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A SMART MOBILE APPS FOR BLIND USER

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Abstract:

Although mobile devices include accessibility features available for visually impaired users, the user interface of the majority of the mobile apps is designed for sighted people. It is clear that "Design for Usability" differs depending if the final user is a sighted user or a visually impaired user. This paper introduces the concept of "Low vision Mobile App Portal", which provides a way to access mobile apps specifically designed for visually impaired users. Some design aspects will be described. Preliminary results show some of the low vision controls specifically design for visually impaired users.

Keywords— **Design; Mobile App; visually impaired; blind; Usability; low vision mobile portal; accessibility; iOS; iphone**

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I. INTRODUCTION

This research work deals about deals about design, mobile App design centered on low vision users. The concept of Universal Design has been widely used in several fields, such as architecture of product design. This term was coined by the Architect Ronald L. Mace, and refers to the idea of designing products to be aesthetic and usable by everyone, regardless of their age, ability or status in life.The most common adjectives used when referring to universal design are: simple, intuitive, equitable, flexibility, perceptible or tolerance for error. The term Universal Design is closely related to other terms such us accessibility or usability.With the appearance of the new technologies, the term accessibility is extended to computer accessibility. The majority of the operative systems include new and innovative solutions for people with disabilities. See Fig 1Due the growth of Internet, there is a specific section inside computer accessibility dealing with web accessibility.Some authors have written about this topic, describing assistive technologies for web browsing: speech.

When mobile phones started to emerge on the market, their accessibility was less complex. Blind people practically had to memorize the layout of the phone's keypad, which is very similar to regular phones, practically with two extra needed keys, send and cancel. After learning these keys, it was possible to use most of the phone's functionality, even without being able to see the display. Of course, initially caller id was not available, but in practice that was the only difference.

As mobile phones started to become more advanced, it required more and more effort to make mobile phones accessible to blind people. Phone manufacturers started to build voice recognition into their still simple phones. While access was very different for blind and sighted people, at least it was possible to use the phone book, check phone status, etc, even if the achievable functionality was limited. After the voice recognition features, phone manufacturers started to build a more complex voice response system into the phones, so some of the menus were able to announce the current item, and the phone's response to user interaction. However, this still only provided limited functionalities.

(a) (b)

Figure 1.1. Accessibility options: (a) Windows 7 (b) Mac OSX

Recognition screen magnification or screen reader software. In 1999, the web accessibility initiative (WAI) published the web content accessibility Guidelines WCAG, to improve the accessibility of the web for people with disabilities.

Since the appearance of mobile devices, human computer interaction has changed signification [8-9]. The usability tests evaluate the user interface and navigation issues in different environment.

A radical changed has occurred since the development of touch screen based mobile devices, such as the iphone, ipad or android devices. In less that a couple of years, gesture based interaction has become a standard on the majority of mobile devices.

It is an emerging area of research since touch display are more and more present in our everyday life {10-11]. Touch screens provide a great flexibility and a direct access to controls and information, but on the other hand, the physical feedback is lost, making them less accessible to visually impaired and blind udders. The goal of our research work is to facilitate low vision users the interaction with devices that use this kind of displays.

So, this paper deals about design. Design of touch based mobile apps usable by visually impaired people. Despite the great effort of hardware manufacturers to include accessibility features in their touch based mobile devices; they are not good enough to obtain a good visually impaired user experience. Since most of the existing apps are designed for sighted users, the accessibility features are not always adequate to obtain a reliable result.

Section II of this paper describes the importance of designing specific mobile apps for low vision users. Design for Usability is an essential requirement to achieve a good feedback from visual impaired users when using the apps.

In section III, the low vision mobile app portal is introduced. Thanks to this portal, visually impaired people will have the possibility of accessing an extensive collection of apps specifically designed for visually impaired user.

Later on, section IV describes some of the mobile apps that will be available in the low vision mobile app portal. Traditional apps such as telephone, calendar or contacts need to be reinvented. On the other hand, specific apps for blind users, such as text magnifiers or GPS, need to be effectively designed.

The paper finishes with some conclusions, which show the benefits of using Design for Usability when designing apps for blind and visually impaired users.

II.DESIGN FOR USABILITY FOR BLIND AND VISUALLY IMPAIRED USERS

Following are described some basic concepts needed in order to design specific mobile apps for visually impaired users. iOS devices (iPhone and iPad) are used to illustrate these ideas.

A. User Experience / Usability

One of the best ways to evaluate the effectiveness of a product design is to obtain a good user experience [12-13].

