Information Technology Based Usable Ballot Interface Design for Persons with Visual Impairment in Sri Lanka

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Abstract. Elections in Sri Lanka are conducted based on a paper-based voting system. Voters with visual impairment requires assistance of another to vote and cannot have an independent vote. In this study, two ballot interfaces were designed and examined that are capable of providing an independent voting experience for voters with visual disabilities: Button Tactile Ballot with button controls, Touch Tactile Ballot based on a touch interface. The design features of the interfaces were based on multi-modality and universal design guidelines. A foam prototype was provided to a group of users and usability metrics were used to measure the results. Feedback received for the test prototype could be interpreted that voters with visual disabilities prefer to use this multi-modal voting solution that provided mean SUS Scores of 88.25 and 84.44 for Button Tactile Ballot and Touch Tactile Ballot respectively. Users preferred the Button Tactile Ballot more than Touch Tactile Ballot while some preferred both. However, in terms of efficiency Touch Tactile Ballot was slightly ahead that of Button Tactile Ballot. Effectiveness wise also Touch Tactile Ballot was slightly higher, which was measured by the number of completed ballots without errors.

Keywords: Electronic voting · Visual impairment · Usability · Ballot interfaces · Independent voting

1 Introduction

Around one million people with visual impairment in Sri Lanka have the right to vote, which is 5.1% out of the total population [1]. According to Elections (Special Provisions) Act [2] in Sri Lanka, voter with a disability is allowed to accompany another individual (an eligible individual adhering to the stated requirements by the act) who is capable of marking the vote on the ballot paper upon the preference of the voter with visual impairment [3]. Although paper-based voting systems provide advantages such as ease of understanding for the voter, those do not support individuals with visual impairments voting independently. However, various voting systems that support voters with visual impairment are utilized all over the world. A preliminary study was conducted on those systems and Table 1 shows a summary of the design features available in those existing voting systems relevant to accessibility, privacy and design methodologies [4].

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Table 1. Summary of review of existing voting systems

Category	Findings
Design features relevant to accessibility	Tactile features
	• Buttons
	• Rotation dials
	• Sleeves with punched holes
	Touch features
	• Single/double tap
	• Slide rule
	Multimodal features
	• Combining tactile, touch and/or voice input
Design features relevant to privacy	Security aspect
	• Cryptography-based solutions
	Interface aspect
	• Accessible interfaces
	• Screen off feature
Design methodologies	Design principles and guidelines
	• User centered design (UCD)
	• Universal design (UD)
	Evaluation models
	• Unified theory of acceptance and use of technology (UTAUT)
	• ISO usability standards
	• System Usability Scale (SUS)

In some contexts, voting systems utilize Braille buttons [5]. However, when considering Braille literacy in Sri Lanka context, only 41% of individuals who know Braille are able to use it [6]. Thus, it is important to have other modes of interactions blind voters. Thus, multi-modality concept has been adhered in voting, which is also following the 2nd universal design principle of Flexibility in Use [7]. One such example is ‘Prime III’ [8], which has accessible modes of buttons and voice-based voting. However, it has only 90% accuracy within a Signal to Noise Ratio (SNR) of 1.44 [9]. Another ballot design, which adheres to multimodal concept is ‘Universal Ballot Design’ interfaces that provide two ballots, ‘Quick ballot’ and ‘EZ ballot’ [10]. In EZ ballot design, interactions based on slide rule [11] are used with a touch interface. Evaluations report that this slide rule is less familiar to blind voters and is less of a natural interaction [12]. However, it also has design issues such as accidental touch on unintended spaces and spending excessive time touching inactive areas due to lack of guidance on the touch interface [12].

Many voting systems consider that ensuring privacy of the vote only as a security aspect. However, some electronic voting machines (e.g. AVC Edge, AutoMARK VAT) have the option of turning off the screen when a blind voter uses the system considering privacy in an interface aspect but voters have reported it less user friendly [5].

Initially, a pre-study was conducted through a design workshop [4]. During the workshop two ballots were designed. Also, the participants of the workshop evaluated the design. The design of the two ballots were aligned with Universal Design [7] guidelines. The remaining sections of the paper are organized as follows. Section 2 summarizes the design features and the findings of the design workshop held in the pre-study (see [4] for more details). Section 3 states the research goal, which drives the present study. Section 4 describes the ballot design and Sect. 5 explains how the research was conducted. Section 6 analyses the data and presents the results. Section 7 discusses the results and finally Sect. 8 concludes this paper.

