Augmented Reality as an Accessibility Tool for Wheelchair Users

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Abstract— An application that aims to give wheelchair users crucial accessibility information, i.e. the existence or not of adaptations, routes and such, using a user friendly interface, the Android Operational System, geo location techniques, filtered internet search results, and the Wikitude Augmented Reality API.

Keywords: augmented reality, android, wheelchair, accessibility.

I. INTRODUCTION

According to studies, approximately 24.6 million people in Brazil have some kind of impairment, (Brazilian Demographic Sense - 2000) it corresponds to 14.5% of the population [1]. The government created several laws and regulations to improve and fix the issues (regarding accessibility) that those people face every day. It is also notable that they are not as effective as they should be, due the fact that many places don’t follow the instructions correctly or just a small fraction of them due many reasons.[2].

This application(app.) focus on those who need wheelchairs to move around, since they are a great part of those 14,5% and also the ones that need the most diverse type of adaptations like elevators, adapted restrooms, visual signs, access ramps, and so on. The app focus to give these people crucial information among the existence or not of those adaptations, trough a user friendly interface and the Android Operating System. It makes use of some geo location techniques, filtered internet search, and the Wikitude Augmented Reality API.

II. RELATED WORK AND INSPIRATIONS

There are several wheelchair navigation and support systems. They vary heavily in terms of features, some provide enhanced maps to online or route planning, but with low mobility and using very few concepts from augmented reality. Some of those works were crucial in inspiring the development of Access in a Touch.

A quick search on the Android Market, presents an application called ADA: Medical Access [3] that contains the American with Disabilities Act. The app presents information that is helpful to Doctors, Hospitals, Nurses, Medical Staff and Patients. The main focus of the app is to educate people regarding what needs to be done to make medical care accessible to everyone. This application worked as key inspiration in making Access in a Touch's goal to make the outside world more accessible, nor only the medical care.

The article EasyWhell – A Mobile Social Navigation and Support System for Wheelchair Users [4] presents a way to enable wheelchair users to become more independent and increase the mobility of handicapped. One of the EasyWheel goals is to create a community that allows the users to communicate, exchange ideas and though, but also detect barriers in their environment and provide this information to the application. That was the inspiration to make the preliminary database (the customized Google Map) for Access In a Touch public and free to be updated by anyone and permit the adding of new information.

There are lots of apps and ideas that tries to improve the accessibility of wheelchair users, but none of them applied augmented reality concepts, witch is an innovative technology and much easier and simple to use and understand. That gap makes Access In a Touch a different app, innovative and with great potential.

III. AUGMENTED REALITY BROWSERS

Augmented reality browser is a new technology that enables the enhancement of real world objects with digital information. The goal of AR browsers are to make the enhanced reality accessible to everyone in an easy way. Usually any web content (with appropriate meta-data and properly formatted) can be converted into AR content.
The main specification of an AR browser is to allow users to find various items based upon augmented reality technology. They tend to be a mobile application, due the fact that the user will be able to take them anywhere and the resources that the browsers usually use, such as the camera, GPS, compass, accelerometer, etc are presented on most of the mobile phones nowadays.

By using the camera, simply hold up the smartphone and explore the surroundings. The AR browser overlays the display and the objects in the direction looked at are presented with additional content and information.

Quite a few AR browsers have emerged today, the main ones are Wikitude[5] and Layar[6]. Both of them are available to iPhones, most of the Android phones, some Symbian and blackberry phones and Wikitude is the only one available to Windows Phone 7 so far.

Wikitude was the world’s very first Augmented Reality Browser for smartphones in 2008. It was first published when Google introduced the first Android device end of 2008 which was the very first mobile device carrying the hardware components required to make AR possible: GPS, accelerometer and digital compass.

IV. ACCESS IN A TOUCH

Usually people do not think how difficult it is to get around with a wheelchair. That’s what Access in a Touch is concern. It is a fantastic Android application that tries to make the life handicapped a little bit easier. Access in a Touch focus on using augmented reality to give some information that helps the use of wheelchairs.

Once the app is open it presents a list of places around the user. Clicking on an item from the list changes the tab to MapView with that specific place centered. Once choosing a place on the map, more information about that location is displayed.

The info tab of a specific location permits to choose between more information, call that place (if telephone number is available), open the web-page, make a route using the GPS and list a problem. When selecting the more information option the user is be presented with what that place has to offer such as access ramps, specific designed bathrooms, parking space and more.

At the bottom there’s a menu that let’s the user switch to AR view or some more info about the app. The AR mode is powered by the AR browser Wikitude (The Wikitude app is required to run Access in a Touch in this mode).

V. MATERIALS AND METHODS

The materials and methods applied in the development process of the app are divided in 6 sessions: “Why Android?”, Android SDK, Google Maps and Geolocation, Accessibility Information, XML Parsing and Wikitude SDK.

A. Why Android?

In order to develop a mobile application, it is needed to choose an operating system that the app will be running on. Currently the common platforms are: Android (Google Inc.), BlackBerry OS (RIM), iOS (Apple), Windows Phone (Microsoft).

According to the Nielsen Company in 2011, Android had the biggest share of the mobile operational system, somewhere around 39%[7]. According to Metrics. AdMob 66% of the android phones were from the United States of America. [8]. It has been clear that Android keeps expanding and so does it is community. The Android is a powerful tool and contains the Android Market, that makes the distribution of an app so much easier.