User Experience is about how a person feels about using a product, system or service. User experience highlights the experiential, affective, meaningful and valuable aspects of human-computer interaction [14]. As its name indicates, user experience focused on the user.

As example of user experience in touch screen based devices, iPhone and iPad have an specific Human Interface Guidelines, which describes the guidelines and principles that help developers to design a superlative user interface and a user experience for the iOS app. These guidelines are oriented to design apps for sighted users. Usability describes the quality of user experience.

B. Accessibility in mobile Apps

Accessibility is a general term used to describe the degree to which a product, device, service, or environment is available to as many people as possible.

As example, iPhone and iPad include a set of features specifically designed to provide accessibility to users with special needs. Some of these features are: Voice Over, Voice Control, White on Black, Zoom, Speak auto-text, tactile buttons, giant fonts, hands-free speakerphone, audible, visible and vibrating alerts or assignable ringtones.

In order to create accessible apps, Apple Accessibility Programming Guide [17] helps iOS developers make their applications accessible to low vision users, using the Voice over feature.

Once user experience, usability and accessibility have been defined, we can concentrate on mobile Apps design. The vast majority of the 425.000 iOS apps available at the App Store have been designed for sighted users. The user interface and the usability tests of these apps have been designed focusing on sighted users. If the designer

decides to make the app accessible for low vision or blind users, he can add an extra layer with useful labels and hints that will be used by VoiceOver feature.

Figure 2a shows this design situation. A mobile app designed for sighted users with an extra layer including accessibility features. Although blind users could use this mobile app, the user interface has not been conceived for blind users. In this case, design for usability applies only for sighted users and blind user experience is not assured at all.

Figure 2b shows a different design scenario. In this case, the mobile app has been designed centered on low vision people. Design for usability applies directly to visually impaired and blind users. It affects to design aspects of the user interface, such us the size of the controls, position, shape, image contrast, brightness, etc. Voice over accessibility features are not just an extra layer, they are directly connected to the main user controls.

If we want to design apps for visually impaired people, we should go to the scenario shown in Figure 2b, instead of adding accessibility features to apps that are not initially conceived for visually impaired users.

According to this premise, specific apps are needed for visually impaired users in order to obtain the best user experience. Even for those general apps, such us calendar, contacts or phone, a specific design app will increase dramatically the usability and user experience for visually impaired users.

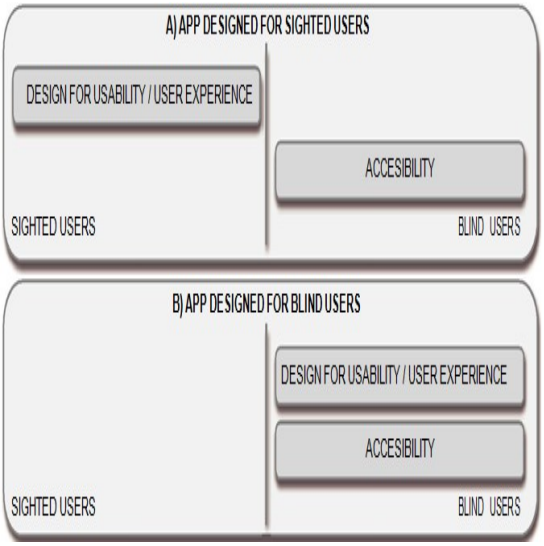

Figure 2.1 Mobile Apps designed for (a) sighted user (b) blind users.

It is also clear the advantage of using this low vision focused design in the development of specific apps, such us magnifiers, screen readers, GPS locators, etc.

An analogy that would help to understand this design singularity occurs between the iPhone and the iPad devices. If you have to design the same app for both devices, the user interface can be dramatically different. There are even specific iOS controls that are available only for iPad. If the size of the device could influence so much the final appearance of user interface, you can imagine how different would be the App user interface whether the final user is sighted or blind.

Fig 2 : Blind Track vision

In other words, the scenario given on Figure 2b would be defined as Usable Accessibility Design. Design for usability is focused on low vision users and it is using the available accessibility features. Another useful analogy to understand our approach is shown in Figure 3. It shows a ramp that is used to cross some steps. The initial design of the steps was not conceived for disable people, but the ramp is an alternative that would work. The slope is quite pronounced and the disabled users would require the assistance of other people to cross the steps. The best alternative would have been the design of an alternative accessible route with a lower slope.

