bachelor's thesis

Accessible UIP client for Windows Phone 8

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Declaration

I declare that I worked out the presented thesis independently and I quoted all used sources of information in accord with Methodical instructions about ethical principles for writing an academic thesis.

Abstract

Text abstraktu česky...

Klíčová slova

Navigace, Generování UI, Přístupnost, Windows Phone 8, UIP

Abstract

This work describes the development of an accessible UIP client application for Windows Phone 8.

Keywords

Navigation, UI Generation, Accessibility, Windows Phone 8, UIP

Contents

Abbreviations

Preliminary text…

FEE CTU	Faculty of Electrical Engineering of the Czech Technical University in Prague
UIP	UI Protocol developed for research purposes at the FEE CTU
TTS	Text-to-Speech

1 intro

Analyse UIP platform, focus on UIP client design.

1.1 UI Protocol

Universal Interface Protocol (UIP) is a user interface specification language developed at CTU for research purposes. At the time of writing this thesis, its specification is not publicly available. UIP provides means for describing user interfaces and transferring data related to interaction between user and an UIP based application. UIP is designed to be cross-platform and programming language independent.
UIP is XML based language that allows describing the hierarchical structure of an user interface, the placement of the components and their appearance.
UIP is designed as a client-server system.

1.1.1 UI Protocol Client Design

The UIP client will be developed for the Windows Phone 8 operating system and written in `C#`. The application will be developed using Visual Studio 2013.

2 Windows Phone 8 Accessibility

This chapter covers all of the features for ease of access that are included in the Windows Phone 8 operating system. For the purposes of this project, we are particularly interested in features that may help the visually impaired users. From this point of view, perhaps the most important are the voice commands and speech recognition features which Windows phone 8 has built-in and which support a wide range of languages.

2.1 Windows Phone 8 Speech Features

Users can interact with the phone using speech. There are three speech components that a developer can integrate in her app and the user can take advantage of them: voice commands, speech recognition, and text-to-speech (TTS). We will explore these features in the following paragraphs. At the time of writing, the speech features support 15 major languages ranging from English to Russian or even English with the Indian accent. Czech, however, is not supported. To use the speech features the user has to download a language pack.

2.1.1 Speech Recognition

Users can give input to an app or accomplish tasks with it using speech recognition. An example usage can be dictating content of an SMS. This is very similar to the Voice Command feature, but the key difference is that speech recognition occurs when user is in the app, and Voice Commands occur from outside of the app . [1] The second key difference is that the Voice Commands are defined on a finite and usually small set of words (commands), whereas the Speech Recognition should recognize words from a much larger dictionary – in ideal case a whole human language.

2.1.2 Voice Commands

When a user installs an app, they can automatically use voice to access it by speaking "open" or "start", followed by the app name. The range of actions that can be triggered by Voice Commands is much wider, the full list of available speech commands that are provided by the operating system is listed in table **. A developer can also define her own set of voice commands and allow users not only to open the app using voice but also to carry out more advanced tasks within the app. This is very important for our work since it allows for exposing a wider range of commands to the visually impaired user. Note that technically, this still happens from the outside of the app, as described in the previous section.

2.1.3 Text to Speech (TTS)

TTS can be used to speak text to the user via the phone's speaker or headset.The spoken text can be simple strings or strings formatted according to the industry-standard Speech Synthesis Markup Language (SSML) Version 1.0. TTS is also used in some of the other features for ease of access which are covered in the next section.

2.1.4 Other Speech Features

A feature named Speech for phone accessibility enables the following: 1) Talking caller ID When getting a call or receiving a text, the phone can announce the name of the caller or the number. 2) Speech-controlled speed dial User can assign a number to a person from the contact list and then say Say "Call speed dial number" (where number is the assigned number) to call the person. Assigning the speed dial number is also speech-enabled. 3) Read aloud incoming text messages Similarly to 1, the phone can read the content of a text.

2.2 Other Tools for Ease of Access

Windows phone 8 comes with more features for ease of access which can help lightly visually impaired users. change font size in apps (not in the tiles of the home screen) switch the display theme to high-contrast colors screen magnifier Mobile accessibility Mobile Accessibility is a set of accessible apps with a screen reader, which helps use the phone by reading the application content aloud. The applications include phone, text, email, and web browsing. When Mobile Accessibility is turned on, notifications like alarms, calendar events, and low battery warnings will be read aloud.