2 Pre-study: Design Workshop

All the participants had some sort of experience in using mobile phones. However, their experience in using different types of mobile phones varied. The majority had the experience of using smartphones but there were persons who had only the experience of using a basic mobile phone with buttons or keypads. Thus, multimodality concept was adhered for the voting design, which is also accommodating the 2nd Universal Design principle of Flexibility in Use [6]. Since voice-based voting is claimed accurate only within certain environments with respect to sound distortions, voting interactions were directed towards using buttons and touch-based voting. Figure 1 shows the ballot interface designed and evaluated during the design workshop.

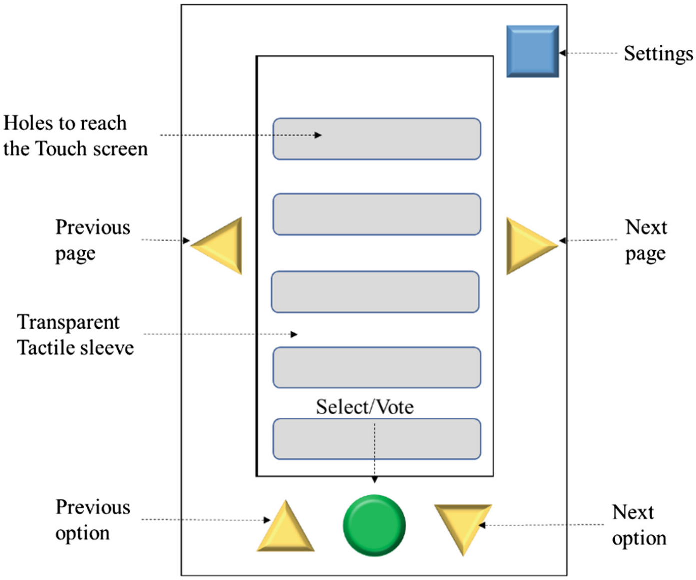

Fig. 1. Voting interface designed and evaluated in the design workshop

2.1 Button Interface

In the button interface, next option, previous option, next page, previous page, and settings buttons are used for navigation and select button (circular green) is used for selections as shown in Fig. 3. Next option button and previous option button are used to navigate the previous and next political party/candidate.

Few participants of the design workshop stated on the difficulties of differentiating colors of buttons, which led to refinement of colors. Also, this indicates that solely depending on color is also not sufficient. Thus, uniqueness of the buttons was also considered by using different shapes.

According to the prototype results, having several navigating buttons as ‘next’, ‘next page’, ‘previous’ and ‘previous page’ was confusing for many users, which was observed by the participant actions of trial and error to identify the buttons. Thus, instead of going through pages, the suggested approach is to consider a single page, which can be scrolled up and down using simple two buttons. This is more intuitive and natural as it is more similar to the paper-based voting, where only a single long ballot paper is provided for voting in the Sri Lankan context. The aim of placing the buttons in different locations was for easy identification. However, participants had difficulties and several responded it as a bad experience. Thus, the layout of buttons should be refined bringing the buttons to close proximity.

2.2 Touch Interface

As explained in Introduction section, some inefficiencies were reported in existing voting systems with touch interfaces [12]: accidental touch, unfamiliar touch interaction, tapping inactive areas. Attempt was made to reduce these inefficiencies by allowing voters to reach only the active areas in the touch interface placing a transparent tactile sleeve with holes (Fig. 1).

Tap interactions were utilized for the touch interface instead of ‘Slide rule’ [11] because it was considered less natural for blind voters [12], which was also confirmed by the findings of initial interviews. When a hole is tapped once, the relevant political party/candidate is announced. If the voter requires to vote, the relevant hole had to be double tapped. This was intended to be of similar nature to smart phone tap interactions. Even though participants were familiar with using smart phones using single tap for listening to description and double tap for selections, participants of the design workshop showed a deviation. It was observed that majority of the blind persons are performed double tap instead of single tap frequently. But there were also some participants who were familiar with a single tap gesture. Thus, both single and double were considered in the revised design.

3 Research Goal

During the pre-study, the interfaces were evaluated only for the voting step and no other steps such as language selection, adjusting settings, etc. Thus, a full comprehensive system was not developed.

The aim of this research is to improve the voting design, develop a system for the intended complete voter journey and conduct evaluation. The research goal aimed by this research is, “Designing usable ballot interfaces to provide an independent voting experience for Sri Lankans with visual impairment”. These features should enable an accessible vote, which also supports to maintain the secrecy of the vote. The usability is defined and measured according to metrics of International Organization for Standardization (ISO 9241-11, 1998), which lists effectiveness, efficiency and user satisfaction as key factors of usability in a design.

