

# Mobile Systems and Services for Guidance of Dependant People

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**Abstract:** This work deals with the problem of personal localization and guidance for impaired people. The authors analyze the user requirements of two groups: elderly and visually impaired people. The goal is to provide users with the most accurate and reliable technology depending on users' profile, adapting the information's contents to their specific needs. Location based services (LBS), integrated in a mobile device, will serve as a pervasive system which ensures the availability of the proposed solution. An initial study has been carried out to know user opinions and experiences about their habits in their routes as well as strategies and utilities users make use of in their urban routes. In order to fulfill the user requirements identified, several wireless technologies have been integrated and location-based services have been developed in mobile devices, under a common service platform using the "Design for All" principle. The main innovation for the developed system is the option of profiling features, which adapt the way of providing information to the user's special needs.

**Keywords:** LBS, visual impairment, navigation, mapping, dependant people

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## 1. Introduction

The heyday of location systems is driven by the growing demand of location-based services applications, such as objects or goods location or person location. From the point of view of applications that provide personal services, there is an increasing demand of that kind of pervasive services with very different purposes: professional, personal, recreational, safety, etc. Care services also are becoming assisted by location information (Hahnel et al., 2003).

When we restrict ourselves to a collective of citizens who have special needs, either sensorial, motor or cognitive (dependant, disabled and elderly people), location based services can provide final users with a high level of autonomy and safety through the assistance these services can supply

(Bradley, Poppen, 2003). Thus, they promote their social inclusion and the ability to avoid physical obstacles by appropriate guidance.

In order to provide a proper location management platform, the development of a location management system is required. Besides, the adaptation of contents provided by those services is required to assure the accessibility of dependant people (Lahav, Mioduser, 2008). Nowadays there are several tools and technologies applied to the adaptation of contents for any type of devices (Berhe, Brunie, Pierson, 2004), (Held, Buchholz, Schill, 2002), (Mohan, Simth, Li, 1999), (Phan, Huang, Dulan, 2002) (Lum, Lau, 2002), some of them include also some kind of adaptation depending on the users' profiles. But they refer to users that are perfectly able to use any kind of device; therefore, a missing feature is the need to focus the adaptation to the user disability. In order to achieve this, it is necessary to expand the standards, build new tools, improve the capability of the process and handling of contents according to the interrelationships among the presentation variables, establish protocols for interchange of disability attributes, and create standards for safety and security. In addition, there is a need to develop all these new applications on already existing commercial platforms. It is also remarked the role of personalization for the localization based services, and to enrich the system with user-generated content: the dynamically changing information generated by other users at a given location maybe be better suited to the needs of next visitors than some kind of general information.

## **2. Requirements, Results and Discussion**

The goal of this study is to know user opinions and experiences about their habits in their routes as well as strategies and utilities users make use of in their urban routes. On the other hand, another aim is to detect user's needs regarding assistive solutions which could help them to move easier and to know the features they would like to find in a GPS or navigation device.

### *2.1. Elderly persons*

One of the problems that they face is getting lost, and also they would like to avoid long and steep walks. The available help is always asking people for help. However, some of them would like to have a device that could help them instead of having to ask, thus they will be more independent. Their usual routes are known destinations, and they never go out alone. On the other hand, people living independently are most used with the use of mobile devices, mainly mobile phones, but not GPS or PDA for navigation. They find them useful and they are willing to use. Main problem for them is the difficulty to use the user interface, the size of buttons and screen, the appearance of menus and geographical information (Abascal, Civit, 2001). They would like to access the device in easier way, such as voice commands, bigger buttons or simpler menu options. The ideal appliance would be the ubiquitous one they are not aware of.

### 2.1. Visually impaired people

Each visually impaired user has his/her own functional diversity and face the situations which may happen in the urban thoroughfare in many different ways according to their limitations, not only physical but also according to their abilities and aids they use. The system should be flexible enough so that the user can set up the parameters for every personal need. Other important aspects are the ergonomics and usability of the device. The device must be omnipresent but should not disturb the user when he/she is moving during navigation. User attention must be focused on environmental conditions. Therefore, it is necessary to create some predefined profiles so that users can choose the ones that meet their needs best, but allowing them to personalize their combination, indicating to what extent users are affected by the different kind of events in their way (doors, pedestrian crossings, barriers, street works, etc). As a result of the study of the different kind of events obtained, regarding navigation and guidance, the system should take into account two kinds of events that can be found during a normal route:

- Temporary obstacles (as for example related to a scaffolding or a trench),
- Permanent obstacles (as for example related to a pedestrian crossing with a traffic island).

The ideal device user thinks of as a personal assistant for navigation and routing should meet some requirements:

- Accessible system.
- The system must have a high degree of personalization to fit their needs by means of a rich interface and easy to use.
- An adequate communication interface which makes use of enough alternative methods to guarantee a good human-machine communication for each one of the user profiles (voice, vibration, alert sounds, etc.).
- A big reliability of the system in aspects related to reception sensitivity and accurate processing of data which come from GPS system.

## 3. Experimental Section

In order to fulfill the user requirements identified, several wireless technologies are integrated: GPS, GSM WIMAX, Bluetooth, WiFi, RFID and UltraWideband. The profiling applications involve the adaptation of services and information, making use of the different types of visual and non-visual interfaces for the mobile device.

