INTERACTING WITH THE IPAD VIA VOICEOVER: ACCESSIBILITY AND USABILITY ISSUES

Abstract. In this paper we analyze the interaction of blind users with the iPad, the popular mobile tablet device that (thanks to its pre-installed VoiceOver screen reader) is also accessible to the blind. Specifically, we consider the gestures offered by VoiceOver to make the device usable by the blind users. Our analysis confirms that VoiceOver makes the iPad device basically accessible to blind users, but there are still some issues related to usability.

Keywords: mobile accessibility, usability, screen reader, blind users

1 Introduction

Mobile devices are increasingly used in daily life for various purposes including e-government, learning and entertainment; smart phones and tablet devices are used by everyone and not just limited to business. Therefore, mobile accessibility should be available to anyone, anywhere -- otherwise, with decreased e-inclusion there will be an inevitable widening of the digital divide.

In this paper we consider accessibility and usability issues for visually impaired people when they interact with a mobile device, i.e. the Apple iPad2 tablet (www.apple.com/ipad). Specifically, when considering mobile accessibility we need to focus on the entire input interaction paradigm (touch, gesture or voice interaction) as well as output modalities, that is, how to convey the displayed textual and graphical content.

Several mobile devices and smart phones are available on the market. Some of them are totally inaccessible, such as BlackBerry (http://us.blackberry.com); others are largely accessible thanks to mobile screen readers (e.g. Symbian-based systems) such as Talks (www.nuance.com/for-individuals/by-solution/talks-zooms/index.htm) or Mobile Speak (www.codefactory.es/en/products.asp?id=316); others are only partially accessible thanks to particular applications that render some functions offered by the devices accessible to blind users (such as the Olympus DM-5 recording device (www.olympus.co.uk/consumer/2581_23113.htm) or Rockbox-based players www.rockbox.org). Some blind persons use tactile overlays to learn the position of objects on the touchscreen device. The latest smart phones as well as PC tablets based on Android OS (www.android.com) or Apple IOS 4 (www.apple.com/iphone/ios4/) systems are designed to be accessible to all users, including those with disabilities.

In this paper we based our study on the evaluation of gestures offered by the iPad device when the screen reader VoiceOver is running. The paper is organized as follows: after a short introduction to the main investigation on mobile accessibility and on Apple VoiceOver gesture-based screen reading software, some usability issues

observed when interacting with iPad are reported and described using examples. A short discussion on the topic concludes the paper.

2 Related Work

2.1 Mobile accessibility

Research on mobile accessibility has evolved in response to rapid changes in technology. Today, features such as touch screens and screen pads (single- and multi-touch input), mobile screen readers, haptic and gesture interfaces and voice navigation functions, are new ways of interacting on mobile devices, that can adapt to different user abilities. Schultz et al. discussed the concept of a Universal Mobile Device intended as a multifunctional accessible and usable mobile device for everyday user activity, and described technologies currently available for developing such solutions [8].

Creating accessible touch screen interfaces is still a challenge. Currently, the iPad can assist people with a wide range of disabilities; augmentative and alternative communication assists persons with learning or developmental disturbances, gesture-based apps facilitate interaction for the motor-impaired. Vass produced a review of more recent applications in the following categories: 1) Symbol-Based and Customizable Apps, 2) Text-to-Speech Apps [9]. However, difficulties remain for the blind [2, 3, 7].

To increase accessibility of touch screen devices, previous studies investigated the use of tactile overlays or customized hardware associated with speech. However tactile overlays limit interface flexibility since elements have to match the physical overlay. To overcome these issues, Kane et al. proposed a specialized touch interface optimized for non-visual browsing on multi-touch devices [6].

McGookin et al. have investigated the accessibility of touch screens for visually impaired persons. The authors carried out a user test with twelve blindfolded and one visually-impaired subject, comparing a raised paper overlay touch screen-based MP3 player with a touch-screen gesture-based one. Although limited both as to the number and nature of participants, this study reveals problems on the use of buttons as well as gestures; the authors proposed general design guidelines for enhancing accessibility for the visually impaired [4].

Two user studies were carried out by Kane et al. comparing how blind and sighted people utilize touch screen gestures. Authors defined metrics to describe how gestures of blind people differ from those of sighted persons and compared differences of participants' gestures. Blind participants prefer gestures that use screen corners, edges, and multi-touch (enabling quicker and easier identification) and suggest new gestures in well-known spatial layouts (such as qwerty keyboard). Based on results, the authors proposed design guidelines for accessible touch screens [5, 6].