4 Ballot Design

The voter journey begins when the voter wears the headphone (Fig. 2). Subsequently, audio instructions are initiated to play. Initially, the voter has to choose the preferred language. After the language selection, the voter is made aware of the ‘settings’ button with the available options that can be modified: language preference, audio volume, audio speed, and color contrast. The voting instructions are played next and the voter can wait to listen or skip the instructions. Next, voter is asked whether they are ready to vote. Subsequently, the voting list is displayed mentioning the number of political parties/candidates with the number of pages. The voter can select the preference by pressing the appropriate button or touching the relevant hole as explained in the subsequent sections.

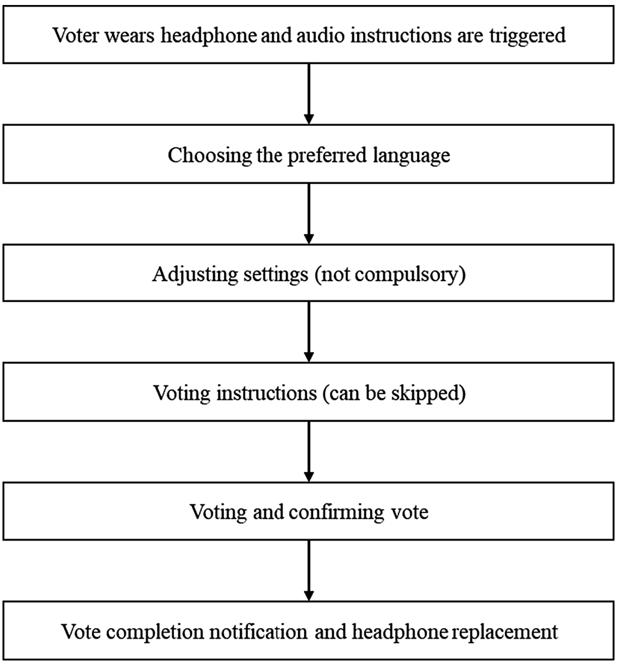

Fig. 2. User flow of the journey of a voter with visual impairment

Then the voter has to confirm the vote in order to complete the voting process. The system acknowledges the voter about the successful completion of the voting and requests the voter to replace the headphone. System replays the list automatically when the voter makes no selection.

In the journey of the voter with visual impairment (Fig. 1), it is required to identify the features that are required for navigation and how the voter interacts with the voting system (Table 2). Thus, voting interfaces with both buttons (Button Tactile Ballot) and touch (Touch Tactile Ballot) were designed as shown in Figs. 3 and 4 based on the results obtained from a preliminary user study and literature review conducted.

Table 2. Navigation and selection actions

Feature type	Actions
Navigation	Navigating through languages
	Navigating through settings
	Navigating through political parties/candidates
Selection	Selecting preferred language
	Adjusting settings
	Selecting the preferred political party/candidate
	Confirming vote

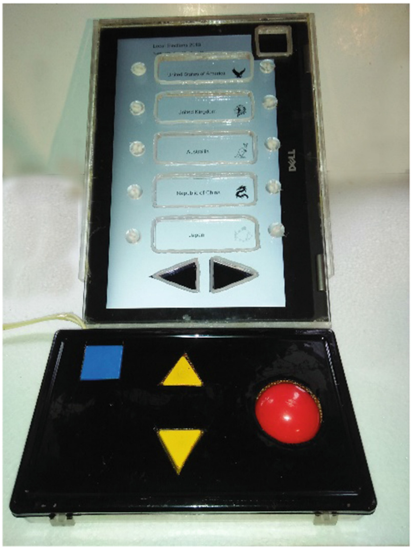

Fig. 3. Button Tactile Ballot and Touch Tactile Ballot (front view)

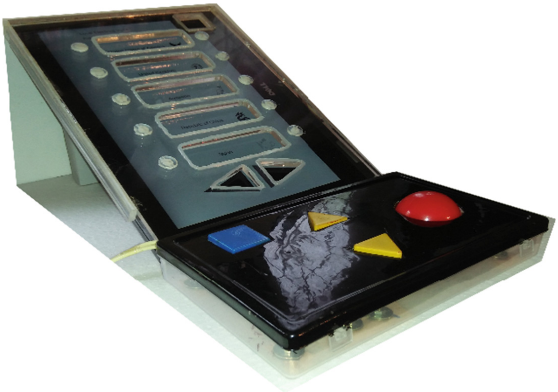

Fig. 4. Button Tactile Ballot and Touch Tactile Ballot (side view)

Voting systems designed based on touch interfaces have reported in many errors due to accidental touch [12]. The findings of the interviews with users also signified the difficulty of scanning the whole touch screen. Thus, a tactile sleeve (Touch Tactile Ballot) was designed to act as a guidance as shown in Fig. 5. It shows that a tactile transparent sleeve with holes is placed on top of the touch interface.

