A MOBILE ASSISTANT IN THE CITY – M.A.C.

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ABSTRACT

This paper proposes M.A.C., an intelligent mobile assistant in the city, specifically designed and aimed as an aid for the visually challenged. Such an aid makes use of a number of technologies, which are meant to help the person using his/her mobile phone, not only get to the target destination, but also avoid any imminent obstacles and dangers which might be on the way. This is a prototype project for demo purposes and it is expected that this project is further developed in, and tested with a number of real users under the assisted living ambient intelligence living labs. Lifelong learning will therefore have prominence in this paper, by highlighting an approach providing users with knowledge and skills which they need in the real world. This paper will also present possible applications of such a concept and show how added functionality can provide users with an overall richer experience contributing to an 'openness' in mobility which would otherwise render use of such a technology based tool inaccessible.

KEYWORDS

Mobility, lifelong learning, assisted living, virtual assistant, intelligent PA.

1. INTRODUCTION

Ubiquitous use of technology-based devices has proliferated amongst not only distinguished societies but also across cultures overcoming barriers of space, time, and all other factors which in one way or another limited accessibility. However amongst citizen groups, one finds those who may find some other barriers to communication accessibility in this modern era. Groups pertaining to the assisted living section of society, often require a degree of support which allows them to lead fairly independent lives whilst at the same time having access to that digital information which is locked within these devices. There has been found to be enormous potential in using mobile devices (such as cell and smart phones) as assistive technologies (Ghiani, Leporini, & Paterno', 2009). A multimodal form of approach for interactive design may include enough functionalities to improve and enhance accessibility for a number of users with varying abilities. Visually impaired users rely heavily on the voice modality with some keypad input. Various projects have taken into consideration enclosed areas such as museums for guiding the mobile users and improving their knowledge of the field (Ghiani, Paterno', Santoro, & Spano, 2009). This is tantamount to a measure of lifelong learning practices as the mobile users become learners, empowered to manage their own learning in a contextual setting (Sharples, 2000). This serendipity which is achieved through the managed *normality* with which the user handles technology in his daily use impinges on the perceptions of learning, and boundaries specified by formality disappear. In their stead, there is a person who is happy to acquire new forms of knowledge irrespective of physical constraints and limitations. It is the scope of this paper to give an insight about the possible applications of this Ambient Intelligence (AmI) based technology devices, not within an enclosed area but applied to a wider space, such as a culturally rich city like Valletta, in Malta. This city is often the destination of many a tourist, getting a bite of the rich heritage which it carries. M.A.C's concept is that of offering visually impaired visitors, a "walking stick" in the form of the mobile device which would help them to detect obstacles in their way, as it guides them through the places which they wish to visit. This paper is structured as follows. The section superseding will go through the concept of a mobile assistant and will look at implications and adaptability of devices. This is followed by a section which looks at the technology of the prototype, giving an overview of its design. The last section will conclude this paper, and will propose possible future developments for enhancing the application.

2. MOBILITY AND IMPLICATIONS

Recent years have shown a great many projects which proposed the use of smart phones as guides during experiences within the cultural heritage field (Ghiani, Paterno', Santoro, & Spano, 2009). The GUIDE project (Cheverst, et al., 2000) developed an intelligent context aware tourist guide, which delivered information based upon the geographical position of the user in a manner which was personalized, depending on user profiles and external affecting factors. VeGame is another interesting project which prompts mobile users to explore the city of Venice, learning about history and architecture through games based upon observation and reflection (Bellotti, et al., 2003). In many upcoming projects, RFID tagging technology is becoming more popular for information retrieval using mobile devices as well as for monitoring user movements internal to a tagged area. One implication of this mobile assistant, is the in-depth study and understanding of the user needs when in the city and to model this guide, according to their needs. Since the target group of users has very specific needs the emerging framework needs to show how the technology is adapted to satisfy the users' requirements.

Location awareness is one important specification which the mobile device needs to achieve, but in this case the ability of the mobile to act as a "walking stick" and therefore provide the users with a virtual sense of touch, by exploiting other senses, such as hearing. M.A.C. will provide the users with a selection of a list matching the criteria specified during the city walk. Therefore as an example, a visually impaired user would wish to go to locations which have audio-visual displays of historic recounts. The 'smart' M.A.C. would identify which places within the city, and walking distance, would suit the user and will give the user a whole list to choose from. Once the user chooses the location, then M.A.C. traces the direction which the user can take based upon current location and target destination. In addition M.A.C. would offer another form of support to visually impaired users. It is the object of M.A.C. to identify possible obstacles which might pose a threat to the users and warn the users against these impending 'dangers' thus facilitating the user's visit through the city.

Such an application has a number of implications which need to be taken into consideration. The system needs to be seamless, unobtrusive and adaptive to the users' needs whilst showing an intelligent response to the environment which surrounds the user. This vision pertains to AmI which empowers people through a digital environment which is "aware" of their presence within a specific context and what characterises these systems is their ability for ubiquity or rather their capability for interconnecting with a number of embedded systems, their transparency and intelligence. AmI lies at the root of solutions dealing with assisted living models and conceptual designs (Doctor, Hagras, & Callaghan, 2005).

Adaptive support is another implication which is given predominance in this project. These adaptive features are based upon user modelling in a way such that user preferences and recorded information is used to compile a personalised portfolio.

One other premise upon which the retrieval of information and the storage of data are built, is that all the relevant city data is digitally encapsulated and available for use. This is then presented as part of the location service module.