3 Android Accessibility

Similarly to the previous chapter, here we will analyze the accessibility options for devices running the Android operating system, with the emphasis on visually impaired users. We will analyze the features of the latest Android OS released, which is version 4.4, codename KitKat. It should be noted that there were no major updates to the accessibility options since Android 4.2.2 Jelly Bean.

3.1 Speech Features

Android also offers the option to interact with the device using speech and has some interesting accessibility features and compared to Windows Phone 8 offers a wider language support. Similarly to Windows Phone, an Android developer can take advantage of speech recognition and text-to-speech (TTS). Android comes with a number of built-in voice commands but unlike the Windows Phone, Android doesn't allow developers to expose their own voice commands. The last important feature on Android is TalkBack. At the time of writing, the speech recognition supports more than 40 languages including several accents of English, and even minor languages such as Czech. Other functions do not have such a wide support.

3.1.1 Speech Recognition

Users can give input to an app or accomplish tasks with it using speech recognition. An example usage can be dictating content of an SMS. As mentioned before, this feature supports many languages but on the other hand required internet connection. There is not an option to use the recognition offline. We do not consider this a major drawback, as nowadays a mobile internet connection is more available than ever.

3.1.2 Voice Action Commands

In Android, Voice Action Commands are closely related to the Google Now feature. Google Now has a wide range of uses not specifically designed for visually impaired. It can, however, serve them well by allowing them to get information using voice. In general, google now should provide the user with relevant information when they need it. Google describes it by the phrase "The right information at just the right time". This includes telling the user the weather forecast, showing the best route to work, calling someone, creating a reminder and much more.

Note that for some commands, the system gives you a spoken answer. The current drawback of the system is that it only supports English, French, German, Spanish, and Italian. With other languages, user can only make a voice-induced Google search with no voice response. Text to Speech (TTS) TTS can be used to speak text to the user via the phone's speaker or headset. The spoken text can be simple strings. The industry-standard Speech Synthesis Markup Language (SSML) is supported only in a limited scope. TTS is also used in TalkBack which is described in the next section.

3.1.3 Other Speech Features

TalkBack is an important functionality that strives for more accessible phone control for visually impaired. Basically, it is a touch-controlled screen reader. When enabled, user can drag finger across the screen selecting the components and getting their acoustic description. By double tapping anywhere in the screen, user can open/use the last selected item. TalkBack also supports gestures. This way, a user can get a complete description of the user interface. The blogpost of a blind accessibility engineer from Mozilla Foundation [3] claims that visually impaired users of this system still have to overcome some obstacles.

3.2 Other Tools for Ease of Access

Android too comes with more features for ease of access which can help lightly visually impaired users. change font size in screen magnifier

4 iPhone Accessibility

In this chapter, we will cover the accessibility of Apple's iOS. Again we consider the latest iOS released, which is version 7.0.4. Overall, the accessibility features of iOS are very similar to those of Android and therefore I will describe the features more briefly.

4.1 Speech Features

As with the previous two platforms, iOS also offers users o interact with a device using speech. Apple was the first one to introduce the features for people with disabilities, such as VoiceOver. iOS supports speech recognition and text-to-speech in 15 major languages (the same number as Windows Phone 8). iOs also comes with a number of built-in voice commands but doesn't allow developers to expose their own voice commands.

4.1.1 Speech Recognition - Dictation

Users can give input to an app or accomplish tasks with it using speech recognition. An example usage can be dictating content of a text. As mentioned before, this feature supports 15 languages and requires an internet connection.

4.1.2 Voice Control - Siri

Siri in iOS can be thought of as an equivalent to Android's Google Now. Siri can send emails, set reminders and more. If asked a question, it can read aloud the answer.

4.1.3 Text to Speech (TTS)

TTS can be used to speak text to the user via the phone's speaker or headset and this feature was added only recently, in iOS 7.0. The spoken text can be simple strings. The industry-standard Speech Synthesis Markup Language (SSML) is not mentioned in the API documentation.