Recently, Bonner at al. developed an eyes-free text entry system incorporating accessibility principles that uses multi-touch input and audio output. The system has been implemented on Apple's iPhone and tested in comparison to the text entry component of Apple's VoiceOver with 10 users. Results showed better performance of the proposed system in terms of speed, accuracy and user preference [3].

Arroba et al. proposed a methodology for making mobile platforms with touchscreen input accessible for visually impaired people. The proposed solution is based on a functional gesture specification, a set of guidelines to assure consistency of mobile platforms and the customization of input application [2].

2.2 VoiceOver and Gestures

VoiceOver is the Apple gesture-based screen reader present in Mac OS and iOS operating systems, that makes products such as iPhone, iPad and iPod touch accessible (www.apple.com/accessibility/voiceover). Using VoiceOver, these products can provide spoken feedback so people who cannot see the screen can still use them. The VoiceOver gestures let a user move around the screen and control the selectable individual elements. VoiceOver gestures use one, two or more fingers to tap or flick [1].

3 Interaction Evaluation

To understand how a blind user can interact with an iPad device, we evaluated some actions and applications available on the device itself. In this section we summarize the main issues observed, while in Section 4, we report some interaction examples to better describe what we observed.
All three authors of this paper participated in this study. They have good knowledge of accessibility and usability of user interfaces for the blind; one, totally blind since childhood, is expert in interacting with screen readers also on mobile devices. One author was fluent with iPad interaction, using this device every day, one was a novice and the blind author uses regularly an iPod touch.
A popular approach for usability tests is the Think Aloud Protocol. However, in its classic form, being a verbal protocol, this method may not be effective for use with blind persons who, interacting via screen reader, already utilize the auditory channel. Thus, verbal comments may be gathered task by task [4]. The difficulties encountered while performing a task were described by voice and recorded by another research group component.

3.1 Method

In order to better focus on the possible issue, we identified some aspects: (1) clarity of user interface and interactive elements, (2) logical navigation order of contents and elements, (3) editing a form. These aspects are crucial for enabling rapid navigation of the content and allowing interaction with the device (user input).

3.2 Accessibility and Usability Issues

After interacting via VoiceOver with the iPad device, we can affirm that it is basically accessible since its content as well as the main activities can carried out by a blind

user through the VoiceOver gestures. Problems are mostly related to the usability aspects of carrying out some activities. The main issues observed were:

Lack of clarity of interactive elements: Usually when the focus is over interactive elements (such as buttons or links), VoiceOver announces the type of element. Unfortunately, in some cases no such indication is provided for elements. For instance, when navigating the available categories in the Apple App Store (a digital application distribution platform for iOS through the iTunes Store) no functional information informs the user that the element can be activated (by a double tap). The user perceives such content as a text string and no additional data is added to make the element clearer.

Lack of logical navigation order: When navigating the content and elements sequentially via "next" (flick right) and "previous" (flick left) gestures, some incongruence occurs when visiting a correct logical order, especially when expanding an item (e.g., contact details in the "Contacts" App - see Fig. 2).

Unsuitable handling of focus: This issue especially occurs when editing a text field while filling in a form composed of several control UI elements. In fact, when activating an edit field by a double tap, the system focus moves on that field and the VoiceOver announces the editing modality. The virtual keyboard appears on the lower part of the screen, so the user understands that (s)he can write the text. By exploring and clicking on the keyboard letters, the focus moves on the keyboard and the user loses the editing point because (s)he is not able to quickly check what was edited. To do this, it is necessary to explore the UI again. This issue also arises when filling in a group of form elements. When a text is edited, to proceed with the next form control the UI must be explored again and the desired element activated. This process disorients the user and could make the action difficult and frustrating.

4 Some Interacting Examples

In this section we report some interaction examples in order to better describe the issues summarized above.

4.1 User Interface Elements

Exploration among the UI elements is possible via the "next" and "previous" gestures. Exploration of the "Home" page(s) is clear, easy and no specific problem is perceived. On the contrary, some difficulties in the navigation order of the elements can observed when exploring, for example, the App Store to search for an App by category. Figure 1 shows the iPad screen with the App Store opened on the available categories. By a four-finger tap, the focus is moved to the first element of the current window, i.e., onto the "Choose a category" heading, making it possible for the user to explore the page from the top. Using the "next" gesture (i.e., flick right), the UI elements are announced by the voice synthesizer and they can be activated by a double-tap. Table 1 reports the list of the elements in the order they are "touched" by the

"next" gesture. The item labels announced by VoiceOver are listed on the left, whereas the additional information on that element is reported on the right.