One important system implication is the knowledge acquisition and the insight gained by users making use of it. In this specific case, technology becomes the communication mediator, and assistant towards reaching target goals. However this needs to be further developed in a way which stimulates more learner actions and therefore contributes to the user's enhanced activities, revolving around the central purpose that the user is transformed into an active learner. Pervasiveness offers the transparency which is needed to overcome barriers to learning, when the truth about learning is perceived as being what it indeed is, that is, that we have the potential to learn and acquire distinct knowledge anytime, anywhere.

3. THE M.A.C. PROTOTYPE

For this prototype a Google Android emulator was used and three separate modules have been designed and implemented using specific technologies. The android media API which were also made use of were the audio system, the face detector, the media player and the media recorder. The functionality from each of these classes was made use of to provide the user with an overall richer experience. The rest of this section is dedicated to the design of the prototype and a brief overview of the technologies which were implemented.

3.1 Conceptual Design

This prototype is built around three core services, which ultimately aim to transform the design into a sleek and smart 'walking stick' used to assist the visually impaired user.

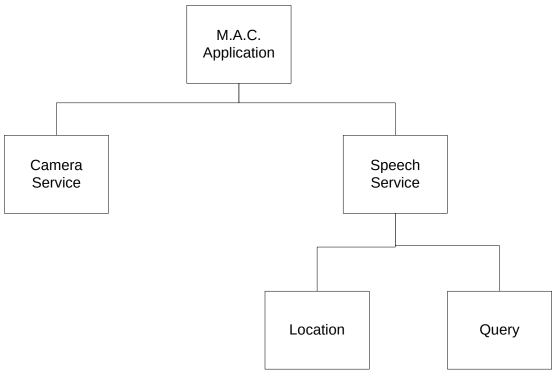

Figure 1 – Overview of M.A.C. conceptual design

To this intent, the three core services consist of a Camera Service, a Location Service and a Query Service. For this prototype, the design involved that whilst one service was active the other services were automatically turned off. This was done to avoid confusion as the user was making his/her way around the city. A number of external services were also implemented within the prototype system, including Text to Speech, Speech to Text, Get RDF Triples, and Get Directions. Many of these services, have not yet been developed for the Android emulator and platform.

The camera service uses a PictureAnalyser module which is used to enable and disable the service. When the service is enabled then two threads are initiated. The first thread retrieves the images, and computes the average RGB components. The other thread compares changes between current image and previously computed images. Any change in RGB display would trigger off an alarm, indicating a possible obstacle.

In the location service, the user is informed of the nearby locations and his respective position. A custom method has been developed for M.A.C. geocoder file (*geodb*) acting as a database storing and computing the location information. This specific method, searches for nearby businesses into the *geodb*, constructing sentences in the meantime containing information about the venues. Links to RDF files are made use of to provide more details about target historical venues and other city related sites. The text to speech service is then initiated to provide the user with an audio guide of the location list.

The query service follows the location service, as the external speech to text service, will ask the user what preferences he/she has following which query is returned as text. The venue category is parsed from the returned text using the method getFromVenueName() the matching venues in the nearby location. The RDF files of the matched venues are parsed and the sentences are formed from the RDF triplet extracted information. The user is provided with an audio list of the options, he/she chooses the venue and the next process is triggered, getting the user to his/her chosen target destination.

The RDF sample example is presented below:

```
<?xml version ='1'?>
<rdf:RDF xmlns:rdf = 'http://www.w3.org/1999/02/22-rdf-syntax-ns#'
         Xmlns = 'http://www.museum.com/art#'>
<rdf:Description rdf:about = 'http://www.museum.com/rdf/fineart.rdf#fineart'>
<opening> 9-5 </opening>
```

```
<street> republicstreet </street>
<phone> (356) 21123456 </phone>
</rdf:description>
</rdf:RDF>
```


Following this information retrieval and display process, the departure and the destination coordinates are mapped out using the external GetDirections() service method. The method has been designed to get the list of directions for Microsoft MapPoint web service. These directions are then played out to the user, one at a time, every time the user gets to a designated checkpoint en route to the final destination picked out. The user is also informed whether he is indeed moving in the right direction. The Haversine formula (Haversine Formula, 2009) is used to map out the overall distance change during the walk.

4. CONCLUSIONS

The lessons learned from this prototype underscore the fact that more users with specific needs need an openness to the technology accessibility which contributes to their improvement of knowledge and skills within the society and environment they live in.

A number of limitations of the system, have been identified mostly related to the Android platform which is still being developed and its emulator. Various services had to be called in externally because these have not been yet developed. One specific limitation is in the lack of speech recognition and synthesis modules which the Android shows. However the Android is still in its experimental phase and therefore one might assume that these changes might be implemented on the phone in the coming future. In this project, specific data sets had to be included in a geocoder file, because the location API specified it. The project would definitely fare better if it could make use of GPS location services. By introducing a new functionality, which would render available methods returning a list of directions from one specific point to another would lessen the application’s limitation as it would decrease the interdependency on external third party software, thus improving maintainability and reliability of the mobile phone application.

Overall, the prototype has achieved the basic functionalities it needs to display as a Mobile Assistant in the City. As has been indicated there have been several projects which have attempted to design and create assistants as city guide, within the cultural heritage field and focusing on a specific target group of users such as the visually impaired. However M.A.C. wanted to achieve a further step in providing additional support, creating an AmI based environment in the assisted living domain. Such a system has the potential for various and improved applications, designed to form part of the living labs environment generated, towards the improvement of the quality of life. Future improvements, point to the use and application of intelligent computer agents as an added functionality to M.A.C. These agents would really emerge as virtual support assistants, accompanying users throughout their experience of the city. Future work would need to include more in-depth validation of the assistant, using both qualitative and quantitative methods to gain further insight into possible personalisation services, and added value to the lifelong learning experience which technology enhanced knowledge acquisition is pointing to.

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