4.1.4 Other Speech Features

It could be said that Google's TalkBack is Apple's VoiceOver. Both offer very similar functions and their key reason for existence is reading the content of the screen based on touch input and control of the device by gestures. The mentioned blogpost of the blind accessibility engineer from Mozilla Foundation [3] favors VoiceOver over TalkBack.

4.2 Other Tools for Ease of Access

iOS too comes with more features for ease of access which can help lightly visually impaired users. change font size Invert Colors screen magnifier (Zoom) Braille Displays for iOS iPad, iPhone (3GS or later), and iPod touch (3rd generation or later) support more than 40 Bluetooth wireless braille displays right out of the box. Simply pair one and start using it to navigate your iOS device with VoiceOver — no additional software needed. In addition, iPad, iPhone, and iPod touch include braille tables for more than 25 languages.

5 Navigational Systems for Visually Impaired

There is a number of interesting papers in the field of navigation systems for visually impaired. Generally speaking, there are ongoing efforts to create maps for indoor environments, with the Google Indoor Maps being the head of this movement. Currently, the Google Indoor Maps are in beta and are not a priori intended for navigation but are able to provide the user with an approximate idea of where they are. In this chapter we will analyze some of the existing works which specifically address the problem of indoor navigation and focus on projects that specialize in navigation of visually impaired.
There are two main approaches to the problem. In the first, the navigation system consist of active parts which, using triangulation or other methods, are able to determine user's position at all times and then give her directions based on knowing where she is. In the second approach, the system does not possess the information about user's position at all times. Instead it synchronizes the position at the beginning of the navigation task and then gives the user directions broken into small chunks. When the user believes she reached the destination described by the first chunk, she asks for the next one and etc. The disadvantage of this approach is that the user can get lost and not end up at the expected location. This problem can be solved by adding more "synchronization points" to strategic locations of the building.

5.1 Analysis of Current Systems

NaviTerier [1] is a research project at FEE CTU in Prague which aims directly at the problem of navigating visually impaired inside buildings. This system does not require any specialized technical equipment. It relies only on mobile phones with voice output, which visually impaired people already use. The navigation system works on a principle of sequential presentation of carefully prepared description of the building to visually impaired user by the current mobile phone voice output. This system does not keep track of the user location. Instead, it breaks the directions into smaller pieces and then sequentially gives the pieces to the user who follows them and asks for next portion when ready. This system was tested with 13 visually impaired users.
Recently this system was combined with UI Protocol platform, which is another research project of FEE CTU developed for the purpose of creating user interfaces customized to abilities and preferences of individual users. The result is navigational system called NaviTerier UIP (NUIP) [2] which combines the navigational part of NaviTerier and the ability of UIP to generate and deliver customized user interfaces that can fit better people with disabilities.

Luis et al.[3] propose a system which uses a infrared transmitter attached to the cane combined with Wiimote units (the device of the Wii game console) placed so that they can determine the user's cane position using triangulation. The information from Wiimote units is communicated via Bluetooth to a computer which computes the position and then sends the directions to the user's smartphone via wifi. TTS engine running on the phone converts the directions to speech. The system has undergone preliminary testing with five blindfolded users.

An indoor navigation system to support the visually impaired is presented in [4]. The paper describes creation of a system that utilizes a commercial Ultra-Wideband (UWB) asset tracking system to support real-time location and navigation information. The paper claims that the advantage of using UWB is its resistance to narrowband interference and its robustness in complex indoor multipath environments. The system finds user position using triangulation and consists of four parts: tracking tag to be worn by the user, sensors that sense the position of the tracking tag, handheld navigator and a server which calculates the location of the tracking tag and communicates it to the navigator. The handheld device runs software which can produce audio directions to the user. In tests, the system proved useful; It was, however, tested only on blindfolded people.

