Eyes-Free Overviews for Mobile Map Applications

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ABSTRACT

We outline two new auditory interaction techniques which build upon existing visual techniques to display off-screen points of interest (POI) in map based mobile computing applications. SonicPie uses a pie menu and compass metaphor, allowing a user to scroll around the environment, hearing off-screen POIs in a spatialised auditory environment. EdgeTouch integrates with the Wedge technique of Gustafson *et al.* [2], sonifying the POIs as the user comes into contact with them when moving his or her finger around a "sonification border".

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: Auditory (non-speech) feedback, Input devices and strategies.

Keywords

Off-Screen Data Presentation, Auditory Display, Digital Maps

1. INTRODUCTION

Geocentric mobile applications are becoming increasingly common, due in part to the proliferation of mobile location aware devices with "always on" Internet connections. These allow users to search for points of interest (POI) such as coffee shops and cash machines, with the results overlaid on a map, showing the geographical positions relative to the user. However, the restricted visual displays of mobile devices limit both the number of POIs that can be presented, as well as the map scale level that can be used to concurrently show both the POIs and the current position of the user. As noted by Seager [4], this can cause confusion for users as they are required to constantly pan and zoom the map to see both the POIs and the map in sufficient detail. Several researchers have proposed techniques that indicate the distance and direction of currently off-screen POIs to the user. Gustafson *et al.* [2] proposed the Wedge technique (see Figure 1 (a)), where a triangle (Wedge), extending from the POI and intruding onto the edge of the visual display, provides information on the direction and distance of the off-screen POI. Far away POIs have a larger angle between the two legs of the Wedge, causing the base (which appears onscreen) to be larger. An evaluation carried out be Gustafson *et al.* showed that users could effectively estimate the off-screen locations of the POIs and plan routing tasks.

Whilst visual based solutions to display off-screen POIs are useful, they also have several disadvantages. Notably, the user must explicitly look at the device to find out the POIs that are around him or her. This may not be convenient if the user is in an "eyes-busy" situation or, as Seager [4] notes, sunlight shining on the visual display may make the screen difficult to see, reducing the usefulness of any visual technique.

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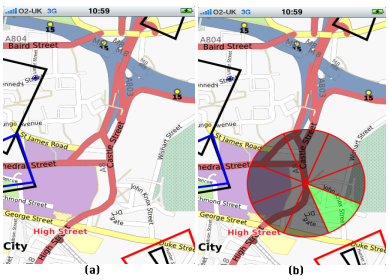

Figure 1: A screenshot showing the map display without (a) and with the pie menu (b).

2. ENVIRONMENTAL AUDIO OVERVIEWS

To overcome the problems of mobile map use identified, we have developed two techniques that provide non-visual auditory browsing of nearby POIs. We do not argue that these are a replacement for the visual techniques already developed, rather a means of augmenting those techniques so that the visual display is not always necessary. Both of our techniques have been developed on an Apple iPhone, and use as their base an implementation of Gustafson *et al.'s* [2] Wedge technique, as this has already been well evaluated.

2.1 SonicPie

SonicPie uses an egocentric interaction to allow a user to browse information in the environment. By tapping the screen, the user causes a pie menu, centred on the tap location, to appear (see Figure 1 (b)). This allows non-visual interaction, as the user can use muscle memory to easily locate the segments of the pie menu. The pie menu has eight segments, arranged so that the middle of each points in a cardinal direction (either front, front-right, right, right-back, back, left-back, left, front-left). Each off-screen POI falls into the extension of exactly one of the segments of the pie menu. When the user touches a segment, all of the POIs that fall in the extension of that segment are concurrently played with a 300ms onset-to-onset delay between each. This is important as it helps to avoid the sounds from masking each other and causing the information they represent to be lost [3]. To allow the user to quickly scan the environment, we represent each POI as a single musical note, the timbre of which relates to the type of the POI. Currently we have four types of POI, Coffee Shops (Piano), ATMs (Violin), Post Office (Trumpet) and

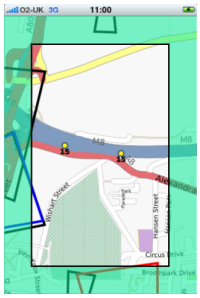

Figure 2: A screenshot showing the "sonification border" used to control the sonification in EdgeTouch.