Fig. 1. App Store screen shot with the available categories highlighted

Table 1. App Store category (bold) of elements: "next" gesture VoiceOver order

	UI labels announced	Type of UI element announced
1	Choose a category	Heading
2	Search	Search field
3	Racconta storie	Image
4	**Books (libri)**	
5	Racconta storie	List start
6	Diabolic	
7	Le bugie hanno le gambe lunghe e tacco 10	List end
8	Splashtop Remote Desktop for iPad	Image
9	**Business (Economia)**	
10	Splashtop Desktop for iPad	List start
11	Office2HD	
12	Quickoffice Connect Mobile Suite for iPad	List end
13	Complete italian dictionary	Image
14	**Education (Istruzione)**	
15	Complete Italian dictionary	List start
	...	...

The sequence of how elements are announced can be difficult and frustrating for the user. Just reading the available categories (to explore them) can require a lot of effort and time. For instance, for only the first three categories (reported in rows 4, 9 and 14) the user has to read some additional useless information. Other issues are related to the detection and announcement of the UI element types. The names of categories are linkable (to open the related category showing the Apps available). Unfortunately, the blind user is not provided with detailed information on the name of the category (see Table 1: nothing is announced as 'category' type - rows 4, 9, 14). The same behavior occurs for the elements reported per each category. By a double touch on a displayed element, the corresponding category is opened, in a sort of inconsistence of the UI interaction. Furthermore, VoiceOver announces some elements as "list start" or "list end" (see Table 1).

4.2 Filling in a Form

The iPad device offers a pre-installed App to handle personal contacts, store telephone data, addresses, etc. The main App shows an index which is a list of the available contacts. The UI offers also buttons to “Add” a new contact or to “Edit” an existing one. The form associated with each contact is composed of several data fields.

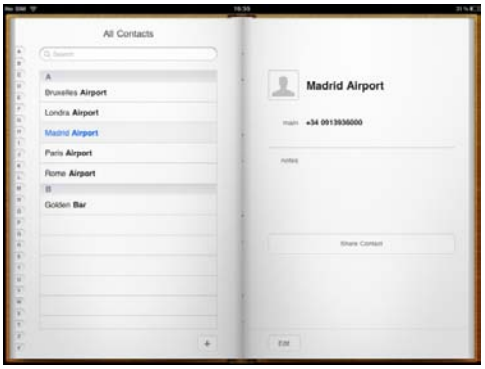

Fig. 2. App Contact UI - Contacts list and selection details

4.3 Reading a contact

By selecting a contact item, the associated details are shown on the right (see Fig. 2). The “next” (or previous) gesture allows the user to explore all the content. With a double touch on the contact item (e.g., “Madrid Airport”), the related details are shown. To read those data, the user must first read all contact items shown on the list (in the example "Paris airport", "Rome airport", and so on) and only afterwards the focus moves to the right part of the UI to read the contact details. This occurs because (1) the dynamic updated data are shown in the same page, and at the same time (2) the focus is not appropriately handled. To make interaction easier, when selecting an item (if the related information is displayed) the focus should follow the “new dynamic part”. Otherwise the user has to explore the entire UI in order to find the new part, unless (s)he tries to explore it in a random way, guessing the location of the elements.

4.4 Editing a contact

When adding a new contact or editing an existing one, a specific data form to be filled in or modified is opened (see Fig. 3). The editing process introduces additional complexity to the interaction, the user has to be aware of: (1) which field (s)he is filling in, (2) the correctness of written text, and (3) how to skip from a control form element to the next one. These activities require the focus to be handled appropriately. Unfortunately, some usability issues occur during the interaction.

