International Journal of Technology (2017) 2: 212-220
ISSN 2086-9614

DESIGNING A CALL CENTER TRAINING SOFTWARE FOR VISUALLY IMPAIRED USERS

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(Received: October 2016 / Revised: December 2016 / Accepted: January 2017)

ABSTRACT

Existing software development studies focus on creating interfaces that cater to improving sensual responses rather than on usability. The variables affecting the performance of visually impaired (VI) individuals in the design of existing software, such as arrangement of design elements, words used in the interface and allowing action reversal were investigated to improve task completion time, number of errors committed and overall satisfaction. Two interface designs of a telephone survey system were developed considering published usability and accessibility guidelines in literature. A total of 30 participants used the software and performed three tasks. Results of the usability test showed that the lowest overall task time was achieved by the current design followed by the panel design. The panel design produced the least number of errors committed. However, VI participants preferred the tab interface because it is more organized.

Keywords: Design; Software design; Usability; User-centered design; Visually- impaired

1. INTRODUCTION

Visual Impairment (VI) is defined as the consequence of a functional loss of vision (Disabled World, 2014). It describes any kind of vision loss that includes partial vision loss up to total blindness (The Nemours Foundation, 2010). Aside from difficulty in seeing there is nothing inherently wrong with visually impaired people, especially as workers (Omvig, 2005). If provided with appropriate training and assistive tools, their ability can be compared to typical workers in performing and accomplishing tasks.

With the current trends in technology, steps have been undertaken to enable the VI population to gain access to information. Assistive devices like screen readers or braille displays have been developed to help visually impaired people to surf the Internet (Abichandani et al., 2009). However, there are only very few VI individuals, who are braille-literate (Belisomo, 2015). Screen readers are good alternatives, but these are language dependent, making it difficult for VI people to have full access to computers (Pavesic et al., 2003). Moreover, screen readers cannot read the texts that are embedded in the graphics based on an interview with a VI person. Assistive devices, therefore, are still insufficient to address the challenges faced by the VI population.

Computer software available in the market is designed on the assumption that users have no disability and are physically able to perceive information from the monitor and manipulate the

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Permalink/DOI: https://doi.org/10.14716/ijtech.v8i2.6130

mouse and keyboard (Berliss et al., 1996). Software design technologies such as the Graphical User Interface (GUI) that make interface designs more attractive do not cater to the information needs of visually impaired users (Leuthold et al., 2008). Studies about software development focus on creating interfaces that cater to improving sensual responses rather than on usability. However, developing distinct software for the use of the visually impaired is unnecessary and illogical since it would double the cost of development (Di Blas et al., 2005).

Studies on software design for the blind focused on design of navigation aids. Sanchez and Saenz (2006) analyzed the design and usability of three-dimensional interactive environments for visually impaired children. The usability evaluation conducted identified sound as a vital element in the interaction between the user and the system. Hink and Suarez (2010) proposed an ideal human computer interface design that would help the blind community in navigating through existing software and applications. GUI, which is one of the most prevalent techniques in designing software, has been widely used primarily because the use of graphics attracts the users of the software. However, this technique is not designed for VI people, since they cannot perceive such things. The study proposed a human computer interface that focused on usability for screen reader applications so that VI people can interpret the things being shown in the application. The application system was highly compatible to speech technologies, making it interpretable by the text-to-speech translators making it useful for the blind. The concept of user-centered design was used so that the program became well suited to the needs of the VI. Factors were gathered through having interviews and questionnaires.

Taking into account previous studies a gap surfaced on the aspect of designing software user-interface for the VI. Existing studies did not consider the influence of the placement of elements in the interface, user-centeredness of terminologies and reversal of actions on the overall performance of VI individuals in accomplishing computer-related tasks. The current study considered the arrangement of design elements such as push buttons and pull down menus, the use of words in the interface and allowing action reversal in improving the task completion time, number of errors committed and satisfaction of visually impaired software users.

