# Perception, Placement and Wayfinding Applied to Mobile Architectural Guides

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**Abstract.** *This paper describes continuing developments of mobile architectural guides. In using the term mobile we refer to a range of hand-held wireless enabled devices. These device present particular problems in terms of user interaction with a set of graphic and textual information that is intended to deliver information on routefinding and the important architectural features that the user will come across en route. This paper describes some of the issues that arise and user testing to determine improvements to the system being used.*
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## Introduction

The work described here deals with a range of issues relating to the delivery of architectural information that includes textual, 2D graphic and 3D graphic information to mobile digital devices. These issues are being investigated, developed and refined as part of an ongoing research project that is being applied in a particular European city (Brown et. al. 2006). The outcomes have broader implications for other applications of the theories and technologies related to pedestrian guides. We begin with a commentary on the issues of perception, wayfinding and placement as they apply within the scope of this research.

Previous works concerned with mobile guides design could be categorised into two approaches; ones using 2D and ones using 3D representations as the main navigation reference. GUIDE and Cyberguide are examples of applying scanned maps and tourism-related information to develop a navigation system for mobile users. On the other hand, the m-LOMA and LOCUS projects focus on using VRML and 3D rendered images to help the user recognise the landmarks by means of offering visualisations that are close to the real-world objects.

In our research we have found that a 3D representation can aid users effectively, to locate themselves in relation to a real urban environment. A problem is that a fully rendered 3D model can be memory intensive so we have adopted what we refer to as a Pseudo-3D representation. Here, a simple 3D model with hidden line removal is used as the 3D representation, and a set of 2D images produced from that model have been saved. Consequently the file sizes are small, but the appearance is as though the user is looking at a 3D representation. Hence the term 'psuedo3D'.

## Perception

In the context of this paper visual perception is concerned with the understanding and recognition of the three-dimensional model, two-dimensional map and related displays from two-dimensional representations on small-screen devices when compared with the real world experience. Parkin (2000: 27) stated that vision 'begins with a two-dimensional image on the retina but ends up as a three-dimensional scene in which there is depth, colour, movement, and so on'; the external world perceived by visual system is conveyed to a series of complex internal processes then the perception of the world is built. Although the images projected on our retina are flat, our cognitive and perceptual system provides assistance with transforming the two-dimensional representations into the three-dimensional world. In short we can say that we 'see' with our brain and not with our eyes.

There are a wide range of approaches proposed to explain visual perception and the processes involved in recognition and understanding of 2D representations of 3D information. Although aspects of each theory may be contradictory or require interdependence of a variety of capabilities of the perceptual system and its processes, there is one influential theory which 'provides a good basic framework for studying vision' as identified by Marr (Parkin, 2000: 29). Marr (1982) specified three distinct stages involved in visual perception: primal sketch, 2½ sketch and 3D sketch as shown in Figure 1 (Eysenck, 2005; Parkin, 2000). The issues relating to our perception of representations of complex 3D environments, such as an urban situation has practical importance in relation to implementation in our guide. This is particularly so given the constraints that mobile devices bring with them in terms of:

- local memory capabilities on the mobile device
- transfer rates and file sizes to be transferred on the fly.

## Wayfinding

The field of wayfinding has had considerable attention in the past. The work that we are particularly concerned with is concerned with wayfinding given the particular constraints and effects of using small mobile digital devices as the medium of transmission for the information that is used as the basis for wayfinding.

The arguments related to the definitions of 'navigation' and 'wayfinding' have been a source of some controversy over years. Darken (1996: 7) stated that "wayfinding precedes or facilities navigation. We will refer to navigation as a directed movement action and wayfinding as cognitive action involving route determination." A contrary view was posed by from the psychological viewpoint, Benyon and Höök (1997: 41) who suggested that "navigation is couched in terms of wayfinding." However, it is difficult to differentiate between the fundamental definitions of navigation and wayfinding and to clarify the distinction between each term. In addition, navigation and wayfinding can be regard as two sides of one coin and each of them is able to encompass the other, depending on the context of research.