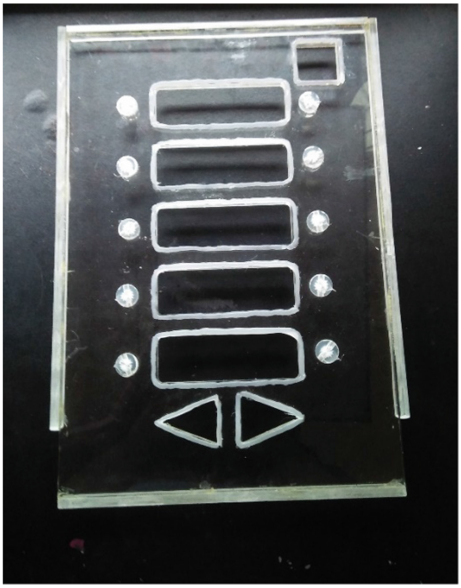

Fig. 5. Transparent sleeve in Touch Tactile Ballot

4.1 Button Tactile Ballot

In the Button Tactile (BT) Ballot (Table 3, Fig. 6), up, down and settings buttons are used for navigation and select (circular red) button is used for selections.

The political parties or the candidates are announced through audio recordings. After each political party/candidate, there is a pause (4 s) allowing the voters to cast their vote. If the voter prefers the particular political party/candidate, then the voter should press the circular red button (Fig. 6). Otherwise the voter can wait until the system announces the next political party/candidate or press the yellow triangular button on the right side (Fig. 6). After a voter presses the circular red button, voter is asked to confirm the vote by pressing the same button again. The list of political parties/candidates in this ballot, has been segmented to number of pages. Thus, navigating through pages is not required (see Table 3).

Table 3. Interactions for navigation and selections using BT Ballot and TT Ballot

	BT Ballot	TT Ballot
Navigating to next option	Down button (1 in Fig. 6)	Touch/tap relevant hole (1 in Fig. 5)
Navigating to previous option	Down button (2 in Fig. 6)	Touch/tap relevant hole (1 in Fig. 5)
Navigating to settings option	Square button (3 in Fig. 6)	Touch/tap square shaped hole (2 in Fig. 5)
Navigating to next page	Null	Touch/Tap triangular shaped hole (3 in Fig. 5)
Navigating to previous page	Null	Touch/tap triangular shaped hole (4 in Fig. 5)
Selecting an option	Round button (4 in Fig. 6)	Touch/tap relevant hole (1 in Fig. 5)
Confirming an option	Round button (4 in Fig. 6)	Touch/tap relevant hole again (1 in Fig. 5)

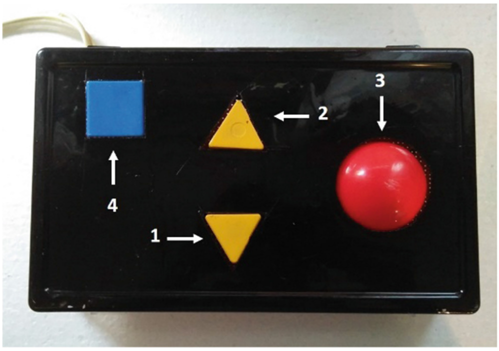

Fig. 6. Layout of Button Tactile Ballot

4.2 Touch Tactile Ballot

The political parties or the candidates are listed as shown in Fig. 7. When a hole is touched/tapped once, the relevant political party/candidate is announced. Then the voter is asked to confirm the vote by tapping again followed by audio instructions (Fig. 7). Here, the transparent sleeve with holes is used as a guidance to reduce the inconvenience of touching unintended areas and screen areas that has no response.