2. METHODOLOGY

2.1. Test Software

An existing telephone survey system software developed for training people with sight disabilities was studied. The users of this software complained of poor design making it inappropriate for use during training in call centers. An informal assessment was done by a call center language trainer/instructor, a web-accessibility expert, and a pioneer user of the current software. Some of the problems encountered in the use of the software are listed in Table 1, grouped according to the assessor.

Table 1 Software evaluation results

Language Trainer	Web-Accessibility Expert	Visually Impaired Pioneer
arrangement of the textboxes and elements cause confusion	Short-cut keys cannot be easily used	Difficult to proceed on with the calls without having the option to go back
	Users cannot easily shift to desired fields	Difficult to recheck or manage the previous customer entries.

2.2. Software Design

In developing the design, the requirements of the system to be improved was documented, analyzed and modeled. A use case diagram (Figure 1) illustrates the relationship of the related use cases or steps done in a specific business process. In this case, the call center set-up to be simulated in the experiments as well as the actors that initiates the use cases.

Two interface designs were developed considering the following guidelines: Research Based Web Design & Usability Guidelines (US Department of Health and Human Services, 2006), Web Content Accessibility Guidelines 2.0 (W3C, 2008), Section 508, 1194.22 Web-based Intranet and Internet Information and Applications (US Patent and Trademark Office, 2012), Nielsen's Ten Usability Heuristics (Nielsen, 1994), and Shneiderman's Eight Golden Rules of Interface Design Guidelines (Schneiderman & Plaisant, 2010). Relevant provisions in these guidelines were cited in Tables 2 and 3 in the context of designing the software. Two designs were generated to compare alternatives.

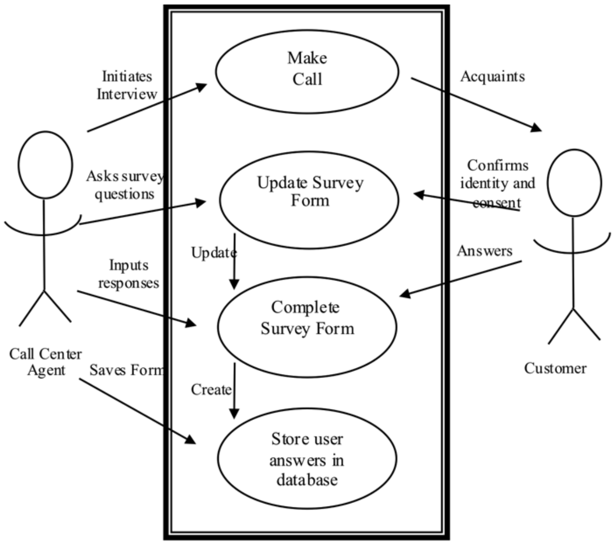

Figure 1 Use case diagram to perform telephone survey

2.3. Panel Design

Figure 2 shows the user-interface of the first proposed design for the call center training software. This design enables the user to do all activities in just one panel by showing all items in one page. Although this is similar to the existing design, the objects and items were rearranged based on existing usability and accessibility guidelines.

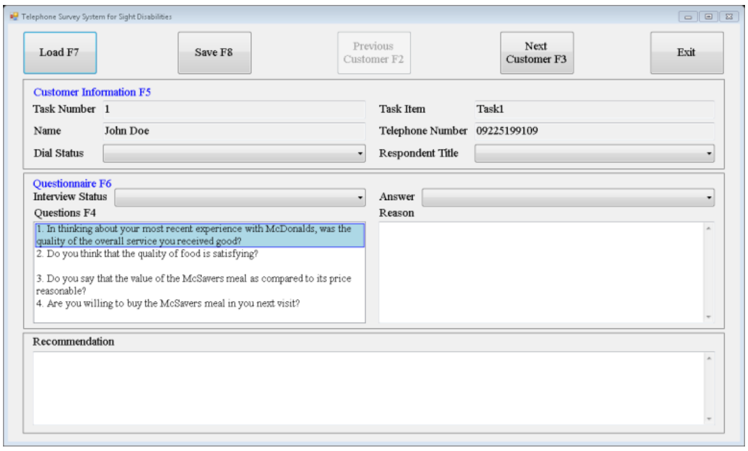

Figure 2 Panel design

The new design allowed the user to skip or go back from customer to customer, giving them the opportunity to edit entries. Also, the telephone number field was introduced to the interface. This field shows the contact number of the customer so that, through a hardware phone, the user of the software can contact the customer. Words used in the software were also made easier to understand. Table 2 shows the guidelines considered in the interface.