A promising approach is shown in the PERCEPT [5] project. Its architecture consists of the three system components: the Environment, the PERCEPT glove and Android client, and the PERCEPT server. In the environment there are passive (i.e. no power supply needed) RFID tags (R-tags) deployed at strategic locations in a defined height and accompanied with signage of high contrast letters and embossed Braille. The next part of the environment are the Kiosks. Kiosks are where the user tells the system her destination. They are located at key locations of the building, such as elevators, entrances and exits and more. The R-tags are present here and the user has to find the one she needs and scan it using the glove. The glove is used to scan the R-tags and also has buttons on it that the user can press to get the instructions for the part of the route, repeat previous instructions and get instructions back to the kiosk. Also, after scanning the R-tag the gloves sends its information to the app running on user's Android phone. The app connects to the internet and downloads the directions from the PERCEPT server. These are then presented to the user through a text-to-speech engine and the user follows them. The system was tested with 24 visually impaired users. Another example of RFID use is presented in Lopez et al. [6] where user is navigated by following paths marked by RFID labels on the floor. The white cane acts as an RFID reader and communicates with a smartphone which, as in other projects, uses TTS to give directions.

There are also research works in the fields of robotics and artificial intelligence that study the problem of navigation. More specifically, they tackle the problem of real time indoor scenes recognition [7], [8], [9]. Some of these solutions allow for creating the reference map dynamically. Even though they proved to be useful in the domain of robotics and automotive industry, their applications to navigating people are limited, as they require expensive sensors and powerful computing resources. Wearing these devices would make the traveling of the users more difficult and limited. For these reasons, the solution proposed by Hesch and Roumeliotis [10] because they integrated these devices (apart from the computing) into a white cane. However, the solution has the limitations of being too heavy and large, and the laser scanner being directional.

sighted people

Bibliography

[1] *NaviTerier. navigation system in buildings for the visually impaired.* 2013. URL: http://usability.felk.cvut.cz/naviterier (visited on 01/01/2014).

[2] Zdenek Mikovec Jan Balata Miroslav Macik. "Context Sensitive Navigation in Hospitals". In: *30th Annual International IEEE EMBS Conference* (2013).

[3] Luis A. Guerrero, Francisco Vasquez, and Sergio F. Ochoa. "An Indoor Navigation System for the Visually Impaired". In: *Proceedings of Sensors 2012*. 2012, pp. 8237–8258. URL: http://www.ncbi.nlm.nih.gov/pubmed/22969398.

[4] N. A. Giudice T. H. Riehle P. Lichter. "An Indoor Navigation System to Support the Visually Impaired". In: *30th Annual International IEEE EMBS Conference* 30 (2009), pp. 4435–4438.

[5] Aura Ganz et al. "PERCEPT Indoor Navigation System for the Blind and Visually Impaired: Architecture and Experimentation". In: *Int. J. Telemedicine Appl.* 2012 (Jan. 2012), 19:19–19:19. ISSN: 1687-6415. DOI: 10.1155/2012/894869. URL: http://dx.doi.org/10.1155/2012/894869.

[6] Diego López-de-Ipiña, Tania Lorido, and Unai López. "Blindshopping: Enabling Accessible Shopping for Visually Impaired People Through Mobile Technologies". In: *Proceedings of the 9th International Conference on Toward Useful Services for Elderly and People with Disabilities: Smart Homes and Health Telematics*. ICOST'11. Montreal, Canada: Springer-Verlag, 2011, pp. 266–270. ISBN: 978-3-642-21534-6. URL: http://dl.acm.org/citation.cfm?id=2026187.2026232.

[7] P. Espinace et al. "Indoor Scene Recognition through Object Detection." In: *Proceedings of the 2010 IEEE International Conference on Robotics and Automation*. 2010, pp. 1406–1413.

[8] A. Quattoni A.; Torralba. "Recognizing Indoor Scenes." In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2009, pp. 413–420.

[9] Anna Bosch, Xavier Muñoz, and Robert Martí. "Review: Which is the Best Way to Organize/Classify Images by Content?" In: *Image Vision Comput.* 25.6 (June 2007), pp. 778–791. ISSN: 0262-8856. DOI: 10.1016/j.imavis.2006.07.015. URL: http://dx.doi.org/10.1016/j.imavis.2006.07.015.

[10] J.A. Hesch and S.I. Roumeliotis. "Design and analysis of a portable indoor localization aid for the visually impaired." In: *Int. J. Robot. Res.* (2010), pp. 1400–1415.