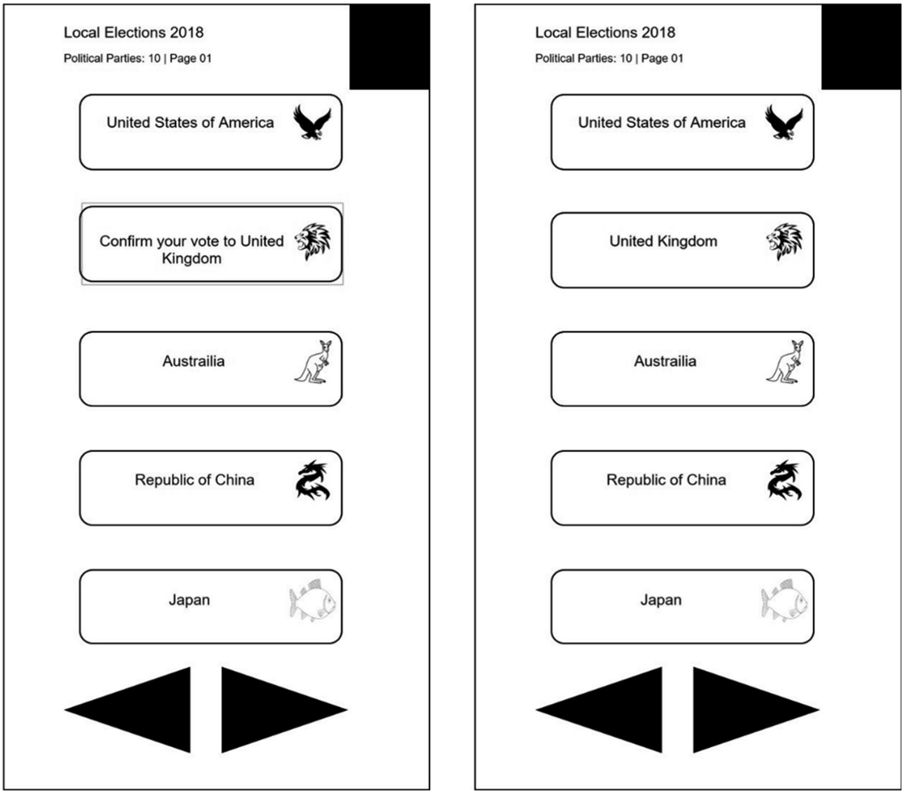

Fig. 7. Screens illustrating voting list and vote confirmation prompt

4.3 Design Concept

Table 4 summarizes the design features of the ballot interfaces designed to support voters with visual impairment. It explains the justifications for these features and how the Universal Design guideline has been followed.

Table 4. Design and justifications

Design	Universal design (UD) principles	Justification
Providing two types of ballot interfaces	UD principle 2: flexibility in use	Voters are given two methods to vote. They can choose their preferred method
Having button controls with unique features	UD principle 4: perceptible information	Satisfying both two sub principles in UD, buttons have different shapes and colors. Thus, it is easily identifiable by persons with visual disabilities by feeling the shape of button. Having differently shaped buttons also helps to guide the voter with instructions
Voting by listening to the list of political parties/candidates and selecting within the given period of time interval	Principle 6: low physical effort	Here the complexity of voting is maintained by the simple press of a button while listening to audio clips. Also, it does not require high physical effort
Simply touching/tapping the desired option	Principle 3: simple and intuitive use	Voters being familiar with single touch/tap interaction due to their experience in using smart phones
Tactile sleeve with punched holes on top of the touch interface	Principle 6: tolerance for error	Tactile sleeve acting as a guidance for voters that would avoid touching unintended areas and less prone to errors that were reported in an existing voting system, which has touch interfaces [6]
Providing two types of ballot interfaces	UD principle 2: flexibility in use	Voters are given two methods to vote. They can choose their preferred method

5 Method

5.1 Participants

A total of 10 participants with visual disabilities were selected (7 men and 3 women, 20–71 years old, mean age 44.7 ± 5.9 years). Among them, 7 totally blind (5 men and 2 women, 20–71 years old, mean age 50.1 ± 7.2 years) and 3 were partially blind (2 men and 1 woman, 22–46 years old, mean age 32 ± 7.2 years).

Experience in using mobile phones or Automatic Teller Machines (ATM), is considered as a potential to use an electronic voting solution with ease implying that similar interfaces are incorporated [13]. Thus, participants were questioned of whether they have prior experience of using digital devices such as an ATM, computer, mobile phones and for how long they have experienced the usage.

5.2 Procedure

Participant consent was obtained for audio recording. Demographic information was collected from the participants by reading out a questionnaire and answers were noted down. Participants faced the training and performed the voting process in the relevant ballot interfaces and they were randomly assigned for the two ballot interfaces. After using each interface, participants were asked to rate their voting experience by agreeing or disagreeing to the 10 statements provided system usability scale (SUS). After both trials were completed, participants were asked to choose their preferred ballot and feedback was noted. Interactions with the interfaces were video recorded and the feedback was audio recorded. Time spent on conducting all trials with training varied (25–45 min). Evaluation was carried out in three steps: conducting pre-trial interviews, participants performing the tasks and conducting post-trial interviews.

5.3 Tasks

Participants were given an introductory training for both ballot interfaces (BT Ballot and TT Ballot). Participants were randomly assigned to use one of the ballots first and the other second.