Table 2 Implemented guidelines for panel design

Guideline	Design Decisions
Place Important Items Consistently	Operational buttons like 'Save', 'Load', 'Previous Customer', etc., which are very important elements in the interface have been placed on the top-center part. It tests whether software users, both abled and disabled, would appreciate having these elements placed in the guidelines' suggested location.
Place Important Items at Top Center	Elements that are related with each other were grouped together and were placed on one location to improve the flow of tasks being done and reduce the chance of forgetting to fill up an element due to getting lost.
Understandable	To ensure that the software users would never get lost upon navigating through the software and to name the groupings of the elements, each group were placed into one frame that was labeled based on the relationship of each element in the group.
Group Related Elements	As assessed by the experts and the group, there are many elements that are present, but these have no function; therefore, in the proposed interface these elements were deleted to avoid cluttering of elements. The result was a cleaner and more organized screen.
Provide Frame Title	The terms used in the interface, especially error messages were made easy to understand.
Use Clear Category Level	Options to undo or redo actions were also introduced in the proposed software. This is to validate whether allowing reversal of actions whenever users commit errors would affect their overall performance.
Avoid Cluttered Displays	
Optimize Display Density	
Display Issues	
Avoid Jargon	
Use Familiar Words	
Help Users Recognize, Diagnose, and Recover from Errors	
Offer Informative Feedback	
Consistency	
Feedback	
Permit Easy Reversal of Actions	
User Control and Freedom	
Modality	
Understandable	

2.4. Tab Design

The second design is shown in Figure 3. It has more screens compared to the Panel Design. The elements and items in the system were subdivided per task. For instance, the items that are concerned with customers were all grouped in the ‘Customer Information’ pane; items related to the questions and the interview proper were grouped under the ‘Questionnaire’ pane; and items that would trigger a change in the state of the system, like ‘Save’, or ‘Previous Customer’, or ‘Next Customer’, were all grouped under the ‘Actions’ pane. Each task was placed in tabs. The same guidelines used for the panel design were used with only a few exceptions. Table 3 shows the summary of additional guidelines considered for the Tab Design.

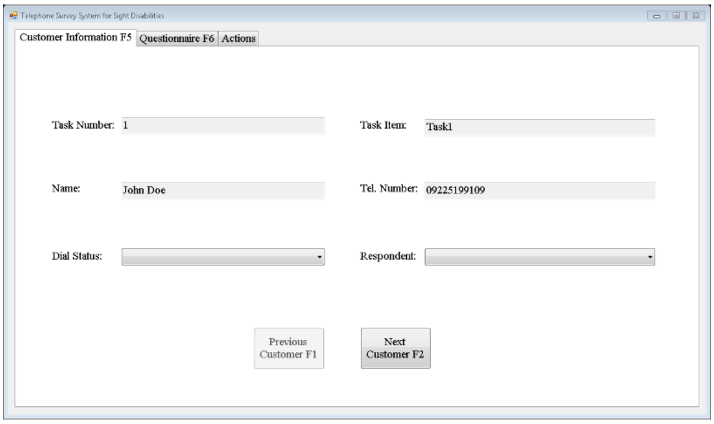

Figure 3 Tab design

Table 3 Implemented guidelines for tab design

Guideline	Design Decisions
Use Descriptive Tab Labels Present Tabs Effectively	The labels that were placed on the tabs were clearly descriptive as per its function. Also, as suggested by the guideline, tabs should be presented at the top of the page. As for the sighted users, the tabs were designed in such a way that it ‘looks’ clickable, to avoid confusion.
Simplicity	Tasks and elements were broken down into smaller units, and grouped into different panes to lessen information on each screen, thus emphasizing simplicity of the interface.
Format Common Items Consistently	The format of related items in the different panes were made consistent to give the users familiarity as they shift from one panel to the other.