If we translate this to the design of mobile apps for visually impaired users, the figure of the ramp would be equivalent to the Voice Over feature included on the iPhone and iPad devices. This feature acts like an extra layer added to the mobile app, which was originally designed for sighted users. Voice Over is a great tool that facilitates low vision users the interaction with apps designed for sighted users, but a design centered on visually impaired users would be a much better solution.

III. LOW VISION MOBILE APP PORTAL

The main goal of our project is to create a

collection of mobile Apps for visually impaired users. In order to facilitate the access to these apps, our approach consists on the creation of a low vision mobile portal. The appearance of the portal is a simple App that connects the low vision user with the most common apps, such as phone, contacts, messages, notes, etc. The user can customize the portal, adding or removing apps directly from the Apple Store. Other features such as icons size, colors, screen contrast or voice speed would also be easily customized by the low vision user.

In order to associate an App to the low vision portal, it should comply with a minimum set of specifications. The main requirement is that the App should be specifically designed for low vision users. An App designed for sighted users should be redesigned to meet this requirement and include it in the low vision portal.

Nowadays, there are thousands of apps available on the Apple Store. Although the Apps are divided in different categories, it is not easy for a low vision user to explore all the apps and find an adequate one. The main idea of this portal is to identify those apps and to facilitate low vision user to locate and use them.

Figure 3.1. Low Vision Mobile App Portal.

Making mobile apps oriented to blind and visually impaired people is not a novel idea. There are already some mobile apps on the market that include a collection of basic Apps such us phone, contacts, etc. The main difference between these mobile apps and our proposed Low Vision Mobile App Portal is that our portal includes own apps and third party apps. Thanks to this portal, low vision users can access easily to a wide variety of Apps specified design for them. On the other side, developers can use this portal to promote their apps between the blind and visually impaired community.

Figure 4 shows an example of the Low Vision Mobile App Portal. It would be defined as a mobile desktop with icons to access apps specifically designed for low vision users. Some of the apps shown in the Figure 4 are Phone, Contacts, SMS, Alarm, Calendar, Battery, Email, Magnifier and GPS Location between others. There is also a setting option to adjust some other features: screen contrast, background, icons size, user interactions, text to speech parameters, etc.

IV.MOBILE APPS FOR VISUALLY IMPAIRED USERS

In order to ensure a good user experience, it will be important that all the apps use the same kind of controls to interact with the low vision user. The way the user navigates through views within the app should be similar across different apps.

To make this possible, the first step is to identify those controls used by sighted users that would be also valid for low vision users. A button type control seems to be valid for both blind and sighted users. But other controls such as toolbars, segmented controls, tables or data pickets would need to be adapted in order to meet the low vision user requirements. At this stage, new controls for visually impaired users could be also created.

Once we have defined those controls, the next step is to create usability tests for those controls. The tests are used to study how the low vision user interacts with a specific control. On the usability test we can also measure the ability of the users navigating across different views, identifying the controls and interacting with them.

The definition and the test of these controls will give the low visual users the needed user experience that will help them to identify view components and to navigate easily across any app of the portal. Voice Over or any other TTS (text to speech) library would are used as complement to the usable accessibility design.

Once we have all the needed ingredients to build a solid low vision user app, the final step is to start with the design of the portal apps. Following are some of the mobile apps that will be included in the basic low vision mobile portal. The majority of these apps are traditional apps that have been redesigned to meet the needs of visually impaired and blind users.

- **Phone:** This App will facilitate the user making phone calls. Figure 5 shows a snapshot of the App. Simple design with buttons and high contrast. As the user moves around the screen touching numbers, the text to speech feature reads those numbers.

Figure 4.1. Phone App for low vision users

- **Contacts:** This App will allow the user to navigate through his contact list. Voice over combined with special gestures will make it easier to locate a specific contact in the list.
- **SMS:** By means of this app, the user will send SMS messages to his contacts in a very simple way.
- Alarm: Date, Time and alarms can be set using this App.
- **Calendar:** The low vision user will use a special context, which will help him adding and editing notes to the calendar.
- **Battery:** Text to speech is used to notify the user about the battery level.
- **Email:** Special email client designed for low vision users.
- **Magnifier:** The iPhone camera works as a magnifier, facilitating the low vision users the reading of books, newspaper, etc. Special image filters are used to create a high contrast inverting the image to obtain a dark background.
- **GPS Location:** This simple App will inform the user about his location: street number, city.
- **Social network clients:** A collection of apps will be developed to allow visually impaired and blind users the connection with social networks, such as twitter or facebook.