Training. The training program of Button Tactile (BT) Ballot described the button placements and its functions. The training for Touch Tactile (TT) Ballot described the positions of the holes and its functions.

Trials. Before using any ballot interface, participants were instructed to listen to voting instructions. If linear navigation was considered instead of page wise navigation, participants were instructed to vote for the 7^{th} political party. Each page displays only five candidates. If page wise navigation is considered, participants were instructed to vote for the 3^{rd} political party in the 2^{nd} page. Here, ballot interfaces used names of countries instead of names of actual political parties.

5.4 Data Collection and Metrics for Analysis

Usability of both Button Tactile (BT) Ballot and Touch Tactile (TT) Ballot were measured using metrics recommended by International Organization for Standardization (ISO 9241-11,1998) and previously conducted studies in a similar research [14] (see chapter 2). Thus, effectiveness, efficiency and user satisfaction were measured. Usability issues observed were noted separately.

Effectiveness. Participant voting choices were captured using logs.

Efficiency. Time stamps were logged when the language selection page was loaded, when the voting list was loaded and when the participant arrives the vote completion page. Ballot completion duration was considered the time between the loading of voting list and loading of vote completion page since initial language selection and instructions were common for all. The durations were marked in seconds.

Satisfaction. The System Usability Scale was adopted and score was calculated by considering the values from 0 to 4. Calculation procedure was followed as explained in literature [15] (see Sect. 3.5.3). For items 1, 3, 5, 7 and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Then the sum was multiplied by 2.5 to obtain the overall value which have a range of 0 to 100 [15].

6 Results

Most of the participants (n = 8) completed all the tasks including training and trials of using the ballot interfaces. Two participants (n = 2) were not able to complete the voting task using Button Tactile (BT) Ballot because they did not confirm the vote. One participant (n = 1) avoided and did not want to test Touch Tactile (TT) Ballot due to personal preferences. Thus, the total number of completed ballots was 17 (TB Ballot interface × 1 trial × 8 participants plus TT Ballot interface × 1 trial × 9 participants).

Eight participants have used touch based smart phones (average of nearly 2 years of experience). Remaining participants have used phones with keypads (average of nearly 3 years of experience). All participants had an experience of using screen reader assisted computers. Some participants had an experience of using an Automated Teller Machine (5 participants).

6.1 Effectiveness

Out of the 17 completed ballots, 10 ballots (58.82%) were completed without error: 50% (n = 4 ballots) with BT Ballot and 66% (n = 6 ballots) with TT Ballot (see Table 5).

Table 5. Ballot completion with and without errors

Ballot	Category of impairment	No error	With error	Total
Button Tactile Ballot	Total blind	3	3	6
	Partial blind	1	1	2
	All	4	4	8
Touch Tactile Ballot	Total blind	4	2	6
	Partial blind	2	1	3
	All	6	3	9

Out of the total number of completed ballots (n = 17 ballots), 7 ballots (41.17%) were completed with an error of not marking the intended political party: Overall, 50% (n = 4) of the ballots with BT Ballot contained the stated error. The number of ballots containing this error also varied by group: the total blind group (38%, n = 3) had the highest number of ballots containing the stated voting error, followed by the partially blind (13%, n = 1). Overall, 33% (n = 3) of ballots with TT Ballot contained the stated error. The number of ballots containing this error also varied by group: the total blind (22%, n = 2) had the highest number of ballots containing at least one voting error, followed by partially blind (11%, n = 1).

6.2 Efficiency

It was identified that ballot completion was faster with Touch Tactile Ballot (M = 92.55 s, SD = 24.40) than with Button Tactile Ballot (M = 105.5 s, SD = 49.63). The ballot completion time varied also by the disability of the participants (see Fig. 8). For the total blind participants, ballot completion time was lesser in Touch Tactile Ballot (M = 89.33 s, SD = 28.57) than with Button Tactile Ballot (M = 107.16 s, SD = 58.61). For the partial blind participants, ballot completion time was lesser in Touch Tactile Ballot (M = 99 s, SD = 15.71) than with Button Tactile Ballot (M = 100.5 s, SD = 2.12).