2.5. Testing Procedure

2.5.1. Participant profile

Potential participants were first time users of any or similar call-center training software. They should all be at least 18 years old and computer literate. VI participants were dependent on screen readers. There were a total of thirty participants with equal number of sighted and visually impaired. The VI participants came from different organizations and institutions for the blind in Manila.

2.5.2. Materials

During the test, the call center set-up was replicated. A standard Acer keyboard attached to the laptop was used as input device because VI users are more familiar with it. A cellular phone was used as replacement for the telephone hardware. The laptops were loaded with a screen reader.

2.5.3. Measurements

The current and proposed designs were compared using the following measures: overall task completion time and error rate. Completion time includes the combined reading, search and thinking time for the task.

2.5.4. Tasks

There were three tasks considered in the experiment as enumerated below. Each of these tasks was performed on the existing design, panel design and the tab design by two sets of participants: Sighted and VI.

2.5.4.1. Log-in – The standard procedure for accomplishing the first task was by inputting the username, the password and then the task code which was given at the start of the experiment.

2.5.4.2. Product survey – The Participant simulated the process of calling up a client using the information presented by the software. They were asked to dial the correct number and when the person answers the call, they were to perform all the necessary actions as required to fulfill the task.

2.5.4.3. Reversal of action – After performing the Product Survey Task, the Participants were asked to reverse their actions by going back to the previous customer and changing the dial status.

2.5.5. Testing Proper

The usability test was conducted following the steps enumerated below:

2.5.5.1. Briefing – The participants were given a consent form and filled out a profile questionnaire. The facilitators then explained the conduct of the test.

2.5.5.2. Actual test – Participants were asked to work on the three tasks for each of the prototype designs of the software, while their actions were recorded using a screen capture software.

2.5.5.3. Debriefing – Participants were interviewed regarding their impressions about the test.

3. RESULTS

Results of the usability test showed that the lowest overall task time was achieved by the current design followed by the panel design (See Figure 4). However, the current design cannot be directly compared with the proposed designs. The most difficult task for both types of participants was the Product Survey Task based on task time. Implementing tabbed dialogues only led to longer task times for both sighted and VI. This may be attributed to the additional time needed to change tabs.

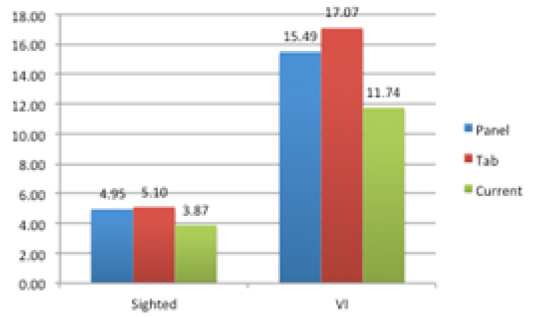

Figure 4 Overall Completion Time

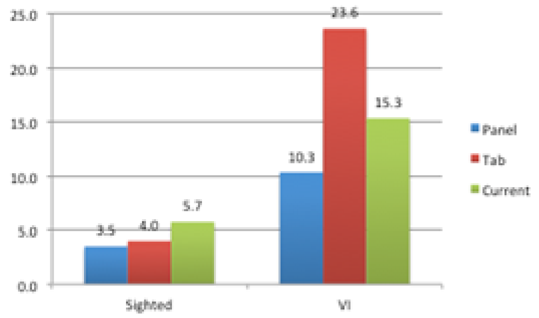

Figure 5 Errors Committed

Consistent with the task time result, the panel design produced the least number of errors committed. However, the VI participants preferred the tab interface because it was more organized. There was significant decrease in the number of errors committed in the proposed designs compared to the current design. The grouping of related objects in the interface had been a factor in the improvement of performance (US Department of Health and Human Services, 2006).