The research described here illustrates the application of the ideas, and takes in ideas relating to wayfinding and navigation when applied specifically to a digital city tour based on mobile devices. We show a particular application of giving assistance in finding directions and walking around the city of Liverpool. As a result of generating a mobile navigation tour which can provide relevant local information and tourist services aids, the activities involved in exploring the city and orientating around the environment are facilitated by the design process. In short,

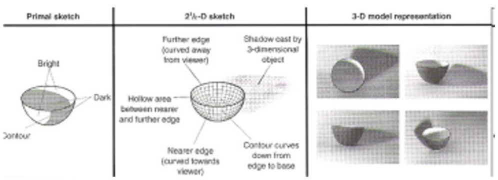


*Figure 1*
*Visual perception: primal, 2.5D sketch and 3D sketch (Source: Parkin, 2000: 29)*

the term navigation specifically in this study is taken as a means to support for a wayfinding activity

## Placement

Clearly, a core issue relating to mobile guides is the placement of the user in the real location. Our previous work has looked at using GPS technologies to do this. However in this paper we outline recent work on using local wireless for both information delivery and for placement of the user.

Furthermore, we mention how technologies such as RFID, that we are now applying, can enhance such systems and help overcome some of the practical problems that beset such technologies when applied to pedestrian architectural guides.

## The Guides

In the prototype of the navigation system, we have investigated further the possibility of using Pseudo-3D representation for mapping and location, linked to the visit-related services on a PDA, to offer the user with the information content according to the selected buildings around the campus of the University of Liverpool. In addition to the Pseudo-3D representation, photos, texts and audio aids of the selected buildings within the visited area for viewing the wayfinding information are implemented to the prototype. In order to simplify the operation and motion of using this system, textural metaphor is applied to design the interface with the functionalities of 'Home' for going back to the starting position of the tour, 'Image' for viewing the images of the buildings, 'Text' for reading the descriptions each building, 'Audio' for listening the details of individual building and 'Zoom' for scaling the representation in an adequate size, as shown in Figure 2. These features allow the user to request information when the user needs a more flexible approach and a more intuitive way to gain the knowledge of the surroundings around the current location.

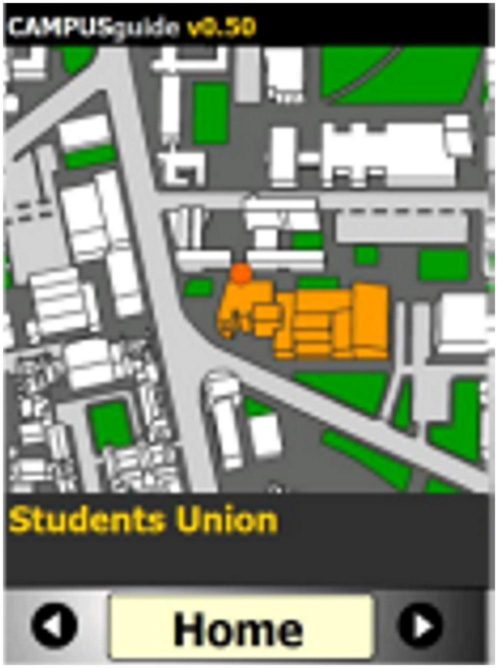


*Figure 2*
*Campus tour interface*

## Evaluating effectiveness

At the end of a tour we wished to capture each user's opinion as to the effectiveness of the system on the mobile device and any problems that were associated with using the tour. We decided that having a questionnaire also located on the mobile device would allow the user to give immediate feedback.

In order to design an appropriate questionnaire for use on mobile devices, a number of PDA databases were evaluated at the beginning of this study. Two of the database software packages considered were HanDB and SprintDB. As shown in Figure 3, these packages are able to run the questionnaire with various features, for instance check box, drop-down list and blank space, to either allow selection of an answer from the given options or to key in the participants' own opinions, but the representations of the questions and the choices cannot be displayed in the same screen at the same time. The users have to click on each question and sometimes scrolloing up and down is required to read the details then select the answers.

Therefore, a well-designed PDA database with the capability of viewing the contents on small-screen devices is essential during the stage of collecting the feedback for further analysis. It appeared that FileMaker, applied to design the questionnaire within this study, would be the most suitable database in the current stage partly as it has the potential to generate a layout that could be adapted to multiple screen sizes, as illustrated in Figure 4.

