were three shopping menus shown in Fig. 2. When user selected the shoe sketch, the footwear page was showed as shown in the Fig. 3. There was also the audio support in their local language (Pashto in this case) to instruct the users.

Fig. 3. The Footwear Page

When user clicked on a specific item then the detail of that item was displayed visually (through pictures) as well as verbally (through audio) as presented in Fig. 4. The price was also displayed in picture format to visualize easily and also it was verbally presented in the audio file. There was also an icon to take printouts. Instructions for taking print were also in audio file which plays automatically in the background.

Fig. 4. The Shoe Page

5. EXPERIMENTAL SETUP

5.1. The Target Populace

We tested the developed website on 31 participants. We also included female participants for the sake of generalizing our research findings as this group was ignored in some studies [12, 17]. Male included in our tested community were 19 (12 illiterates and 7 semi-literates) while female were 12 (8 illiterate and 4 semi-literate). The age group ranges from 22 to 55 having mean 34.77 and standard deviation 10.34.

5.2. Procedure for Data Collection

We tested all the participants on the proposed website and used a questionnaire called the SUS (Software Usability Scale). This include 10 questions about the system that was used by the users. Questions were asked from them in their local language and the questionnaire was filled by us as they were unable to fill that. Every question has points from 1 to 5 (1 for strongly disagree and 5 for strongly agree). The collected data was then passed through statistical T-Tests to find results.

The next section described the data of the participants. T-tests were applied on the collected data and there results were given in the coming section. The results were gathered to answer the following research questions.
"How the illiterate and semi-literate community of different age groups, literacy level and gender access and get benefit from different ICT solutions and what are the similarities and differences between them?"

6. RESULTS

Statistical T-Tests were applied on data. Results showed that the interface with and without audio support gives completely different outcomes. It was also noticed that gender and literacy level played important roles in concluding results. Different data was recorded when gender based test was conducted. Same behavior was noticed in literacy level based test.

6.1. The Effect of Audio Support

A clear difference was seen in the results of with and without audio assistance. The mean of SUS data with audio was 93.39 and without audio was 67.08. The standard deviation of with audio was 1.22 and without audio was 10.96.
Dependent t-test was conducted on the data because the participants were identical in both groups. The t-value obtained from the test was 4.66, whereas the p-value = 3.2 x 10-15. The p-value was very small. We can conclude that there was 3.2 x 10-15 % chance that the population mean SUS scores were equal to each other. Put another way, we can be over 99.99% sure that Products X (with audio) and Y (without audio) have different SUS scores. Product X's SUS score of 93.39 was statistically significantly higher than Product Y's of 67.08. We can conclude that users perceive Product X as easier to use. The detail is given in below graph.