Based on the debriefing, as a whole the participants preferred the tab design. Fifty percent of the total number of participants (15 out of 30) chose the tab user-interface design, 47% the panel design, and only 3% the existing user-interface. However, in breaking down the results further, VI and sighted participants had different preferences. Most of the VI preferred the tab design due to the following reasons: a) users were able to shift immediately without going through all the content b) contents were segregated into different parts with less clutter, making them easier to remember c) generally, sequencing was better exemplified in this design so lesser confusions occurred. Though 27% who preferred the panel design stated that everything was intact in this design and there was no added tension from moving to one tab from another. The 6% (1 out of 15) who preferred the existing design stated that it was easier since the "reasons" text box was eliminated.

The sighted participants' preference was divided into two: 67% preferred the panel user-interface design, while 33% preferred the tab design. Most of the sighted preferred the panel design due to the following reasons: (a) all of the needed information was already shown in page layout; (b) all icons presented in one page, and chronologically arranged; (c) there was no need to switch tabs. Though, 33% who preferred the tab user-interface design stated it was easier to perform and accomplish the tasks since lesser amount of information was displayed. Many of them were also accustomed to tabbing, since this is used in navigating websites.

4. DISCUSSION

The time advantage of the current design may be attributed to its limitations such as the use of the 'Dial' and 'Hang Up' buttons as well as the absence of the function to input content in the 'Reasons' field. In the current software, only the 'Dial' button needs to be pressed instead of dialing the contact number in a hardware telephone. Moreover, there was no need to input anything in the 'Reasons' field of the existing software so the participants did not have to spend time asking the customer and documenting the answers. The easiest task for the participants was the Log-In Task.

Through the grouping of related items together, the number of times when fields were not filled up on the current software was reduced and the participants needed to be prompted less. In the existing design, the related elements were not grouped together so the 'Respondent' field was unnoticeable. Moving it to similar fields made it easier to notice. The addition of action reversal has improved the efficiency of the software. The users were able to correct their mistakes and became more confident in using the system.

According to one VI user interviewed that was trained in the current software, one of the weaknesses of the software is the absence of an option to go back and undo the error done. She highly suggested that an option to have action reversal be included in the software. According to Schneiderman (2004), allowing the software user to undo or redo an activity done with the software relieves the user of anxiety and encourages the user to explore unfamiliar options in the software. There should also be allowable escape routes just in case errors have been committed. The use of tabbed dialogs in the proposed software design only lead to more errors especially for the VI. They tended to get 'lost' in the interface as they shift from one tab to another.

The testing was designed in a way that the users would be able to finish the tasks assigned to them. To measure their success, errors were counted and these indicated that for all the interface designs, the sighted had fewer errors than the VI.

The most evident error that both types of participants encountered was the need for instruction from the test host on what needs to be done. The second usual error was the need for help. The instruction and help errors occurred frequently because the participants were not aware they were committing a mistake. There was a need for the test host to interfere to avoid the crashing of the software and to aid the participants to proceed to the next step. The VI participants were more confused so they had significantly more help errors.

Failure to do a task was encountered more frequently on the existing software compared to the proposed design, since the design of the existing software limited the participants to finish the last task. Both types of participants pressed the wrong buttons, but were able to undo whatever mistakes they had done.

Based on the tests conducted, it can be concluded that both proposed designs were favored above the existing design, however, there is no definite conclusion as to which design was ideal because of the opposing preferences and capabilities of the two types of participants. Compromises with regards to the design need to be made in order to develop a user-interface that would cater to both of these participants.

5. CONCLUSION

Experiments conducted showed that placement of elements that appeared on the interface, type of wordings used, and the option for action reversal affect the overall performance of both sighted and VI users. Participants preferred to use the software designed, considering usability and accessibility guidelines. Though the participants experienced longer task times with the proposed software designs, there was an assurance of the completeness of all the functions. In addition, the number of errors commited were reduced compared to the existing software. As to the screen estate structure, sighted users prefer that all the items be placed in just one page to reduce additional cognitive workload. On the other hand, the VI prefer to use the tab design since there are lesser items to navigate through. Since they rely greatly on their hearing and memory skills, having less information on the screen suited them.

Both sighted and VI participants preferred words that are common and understandable than technical terms are difficult to comprehend. Even first time users and those without background on the use of the software were able to understand the terms. In doing this, the overall satisfaction increased as evidenced by the results of the experiments.

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