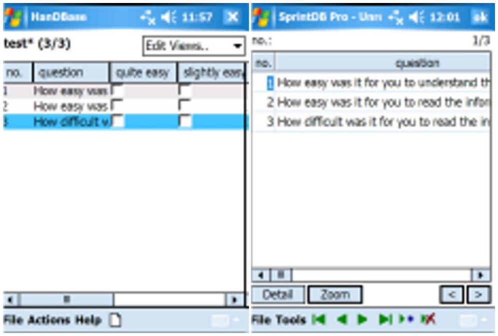


*Figure 3*
*Screenshots of HanDB and SprintDB*

## User surveys and feedback

The prototype had been examined in the field using the campus of the University of Liverpool. A preliminary test was carried out by asking nine participants to navigate around the campus via the system. After brief introduction of the aim of the experiment and the way of using this system, the participants were asked to walk independently along the pre-defined route from the Guild of Students to the Melville Grove Halls of Residence (accommodation) with the intention of simulating the real-world navigation and wayfinding situation; the route is shown in Figure 5. When the tour was completed, a questionnaire survey with both closed and open-ended questions was answered by the participants in order to receive the opinions upon the understanding of the representation, the ease of using the interface and following the given direction and the feedbacks upon improving our future system developments.


*Figure 4*
*Screenshot of FileMaker*

Analysis of questionnaires from this preliminary study showed that users found that the Pseudo-3D representation was generally very understandable in both locating themselves and recognising the buildings, but it was difficult to identify the buildings from the photos only for some of the users. Moreover, six participants mentioned that it is helpful to identify individual building with the integration of Pseudo-3D map and the photos, while only one of them thought it would not be useful. The colored routes between the buildings within the tour were found useful to not only navigate around the campus, but also identify the directions.

There was feedback, which was received from the open-ended section of the questionnaire, that suggested some useful ways to improve the prototype:

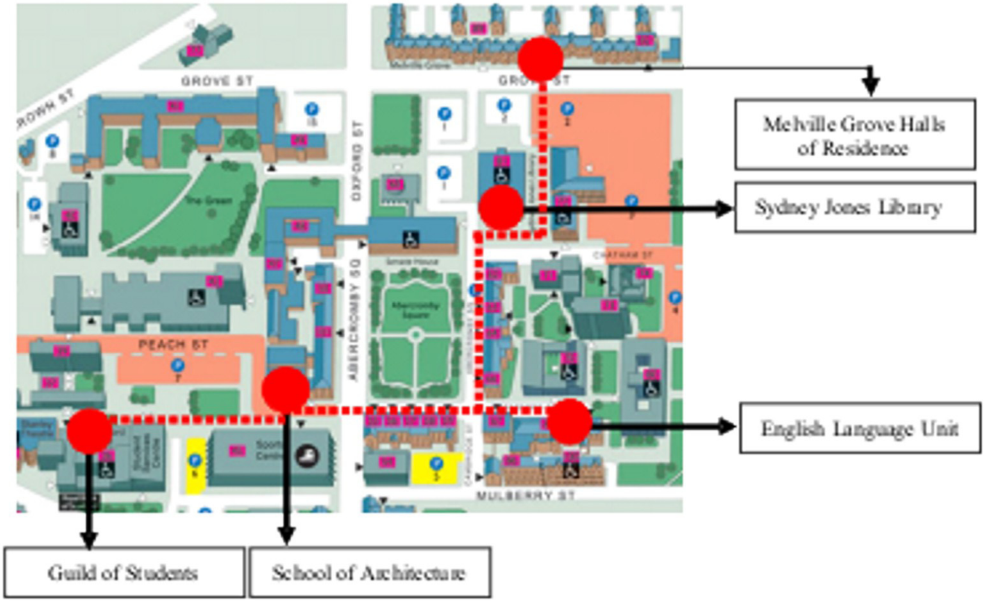


*Figure 5*
*Route taken in trials*

one of the participants indicated that the functionality of 'Zoom' did not help on viewing the details of the buildings; one of them mentioned that a distinct feature on the route could aid navigation (a distinctive gate between Pilkington building and School of Architecture was mentioned in this regard); two of the users noted that texts on the map such as a street name and a building's name would helpful to help recognize the surroundings.

## Conclusions

The method of communicating this information visually on mobile devices requires a rethink on the part of the system designer to work within and with the limitations of on the small screen size. The work reported here shows that whilst there is significant potential for the delivery of digital guides to mobile devices, equally there are significant challenges to make the guides work more effectively and usefully than their paper counterpart Our work is ongoing to establish large scale working examples that can be user tested with a wider base of user types.

We are currently implementing the next stage of the system which uses the interface experiences of this pilot study to build a user selected tour (as opposed to the fixed tour described here) where the route calculation is performed on the fly and the results displayed on a pseudo – 3D map representation.

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