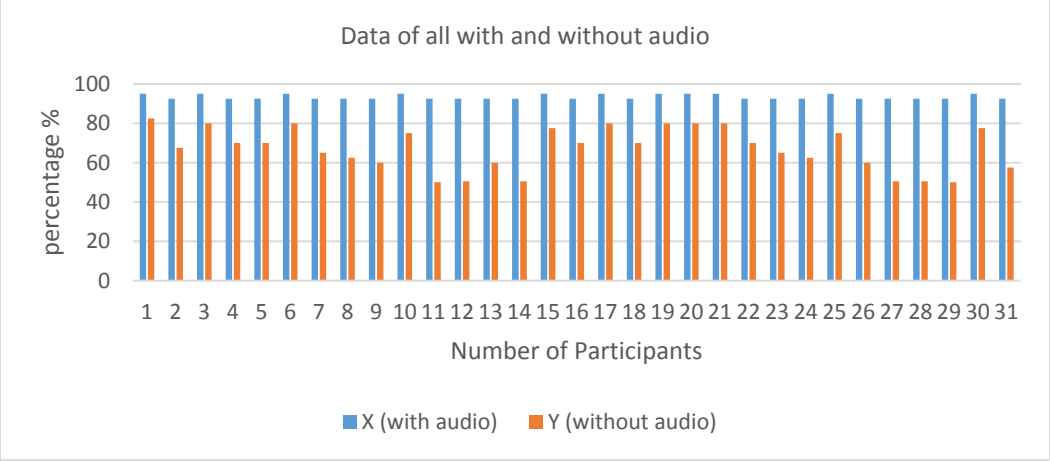

Fig. 5. Data of all with and without audio

6.2. Grouping by Literacy Level

6.2.1. Data of Illiterate vs. Semi-literate with Audio

It came into notice that both of these group showed equal behavior. The means were marginally different. The mean of SUS data of illiterate was 92.5 while that of semi-literate was 95. The standard deviation of both of these groups was 0. This implies that all data values were equal to mean.
Independent T-Test was applied on the collected data of both these groups. From the t-test degree of freedom was observed to be zero. By definition, when degree of freedom equals to zero, this make the value of P quite low, which makes one hesitant about being able to interpret some kind of results. There is no way to affirm or reject the model. In this sense, the data have no freedom to vary and we do not have any freedom to conduct research. In a nutshell, all the illiterate and semi-illiterate showed the same behavior as shown in Fig. 6.

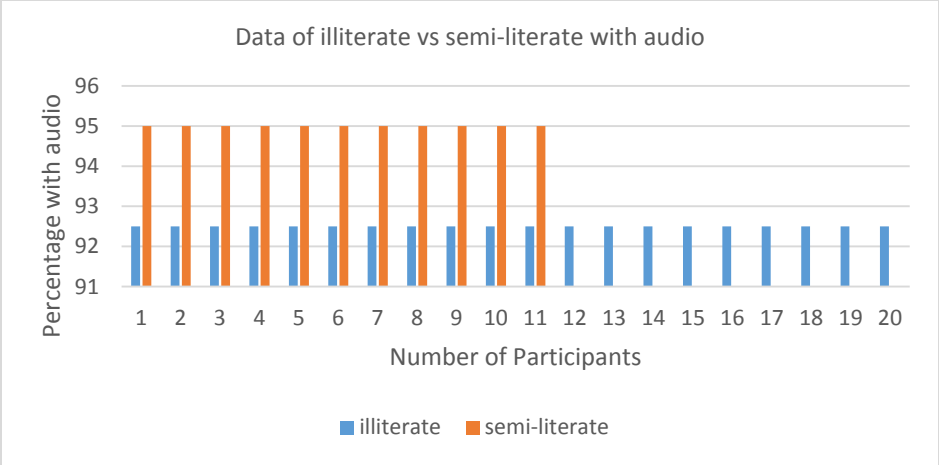

Fig. 6. Data of illiterate VS semi-literate with audio

6.2.2. Data of Illiterate VS Semi-literate without Audio

When the group was tested on without audio support it showed different kind of results. The mean of SUS data of illiterate=60.6 while that of semi-literate=78.86 which showed a clear difference between their means. The standard deviation of SUS data of illiterate was 7.88 while that of semi-literate was 2.34.

Independent t-test was applied on the collected data of both these groups. The t-value obtained from the test was 9.63, whereas the p-value = 7.19 x 10-5. The p-value was below 0.05 or 0.1. A p-value of 7.19 x 10-5 indicates the probability that this difference of two points was due to chance was 7.19 x 10-5 %. Put another way, we can be about 99.99 sure that products A and B have different SUS scores. The percentage is given below graphically.