Fig. 3. App Contact UI where a contact can be edited

When choosing the "Add a contact" button, a new window form is opened and the focus moves automatically to the first edit field (i.e., First name). VoiceOver announces this status correctly, and on the lower area of the window, a virtual keyboard appears. The user needs to explore the screen by a single touch (tap) to locate the letters, which can be selected via a double touch [1]. The focus on the keyboard moves and all strings can be written by selecting the needed letters. If the user wants to read what (s)he has written to check its correctness, (s)he must explore all the forms to find the editing field. As soon as it is finished, the next field or control UI element needs to be located and activated via a double touch. In this case, the "next" gesture works correctly only if the focus is on the previous text field. Otherwise, the user has to move the focus to the next text field, carrying out the steps (described above) to locate and move the focus to the text field that is being edited. Similar behavior is needed after filling in the form: the user must explore the UI to find the "Cancel" or "Done" button to cancel or confirm the editing process.
Even when editing an existing contact form, the issues are the same. The process is just slightly more complicated, because it requires additional steps and the UI is more complex: it is a combination of the "Reading a contact" UI – where a dynamic part is displayed on the right – and the Editing activities UI (including the keyboard and so on). The usability issues are therefore the sum of those described for both cases.

5 Discussion and Conclusions

In this paper we considered the interaction via VoiceOver with the main features available on the iPad device. The investigation aimed to identify the main accessibility and usability issues for the blind when using the gesture-based screen reader VoiceOver. The interaction is fundamentally accessible for a blind user; main issues are related to usability and simplicity: 1) focus handling when filling a form, 2) logical navigation order of elements when expanding an item or contents, and 3) lack of clarity in providing appropriate details of interactive elements. These activities, even if fully accessible, are a difficult and laborious procedure for a blind user. Some additional gestures or specific touch points to be used for some common actions or checking could be considered to improve user interaction. In particular, a specific gesture or

buttons should be made available to simulate the Tab key behavior and the command for reading the current line, as offered by several screen readers (e.g. JAWS for Windows http://www.freedomscientific.com/products/fs/jaws-product-page.asp). Thus, adding possible control elements at fixed reference points (such as near the edge or the four corners) to carry out specific actions (e.g., reading the current line or moving to next field) could improve user interaction.

Mobile devices, especially tablets, represent a new frontier in technology. The convergence of laptops decreasing in size, and tablets increasing resources and elaboration power, will in the near future lead to handheld devices offering natural interaction paradigms, involving more and more voice and gesture. This will open up new horizons for disabled persons if designers of devices and applications keep in mind accessibility and usability for all.

This preliminary study provides quantitative data that offer better insight into issues faced by blind users when interacting with iPad devices; however, due to the small size of the sample, they are not generalizable since the range of interaction possibilities is not covered. As future work, a study with a sample of blind participants will be performed to collect quantitative data and assess the qualitative issues that emerged from this preliminary study in order to better evaluate important aspects for mobile designers to keep in mind.

6 References

1. Apple, iPad 2 User Guide (For iOS 4.3 Software), March, 2011, at http://manuals.info.apple.com/en_US/ipad_2_user_guide.pdf
2. Arroba, P., Vallejo, J.C., Araujo, A., Fraga D., Moya, J.M.: A Methodology for Developing Accessible Mobile Platforms over Leading Devices for Visually Impaired People. Ambient Assisted Living. LNCS, Vol. 6693, 209--215, DOI: 10.1007/978-3-642-21303-8_29 (2011)
3. Bonner, M., Brudvik, J., Abowd, G., Edwards, W.K.: No-Look Notes: Accessible eyes-free multi-touch text entry. Pervasive 2010, LNCS, Vol. 6030, Springer, 409--426 (2010)
4. Sambhavi Chandrashekar, Tony Stockman, Deborah Fels, and Rachel Benedyk.: Using think aloud protocol with blind users: a case for inclusive usability evaluation methods. In Proc. of Assets '06. ACM, New York, USA, 251-252 (2006)
5. Kane, S.K., Wobbrock, J.O., Ladner, R.E.: Usable gestures for blind people: understanding preference and performance. In Proc. of CHI '11, ACM. 413-422 (2011).
6. Kane, S.K., Bigham, J. P., Wobbrock, J.O.: Slide rule: making mobile touch screens accessible to blind people using multi-touch interaction techniques. In Proc. of Assets '08. ACM, 73-80 (2008)
7. McGookin, D., Brewster, S., Jiang, W. W.: Investigating touchscreen accessibility for people with visual impairments. In Proc. of NordiCHI '08. ACM, 298--307. http://doi.acm.org/10.1145/1463160.1463193 (2008)
8. Schulz, T., Fuglerud, K.: Universal Mobile Device (UMD)—Methods, Inventory, and Dissemination. Note no DART/2010/01, January 29 (2010)
9. Vass, A.: A review, TechnoTalk Newsletter, Angela Vass Communication Apps – Vol. 19 - Issue 5 - NOV 2010