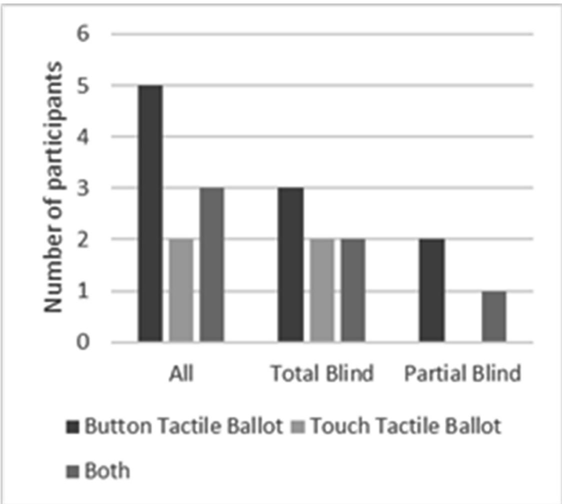

Fig. 8. Mean ballot completion time varied by ballot type and blind context

6.3 Usability with Satisfaction

The mean SUS score of both ballots (Button Tactile Ballot: M = 88.25 and SD = 7.91, Touch Tactile Ballot: M = 84.44 and SD = 6.09) was above the average score (68) [16]. Figure 9 presents how the mean of the SUS score varies for each ballot by the blind disability.

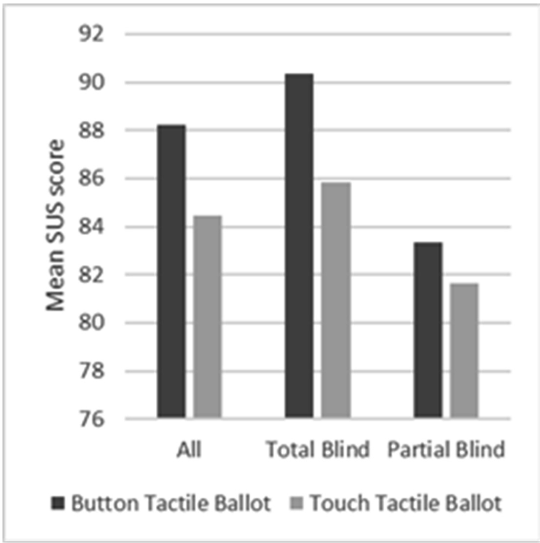

Fig. 9. Mean SUS Score for two ballots varied by blind context

6.4 Preference

Participants preferred using Button Tactile Ballot interfaces (50%, n = 5) than using Touch Tactile Ballot interfaces (20%, n = 2) irrespective of the variation in visual disability (Fig. 10). Also, some participants did not like choosing the most preferred and stated that they prefer both (30%, n = 3).

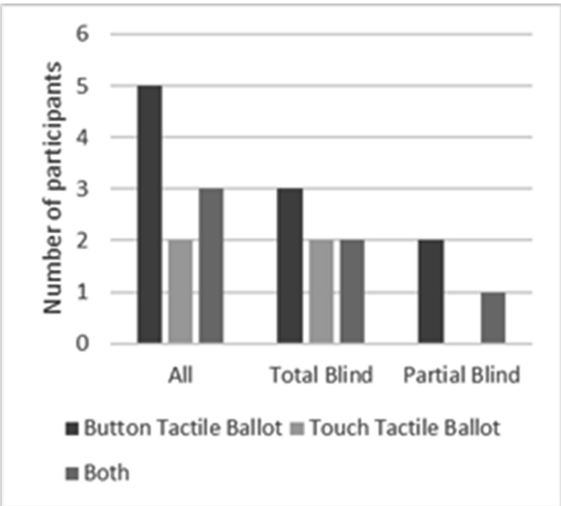

Fig. 10. Preference of the ballot interface type varied by blind context

A majority of total blind participants (30%, n = 3) preferred the Button Tactile Ballot to Touch Tactile Ballot (20%, n = 2). The reasons why they preferred the Button Tactile Ballot to Touch Tactile Ballot included the following: easier to use compared to touch (n = 2), identifying the buttons was easier (n = 2), only few buttons were there to learn (n = 2), pressing of the buttons felt more in touch sensory (n = 1).

The reasons why they preferred Touch Tactile Ballot to Button Tactile included the following: they were familiar with using touch phones so it was easier than using buttons (n = 2), it was quicker (n = 1), no accidental touch when compared to usual touch phones that need whole screen scanning to identify locations (n = 1).

The reasons provided by the participants who preferred both ballots (n = 3) included: both are equally easy (n = 2), 'it was easy to use Touch Tactile, even if the touch concept is given in a different way here' (n = 1), 'buttons were easy to handle but using touch tactile allowed to vote in a different contrast color setting, so I like both' (n = 1).

