Enabling Orientation for the Blind by Means of Mobile Guides

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ABSTRACT

I propose an investigation on *location sensing* and *multimodal output* for aiding blinds in mobility and orientation. The aim of my thesis is the design and evaluation of a compact and cost-effective configuration based on a consumer PDA with little custom hardware. The results of the performed tests will allow to define a set of guidelines to enhance the future generation of mobile devices with sensors and actuators.

Categories and Subject Descriptors

H.5.m. [**Information interfaces and presentation (e.g., HCI)**].

General Terms

Design, Experimentation, Human Factors.

1. INTRODUCTION AND PRELIMINARY EXPERIMENTS

Blind people visiting an unknown place are accompanied by a person, typically a familiar or friend, who supports them both for mobility and for descriptive purposes. Indeed, even blind users can access information regarding items in their original locations, even if they cannot actually watch them.

An efficient automatic and portable orientation system would allow the blind to move autonomously, for example, through an exhibition, thus improving social integration as well as enjoyment.

In the past years, research has led to several mobile solutions for facilitating the mobility of the blinds. An example is Navbelt [2], an obstacle avoidance system for unfamiliar environments exploration. It exploits a combination of ultrasonic sensors and headphones to detect obstacle providing feedback. Another example is the wearable solution, described in [1], for supporting the visually impaired in critical situations such as street-crossings. For the mentioned guides, the equipment consists of many dedicated hardware devices and some of them must be placed in a rucksack that the user has to wear.

The aim of my thesis, instead, is to design a very compact and cost-effective configuration based on a consumer PDA with little custom hardware and to evaluate the benefits it may bring to the blinds. The solution will have to enable the mobility of visually disabled users, i.e. to support them in achieving the key points on the environment and to describe the relevant items.

The main aspects of this investigation will be *location sensing* and *multimodal output*. User position and orientation and needed to compute the best path to the target (i.e. the suggested artwork of a museum) while the feedback modality is fundamental to let the user follow that path and to raise alerts whenever s/he loses the right direction.

1.1 Location Sensing

Up to now, I have investigated the *active RFID* (Radio Frequency IDentification) as indoor localization technology. Active RFID tags are self-powered transponders with extended reading range. RFID readers with compact antennas are pluggable in the PDA enabling tags' detection from many meters. Even if there exist several ready-to-use RFID solutions, I would not exclude the possibility of creating a novel localization platform if it led to some benefits (for example the reuse of capabilities already embedded on the PDA). Orientation functionality is also needed to provide directional aid. I already conducted preliminary experiments (see for example [3]) on direction sensing through an electronic compass to support blind users' mobility.

1.2 Multimodal Output

The feedback strategy is an issue too: since the blinds cannot see any graphical interface, alternative channels such as the audio/speech and the haptic ones may be exploited. According to the results of the test reported in [4], that did not show a significant difference between vocal and haptic modes preference, I opted for a multimodal output strategy to combine vocal/speech and haptic messages.

So far, as haptic feedback, I have considered vibrotactile sequences generated by a two-way handheld actuator fixable to the PDA. Observations emerging from a user test I have recently performed show appreciation towards the multimodal feedback. Obstacle detection by means of a distance sensor is felt as useful. However, not all the interviewed users agree on which is the best modality: while some of them preferred a continuous feedback about neighbouring obstacles due to safety, others considered as less annoying a feedback depending only on obstacle approaching.

Additional considerations regarded the too high system latency in providing aids and the form factor of the hardware which should be made less obtrusive.

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1.3 Future work

Since the preliminary evaluation showed that many improvements are still needed, my research will further investigate how to cope with some usability issues:

- *Ergonomic problems*: hardware size/weight, arms/hands fatigue.
- *Reliability*: speed and precision in detecting position/direction.
- *Convenience*: benefit/cost ratio; scalability of the solution.

Some hardware devices will be designed specifically for this application to meet the above mentioned requirements and will be tested by blind users. The results of the performed tests will allow to define a set of guidelines to enhance the future generation of mobile devices with sensors (such as electronic compass) and tactile actuators useful to support the blind.

2. REFERENCES

[1] Ross, D. and Blash, D. Development of a Wearable Computer Orientation System. Personal Ubiquitous Computing. Vol. 6. Springer-Verlag, pp.49-63.

[2] Shoval, S., Borenstein, J. and Koren Y. Mobile Robot Obstacle Avoidance in a Computerized Travel Aid for the Blind. Proc. IEEE Robotics and Automation Conference (1994) 2023-2029.

[3] Ghiani, G., Leporini, B. and Paterno, F. (2008). Supporting orientation for blind people using museum guides. CHI '08 Extended Abstracts. ACM Press, pp. 3417-3422, DOI= http://doi.acm.org/10.1145/1358628.1358867 .

[4] Ghiani, G., Leporini, B. and Paterno, F. (2008). Vibrotactile Feedback as an Orientation Aid for Blind Users of Mobile Guides. To appear in the Proc. of the conference: MobileHCI 2008, 2-5 September 2008, Amsterdam, The Netherlands