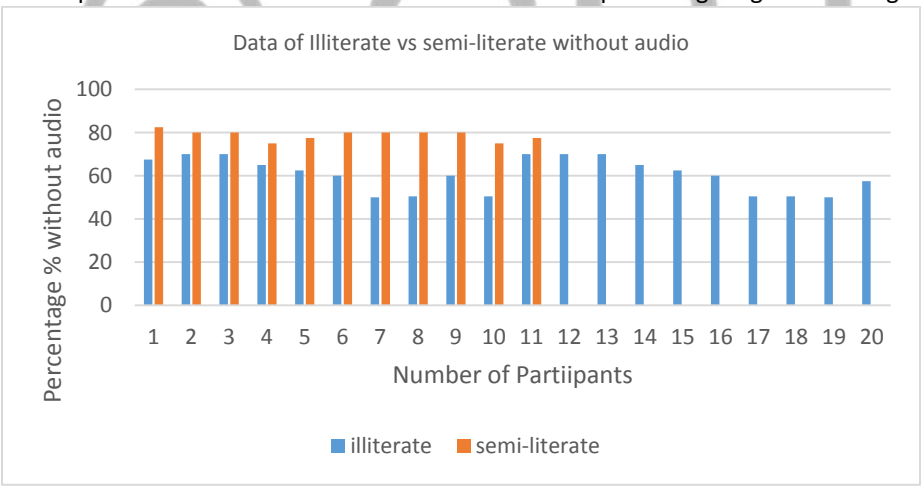

Fig. 7. Data of illiterate VS semi-literate without audio

6.3. Gender Based Results

6.3.1. Data of Male VS Female with Audio

It was observed that both groups have same data with same mean (mean of SUS data of male participants=93.42, mean of SUS data of female=93.33). This little difference was just because there were greater number of male (19 male whereas 12 female). The standard deviation of SUS data of male was 1.24 while that of female was 1.23.

T -value obtained from the test was 0.19, whereas the p-value =0.85. The p-value was above 0.05 or 0.1. We can't conclude that the difference was greater than chance. A p-value of 0.85 tells us that this difference of two points was due to chance was 84.88%. Put another way, we can be only about 15.12% sure that Fig. 8 showed the percentage of male VS female with audio assistance with the help of bar graph.

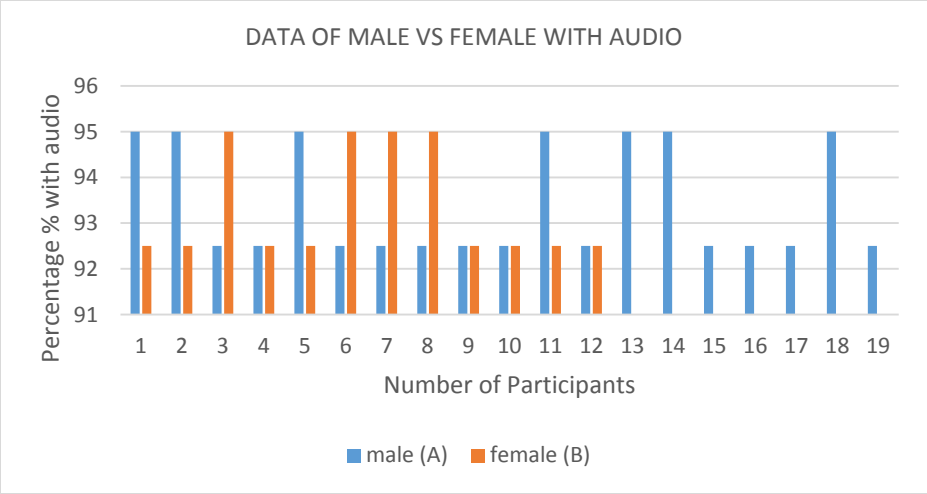

Fig. 8. Data of male VS female with audio

6.3.2. Data of Male VS Female without Audio

It was noticed that there was significant difference between the data of the male and female. The mean of SUS data of male=70.16 and of female=62.21. Here the standard deviation of SUS data of male=9.16 whereas of female =12.15.

The t-value obtained from the Independent T-Test was 1.94, whereas the p-value = 0.07. The p-value was large and above 0.05 or 0.1. We can't conclude that the difference was greater than chance. A p-value of 0.07 tells us the probability that this difference of two points was due to chance was 6.68%. Put another way, we can be only about 93.32% sure that Products A and B have different SUS scores. The percentage of this record is given below in Fig. 9.