6.5 Usability Issues

It was observed that, 40% of the participants (n = 4) started touching the holes from the bottom instead of top using Touch Tactile Ballot. Some stated that this issue could have been avoided if audio instructions stated that the hole numbers start from top (n = 2), one suggested that design can be modified to begin hole number from the top and another stated 'this won't be an issue if we are given more time to be familiar with the device physically'. Another issue noted was that two participants accidently used double tap which led to skipping options ahead. Some participants (n = 4) stated that since they are familiar with touch phones, they tend to double tap to do a selection although this design is catered to avoid double tap. One participant stated that the gap is not enough between the holes located in the middle which listed the political parties. Another participant stated that holes sizes are too large and that can lead to accidental touch of holes. Using Button Tactile Ballot, 50% of participants (n = 5) faced a technical issue of hearing response alerts and instructions (dual sound clips playing) together in some situations which was disturbing to them.

In both ballots, two participants reported that language selection and vote ready pages also require response feedback when a selection is made and it should not be limited to the voting list page. Some participants mentioned that waiting period (4 s) was too long (n = 3). However, using Button Tactile Ballot interface, two participants voted mistakenly to the following political party (political party listed after 'Norway') because the waiting period was not enough. One person stated that instead of having separate training interface, it is better to combine training and voting instructions for both ballots.

7 Discussion

The research was aimed at designing usable ballot interfaces having aligned with Principles of Universal Design [7] supporting voters with visual abilities (total blind and partial blind). Results of the study indicate that participants did not perform equally on the two ballots when considering usability metrics of effectiveness, efficiency, and satisfaction.

Effectiveness is achieved when the voters are able to cast their vote for the intended political party/candidate. Only 85% ballots were completed with or without errors because the remaining did not confirm the vote as instructed. However, a majority of 58.82% were able to complete it without error. Participants marked the ballot incorrectly in Button Tactile Ballot slightly than in Touch Tactile Ballot irrespective of the blind category they belonged to. It was observed that few of them were late to press the button when the political party was announced. Errors were reported using Touch Tactile Ballot were mainly due to participants' double tapping rather than single tap because of their prior experience in using smart phones. This can be addressed by adjusting the touch with de-bounce feature [12].

When considering the efficiency measure, participants were slightly faster using Touch Tactile Ballot than using Button Tactile Ballot. This can be due to Touch Tactile Ballot displays candidates all at once and participants can go through it. However, the difference is not high because participants made well use of the 'up' and 'down' buttons of Button Tactile Ballot to go through the voting list quickly.

Although effectiveness was not significant, satisfaction in terms of the SUS score showed beyond average and excellent results (BT = 84.44 and TT = 88.25) according to the grading scales [16]. According to Nielsen Norman Group, 'Users generally prefer designs that are fast and easy to use, but satisfaction isn't 100% correlated with objective usability metrics' [17]. Thus, it is clearly evident that effectiveness and satisfaction can show no correlation as the results gained from the test prototype.

In existing voting systems with touch interfaces [12] the major inefficiencies reported were accidental touch and tapping inactive areas. These inefficiencies can be reduced by allowing voters to reach only the active areas as in Touch Tactile Ballot. Prototype results show that, users are capable and preferred to use the tactile sleeve (Touch Tactile Ballot preference only = 20%, both ballot preference = 30%), which is also evident by the SUS Score gained (84.44). However, it was observed that some participants used trial and error in tracking the holes. Thus, improvements have to be made by including a feature as a guidance to track the holes, so that they do not require to remember the holes or guess. Majority of the participants preferred the Button Ballot Interfaces (Button Tactile Ballot preference only = 50%, both ballot preference = 30%) due to its minimalist design of few unique buttons made with known shapes. It was stated by one the participants that, irrespective of any prior knowledge on touch or other technologies, they can easily use this.

8 Conclusion

Persons with visual disabilities are more accustomed to use mobile phones because inbuilt accessibility features exist. All the participants also had some sort of experience in using mobile phones compared to other IT related devices. However, their experience in using different types of mobile phones varied. Majority (80%) had an experience of using smart phones but there were persons who had only the experience of using a basic mobile phone with buttons or keypads. Also, there can be blind voters without any mobile device experience. Thus, in order to interact with the voting system, voters should be provided with several options such that they will choose the more familiar way, which is bringing in multi-modality concept for voting. Such concept is also aligned to facilitate the universal design principle. Few systems were already designed based on this concept whereas certain challenges remained to be addressed. Aim of this research was to design ballot interfaces that fit into the Sri Lankan context. Results obtained from the test prototype were promising and provided a greater SUS score. However, few usability issues were identified that requires certain modifications to improve the voting experience: Adjusting touch sensitivity to accommodate double tap errors, improving audio instructions, changing how the training is provided. After modifications are made, the ballots have to be tested again by voters with visual disabilities and without visual disabilities both.

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