Android grew a lot since its release and currently there's an extensive list of gadgets using it (cellphones and tablets). There's a big price range for these gadgets, witch allows the user to have access to the app without spending more than he can afford. Another factor that needs to be taken in consideration, is that Android uses the Java programming language. The Java programming language is powerful, useful and with an ample community.

The other mobile operating systems weren't chosen due low usage, specific requirements while developing and limitation of gadgets which would make the application itself less accessible.

B. Android SDK

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language [9].

The Android SDK includes a set of development tools like debugger, libraries, documentation, sample code, tutorials, etc. Currently supported development platforms include computers running Linux (any modern Linux distribution), Mac OS X 10.4.9 or later, Windows XP or later. The officially supported integrated development environment (IDE) is Eclipse using the Android Development Tools (ADT) Plugin.

In order to provide a user-friendly environment, a Tab-view (Figure 1) layout with two tabs (List-view and MapView) as the main screen was chosen. The Tab-view option works like most of the web browsers now a days, except that it only has two tabs and the user can't open a
new one. The List-view will list an amount of places and locations near the user that are in the database, while the map-view will present the same thing on a map. There's an option panel which can be accessed by pressing the menu button, that enables the user to turn the Augmented Reality view on and check more information about the app. The app rely on internet connection (Wi-Fi or 3G) to obtain the information like the list of locations, images, map, information (via Google Maps API) and many more. In order to use the least possible data storage space on the phone/tablet, all the images and data collect are stored in memory cache and deleted as soon as the app is terminated.

C. Google Maps and Geolocation

The Android Google Maps API [10] provides geo location tools, information about a selected geo points and lots of data that were needed to develop the project. The app presents a map view with two layers as shown in Figure 2, being:
- My Location Layer: presents the user current location. This is done by trying to use a method provided by Google, if it fails, it tries to access the phone location data directly. It tries to get the best source (regarding accuracy) by an implementation that uses the data provided by cell tower triangulation or GPS. The accuracy of this will depend on signal strength, cellphone model and internet speed.
- Points Of Interest Layer: shows the points of interest with a specific set of icons relating to the location category (shops, banks, restaurants, etc.).

D. Accessibility Information

It was required to have at least a few points with complete information to launch the app, so the Access in a Touch Team visited some places and collected the information needed. It is important to remark that this superficial gathering was only done in the city of São José dos Campos – São Paulo – Brazil. The idea is to let the community (users, ONGs that wish to help, the owner of an establishments that is adapted and more) insert the points and information that they consider important and useful. The option to add more information by a user needs to be optimized, due to that it is currently disabled.

E. XML Parsing

As the database is currently, constituted of a collaborative Google Map, it inflates the app data by getting the map information from a KML[11] (a specific type of XML) and parse it to make the information easy to be dealt with.

F. Wikitude SDK

The Wikitude SDK is a powerful software developer kit which allows the open development of marker-less AR
experiences, providing developers with the tools to either create their own augmented reality applications, or enhance their existing applications with an AR camera-view engine [5].

Access in a Touch wouldn't be the same without the aid of the Wikitude SDK. We used the SDK to provide an AR camera view (just like the AR browsers) with personalized icons (the same ones as in the map view) to each type of location, show relevant information about it and also enabled the options menu as callback intent (Figure 3). There is also an Wikitude application that is required to be installed in order to the AR function of Access in a touch to work properly.

![Figure 3. AR Camera View](image)

VI. RESULTS AND DISCUSSION

As the developed of Access in a Touch progressed, some problems and difficulties were faced. Some of the biggest flaws at the moment are: database reliability, the use of a simple Map and the lack of “freedom” do to utilization of the Wikitude API.

The problem with database reliability consists on the fact that the search results are not always accurate or the Google search ends with no answer. The reason to this are the following: poor numbering on houses, wrong street name, lack of information such as phone numbers, and many more regarding the location. To solve this problem, a “redundant” database could help. If the app couldn’t find a result on the search or if that the result gives a bad or wrong answer the app would be able to search on the database (that could be provided from the users community) and return the best answer.

The problem with using a simple Google Map is the lack of freedom and control over the editors. Using the Maps API directly (via JavaScript) can solve the problem and enable some new features such as adding a POI from the app. As for the lack of freedom found on the Wikitude API, there are two possible solutions, one is to contact the API development team and ask for help, and the other is to create a specific API. It is rare to get an answer from the Wikitude team, but it already happened before with some other developers. Creating the specific API would be a whole new project and it would cost a lot more.

At the moment the application has been installed by almost 100 users in 11 different cellphones models and 2 tablets and most of them are running Android 2.2+ versions.

VII. CONCLUSION

The application is able to help many wheelchair users, giving them the information about accessibility and permitting them to move around more freely. There is a good amount of work that should be done in order to make the app 100%. In addition to solving the already found problems and difficulties; it is also needed to develop new features, find ways to make the application well known and let the community grow with many users to auto sustain it.

The augmented reality tools used in this version presented a lack of resources, but in future versions it will be using a more complete tool or even a specific one. This way, the user will be presented with more interesting and useful features such as an augmented reality navigation system, voice signals, voice commands, more precise and updated routes, updated information, and more.

It is important to say that the app is only focusing on the aid of people who require wheelchairs. The perspective for the future is to make the whole world more accessible for anyone with some kind of difficulty. The Access in a Touch team believe that the augmented reality will be able to enhance the experience of life to anyone.

REFERENCES