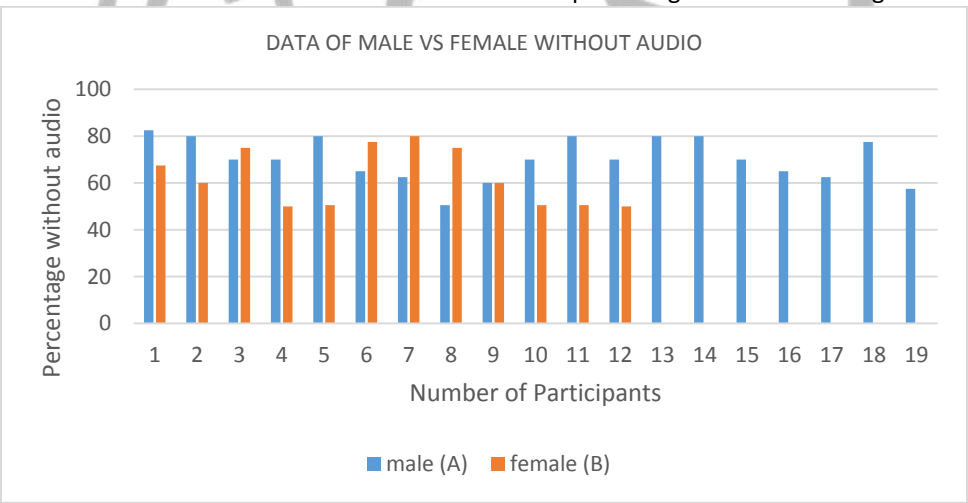

Fig. 9. Data of male VS female without audio

7. COMPARISON OF RESULTS AND DISCUSSIONS

First of all, from results we saw that G1 (age below 25 years) were more amiable to the developed interface than the G2 (age ranges from 25 to 35 years) and same was the case with G3 (age above 35 years). From this data we can conclude that the lower age population were more at ease while using the interface.

The important thing was that when users were asked if they used some kind of technological or computerized equipment e.g. television remote control or mobile/smart phone or computer. Some of them replied in positive and some of them gave a negative response. Greater number of positive responses were received from the lower age users. This means that the difference between the data of G1, G2 and G3 was due to the awareness of some

kind of technology. Some of them having their own smartphones however they were illiterate but they can use it. Some of them having television in their homes and they used the remote control and some of them have computers in their homes. Those who do not fall in these categories, they saw some kind of technological equipment e.g. simple mobile phones, smartphones, remote controls of Television, computer etc. with their family members or friends. These varying results may be due to another cause as one research showed that male participants were more at ease while using the interface as compare to the female [1]. In our group division we were having different number of female participants. For example, in G1 we have 2 females, in G2 we have 4 females while in G3 we have 6 female users. As the number of female populace increased the response decreased.
When the interface was tested with audio support it was concluded that all the participants showed very good response and gave same results but when it was tested without audio support they showed completely different results. From the independent t-test we can be about 93.32% sure that male and female have different SUS scores. The response of both genders were different [1]. All the illiterate gave same outcomes and all the semi-literate gave same kind of results on with audio support. Both these parties gave different behavior when it was tested on without audio application. By using independent T-Test we concluded that there was 99.99% surety that both of these give different responses without audio support.
When all the participants were tested with and without audio backing, it become clear by the dependent T-Test that both of these products (interface with and without audio) were completely different for this population because result showed that there was only 3.2 x 10-15 % chance that both these products gave same response. It means that we can be over 99.99 % sure that both of these products gave different response. The detail of SUS score is shown in Fig. 10.