In order to help developers to add their own apps to the mobile portal, a specified API will be designed. This API will include the low vision mobile app portal features, which will facilitate developers the design of Apps for low vision users. Design for usability is an essential premise in order to achieve the best user experience.

V.PRELIMINARY RESULTS

The results for task completion time and perceived easiness of authenticating with tap phrases are encouraging. Even so, the relatively large standard deviation in task completion time deserves a closer look. From our observations, there are two possible explanations for this fact: 1) some users, lacking the confidence and experience using smartphones, operated the device with an unusual level of caution, thus taking more time and 2) there may be, in fact, an extended initial period where a blind user needs to situate himself before starting tapping with confidence.

The first stage of the project consisted on the design and development of a low vision library for iOS devices (iPhone & iPad). This library includes several controls specifically designed for low vision and visually impaired users. Two are described:

- **Low Vision Wheel Control**: This control was conceived to allow low vision users to navigate through a collection of data. An example would be the navigation through the telephone contact list. iPhone and iPad devices offer accessibility options to interact with tables, but they require users to use many gestures to get to the desired location. If the users are manipulating a long list it is really annoying to move up and down the list. Our alternative uses a wheel control. The metaphor behind this control is the same that using the wheel button of a traditional mouse. When the user touches the control on the screen, a speech message tells him that it is a wheel control that is connected to a given list. Then, the user touches the screen with a second finger and starts moving it vertically up and down. As the user moves through the list, the system starts speaking the list content. The sensibility of the wheel can be changed. The control is smart enough to detect slow and fast movements of the second finger, which are related to slow or fast movements through the list. This control can be defined vertically or horizontally.

- **Low Vision Segmented Control:** This control was conceived to facilitate low vision users the interaction with a segmented control. This kind of control is used when the user has to select an option from a small list of options. A good example of segmented control would be a list of colors where the user has to choose one color from a list of four colors. The iPhone offers a native segmented controlÓ that includes accessibility options, but low vision users find it difficult to interact with it. We have designed an alternative that uses a single button to choose a value from a small list. When the user touches the button, a speech message tells him that he has found a segmented control, with a specific value (ex: color oared selected). To select other values from the list, the user just need to tap with a second finger on the screen until the desired value appears.

Other low vision controls have been designed and

tested by a group of low vision users, that have been involved in the design of these controls. An iOS Low Vision control library will be available to allow developers to use these controls in their apps.

We propose a method in which authentication is accomplished by recognizing rich tapping patterns that can be performed with a single hand, using a Smartphone's entire screen as a single button. We presented results of a user study that shows that this method is usable and that it Affords inconspicuous interactions, thus not only offering increased security but also enabling compliance with social norms. Clear avenues for further research were opened, namely exploring longer-term usage and real - world feasibility of inconspicuous authentication scenarios, measuring resistance to eavesdropping, and expanding the matching of tap patterns to accommodate other interactions other than authentication

To help you manage your closet and assist you with your personal image, there are color identifiers as well as the option to get support and advice from others (although they are not physically present) via videoconference or by sending photos in an instant message, etc. This type of service is really helpful for people who live alone and need assistance on how to match clothes, footwear or about the state of the environment

VI. CONCLUSIONS AND FUTURE WORK

This paper deals about mobile apps design, focusing on design for usability centered on visually impaired and blind people. The majority of the existing mobile Apps have been initially designed for sighted people. Some of them have been adapted, including accessibility features that allow low vision people to use them. In terms of design, accessibility features are added as a new layer to the apps, acting as a patch that is placed over the initial design layer. iPhone and iPad devices use Voice Over feature to facilitate the accessibility. Although Voice Over is a power tool to make the apps accessible, it is not enough. Our way of thinking is that the best way to ensure that the app will be usable by low vision users is to design the App specifically for them, instead of designing the app for sighted people and adding extra accessibility features. In order to achieve this goal, special controls (buttons, sliders, tablesÉ) have been redesigned to comply with low vision users needs.

According to this, our research work has lead us to the creation of a collection of Apps, following a common redesign centered on visually impaired and blind users. We have also created a low vision mobile portal that includes these apps, facilitating the visually impaired and blind users the access to a wide collection of Apps specifically designed for them. The portal is open to any developer willing to design an App for low visual users. An API including special low vision controls will be available to facilitate the design of the App in order to achieve the best user experience. An iOs Low Vision Library is been developed to allow other users to include these controls in their apps and offer them in the low vision portal.

Future work will consist on the use of technology and mobile devices in order to create new products to assist visually impaired and blind users, making their life more accessible.

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