The following set of applications could be included in the mobile device:

- Application for sensing the context where the user is located.
- Application for filtering the geographical information.
- Detection of the profile (needs and preferences) of the users.
- Detection of the profile of the mobile device (which hardware and software modules are installed).
- Adaptation of the contents and interfaces according to the above information.

It is necessary to define the parameters which will lead the profiling of the interfaces of the applications or services, always taking into account the technologies for accessibility. A first step is

the segmentation of the typology of users (elderly, partially sighted, blind,...), analyzing their functional disabilities: cognitive disability, low vision, mobility disability... Also other features not linked with disabilities, but with specific context situations (hiking, bike cycling, ambient light...) are considered. For each case, different aspects must be taken into account when designing the interfaces:

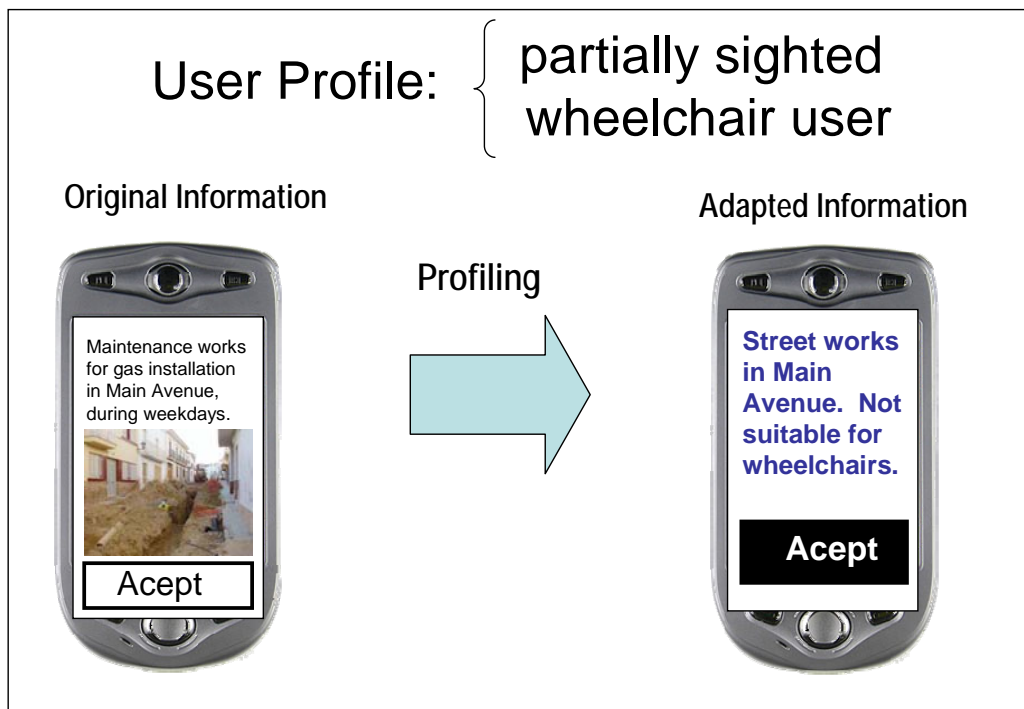
- Configuration of graphic representations: colors, contrast, text size, icons, distribution over the screen.
- Input modes by the user: voice, gestures, buttons, touch screen,...
- Output modes to show information: voice synthesis, vibration, text,...

In addition to these features which reflect the abilities of the users, the segmentation also includes the preferences of the users. Changes over the time of the user's profile have to be taken into account.

The adaptation applications have the following features:

- Repository of interfaces to allow quick execution and adaptation.
- Monitoring of relevant context for the applications, from the point of view of interfaces.
- Mechanisms to create selection rules to link optimal functionalities/interfaces with the context.
- Mechanisms to configure resources of the device (volume of loudspeaker, screen brightness,...) to keep the usability of applications in unfavorable circumstances. This will have to be done on startup and dynamically.
- Selection of the optimal mode of application, on startup and on execution time, when changes in context require re-configuration of the application.
- Scalable to different types of mobile devices and platforms.

**Figure 1. (a)** profiling process to adapt the information to the specific needs of an impaired user.



#### 4. Conclusions

This paper shows a first good base for the development of an integral system to help impaired people navigate with the support of a location and guidance mobile solution, for urban environments. The deployment of such a system providing both location based services and guidance for disabled and the elderly will improve users' quality of life, by eliminating/avoiding barriers and increasing their autonomy. Our first base study also discovers the importance of some critical elements in the application of navigations systems for visual impaired users:

- Accuracy of the cartography with the required level of detail: side walks, traffic lights, and other barriers.
- Accuracy of GPS system. It needs other necessary technologies to win a good precision of position like: accelerometer, compass, gyroscope, pedometer, etc.
- Necessary vocal interface user/device to leave the user's hands free to manage the cane, etc.

#### Acknowledgements

The technologies and developments presented in this paper are partially supported by the European Commission (ICT project HAPTIMAP, contract N. 224675) and by Spanish Ministry of Industry, Tourism and Trade (project ELISA, contract N. TSI-020301-2008-16).

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