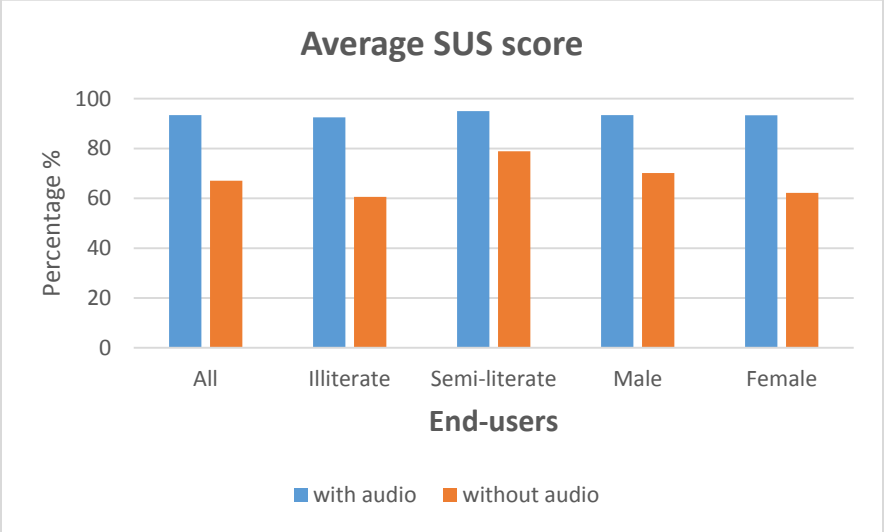

Fig. 10. Average SUS Score

8. CONCLUSION, LIMITATION AND FUTURE WORK

Illiterate has no idea of text and cannot recognize it. They do not know the purpose of the text. It was also cleared from the literature review that there is alternative to the text which is the audio support for these populace. Many researchers support the idea to use sketches as these are more amenable for illiterate. Keeping all these ideas of many researchers, a web application was designed for the purpose of online shopping. The purpose of this was to clarify the ideas of such an interface for illiterate which will be more responsive. Using this interface, the illiterate people was more at ease while using that application. The application also found the different requirements of illiterate and semi-literate while designing interfaces.
Earlier findings were confirmed by this research that the inclusion of audio support was really helpful for illiterate community. Illiterate were found more enthusiastic while using the website with audio support. Semi-literate completed their task more rapidly as compared to the illiterate and was also not so much interested in listening audio. This also confirmed that the requirements for designing interfaces for illiterate and semi-literate are

different. Sketches were used in the website design but the actual shopping materials were in their original form. This also clarified the difference between the actual shopping items and menu. It was also confirmed that sketch based interface was easier for illiterate as compared to heavy graphics.

Different age groups (G1, G2 and G3 discussed in section 6) had different SUS (Software Usability Scale) score. It was just because of the awareness of some kind of technological equipment and different number of ration of male and female participants as well as dissimilar number of illiterate and semi-literate people in each group. This difference was not because of their age. The awareness of modern technologies (e.g. Television or television remote control or simple mobile or smartphone or computer etc.) only effect the duration of time for the completion of task but has no effect on the correction of a complete task. This may indicate that the website design was suitable for all the participants regardless of the points of their age, the awareness of technology or some kind of experience.

There are a number of limitations of this research work e.g. our participants belong to only three districts of the KPK. Therefore, we cannot generalize this work to the whole province or country. The culture and social aspects are almost same so we can assume this website suitable for the whole province. We cannot assume this suitability for the whole country (Pakistan here) because there are differences in the populace of Pakistan not only in their culture but also in social aspects. Female participants are also included in this study. Therefore, the generalization of this work is supported through this point. The results were affected by computer literacy as well as the awareness of modern technology.

In future this work could be extended to a wide geographical area by including people from all the provinces to generalize it for the whole country. In future we are looking to enhance the capability of this work by including video support as well. In addition, with that, this work could also be extended towards a dynamic and commercial shopping website for illiterate. These research findings could also be applied on different areas of research like health, games, self-learning, communication purposes, mobile and ATM interfaces etc.

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