Police Station (Guitar). We also use a "tap" sound as a "place holder" that is played when the user enters a pie menu segment where no POIs are located. The note's pitch represents how far away the POI is from the user position (centre of the visual display), with lower pitches representing further away POIs. We position each sound in a 3D environment around the user's head. Therefore, POIs that fall in the right-back pie menu segment will be heard to the right and back of the user. With the addition of GPS positioning and an electronic compass, the POI would be played in the same direction as the real POI is in the environment. This should make it easier to overcome the context shift that exists when trying to relate information on a map to information in the environment [1].

2.2 EdgeTouch

Our second interaction technique, called EdgeTouch, is more tightly integrated to the original Wedge concept of Gustafson *et al.* [2]. Instead of the user needing to tap the screen to activate a menu, we define an 40 pixel border around the edge of the map display (see Figure 2), covering the intrusion depth of the visual Wedges. As the user moves a finger around this "sonification border", the finger will come into contact with the triangles representing the off-screen POIs (the leg intrusion [2]). When the user's finger passes through the centre of the wedge, a musical note is played using the same musical and spatial mapping as for the SonicPie technique described in Section 2.1. The user can therefore run a finger around the edge of the screen and receive an overview of the off-screen POIs, and where those POIs are relative to the user.

2.3 Technique Comparison

Whilst both of the techniques outlined allow users to obtain a non-visual overview of their immediate surroundings and relate that information to the visual map, they each have trade-offs in the ease at which this can be accomplished.

Coupling of Environment, Auditory and Visual Information: EdgeTouch allows the auditory representation of the off-screen POIs to be more tightly coupled with the existing visual Wedge display. Wherever the user's finger is when the musical note is played, is the same location that the corresponding visual wedge is drawn. This is unlike the SonicPie technique, which draws a pie menu centred on the position where a user taps on the screen. SonicPie allows closer coupling with the environment by using a compass metaphor for both the auditory representations of the POIs, and the means by which the user interacts with the auditory representation - the pie menu. However, the logical centre of the pie menu is the same as the logical centre used to calculate the visual Wedges, namely the user's current location in the environment (in our system the centre of the visual display). This means that if the user is obtaining an auditory overview, and decides to look at the map, he or she must make a mental adjustment to relate the currently touched segment of the pie menu to the onscreen wedge that it represents, as the pie menu may not be centred in the middle of the display.

Non-Visual Browsing: Although both techniques allow non-visual interaction by the sonification of POIs, the EdgeTouch system requires the user to be able to follow along the edge of the visual display. For this to be successful the user must be able to distinguish between the interaction surface of the device and its surround. On most mobile devices that have a resistive touch screen this is straightforward, as such a display does not lie flush with the surface of the device, so there is a ridge the user can follow. However some devices, such as the iPhone, have capacitive touch screens that can lie flush with the surface of the device, meaning that there is no tactile distinguishment that the user can follow. On our prototype implementation we use a screen protector on the iPhone which allows the edges of the touch screen to be followed, but this may not be suitable in all cases.

3. DISCUSSION

Both of the techniques show promise in allowing non-visual overviews of POIs in the environment, but each has trade-offs that may impact on its overall usefulness. We are therefore planning to carry out a two stage evaluation of SonicPie, EdgeTouch and Gustafson *et al's* Wedge technique, to validate our assumptions on the advantages and disadvantages of each. The first stage will be lab based, and focused around navigation and routing tasks similar to Gustafson *et al* [2]. The second stage will be more qualitative and consider how the user uses the various techniques in real world navigation tasks. This is important, as real on-device evaluation has not yet been carried out for either visual or non-visual off-screen techniques (Gustafson *et al's* evaluation was carried out on a simulated PDA running on a desktop computer). We do not know how users would switch between the various techniques and the issues this would raise.

In conclusion, we have outlined two new techniques that allow non-visual overviews of nearby POIs, overcoming eyes busy situations, and providing ways to effectively interact with touch screen based devices non-visually.

Acknowledgements

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4. REFERENCES

[1] B. Brown and M. Chalmers. Tourism and mobile technology. In *Eighth European Conference on CSCW*, pages 335–354, Helsinki, Finland, 2003. Kluwer.

[2] S. Gustafson, P. Baudisch, C. Gutwin, and P. Irani. Wedge: clutter-free visualization of off-screen locations. In *CHI '08*, volume 1, pages 787–796. ACM Press, 2008.

[3] D. K. McGookin and S. A. Brewster. Understanding concurrent earcons: Applying auditory scene analysis principles to concurrent earcon recognition. *ACM Transactions on Applied Perception*, 1(2):130–155, 2004.

[4] W. Seager. *The Usability of Map-based Applications for Pedestrian Navigation*. PhD thesis, University of Nottingham, 2007.