LAZY PANORAMA MONOPOLY TABLE: *Take Your City for a Spin*

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Abstract. While conventional information displays are still effective, a lack of integration between descriptive and contextual information means they cannot be used independently of additional external information. New digital systems such as Google Maps are increasing in popularity. Unfortunately these present some limitations in terms of understanding both route and survey information, and in particular navigation and orientation, such as intuitively understanding a plan view no matter which way one is facing, so visitors can quickly and intuitively learn how to get to specific buildings or to specific facilities. Digital systems may also alienate older and non computer literate users; and they display contextual information inside an interface which limits the possible range of interaction methods offered by physical interaction. Our solution was to create a 3D physical model that one could spin, which would in turn display digital panoramas that spun in rotational alignment with the physical city model. Further, the user could place category tokens in intersections of the city model, which would bring up digital panoramas on the screen and highlight facilities linked to the category chosen. Rotating the token would also rotate the digital panorama.

Keywords. Urban visualization, panorama, tangible user interface, phidgets.

1. Introduction

Two types of information are required for a successful directory system; contextual information of the area (What are the landmarks and buildings around the location? Which way is north?), and descriptive information of the specific location (Which street is it located at? Which building is it? What does the building look like? What additional locative information is required?).

We have examined current information directories and services, and how well they present contextual and descriptive information; and the user's experience of the system. Additionally, we investigated other physical and digital devices and technologies, which are designed specifically to show only a single form of information (either contextual or descriptive). From this we have built a horizontal evaluation prototype, combining contextual information through a physical medium (an abstract model of the area) with descriptive information displayed digitally (panoramas and information overlays about specific locations in the area), which is merged through the user interaction. We evaluated the prototype based on user experience, memorization, and fun, compared to current directories.

2. Previous and Parallel Research

This project may be considered either a "graspable" (Fitzmaurice et al, 1995), or "tangible" user interface (Ulmer & Ishii, 2001). We have adopted, where possible, Ulmer and Ishii's terminology (Ulmer and Ishii, 1997a; Ulmer & Ishii, 2001), but we are not convinced tangible fully conveys the graspable features of the project, and we have used tokens instead of physical icons or phicons, but tokens also do not fully express the graspable and twistable nature of the movable and rotatable objects.

We have been most influenced by the metaDESK project (Ulmer & Ishii, 1997b), but that work uses a more complicated mapping system without the use of photo-realistic panoramas or focal points based on major street intersections. Since the development of this project in 2006 we have discovered related research (Shen, 2006; Wesugi & Miwa, 2006; Rogers, Lim & Hazelwood, 2006), which also use rotating tables or rotating images, but not (as far as we know) for urban visualization, and they don't include digital panoramas or urban category selections based on street intersections.

3. Process

We conducted surveys of thirty people visiting the country town of Ipswich to ascertain which current information services were most popular. The surveys found that Whereis.com.au was the most popular form of information directory, due to the high level of integration of contextual information (similar to a Street Directory) and the ability to find descriptive information (Yellow Pages). Although Whereis.com.au was the most popular system, older people interviewed (aged 30-50) did not use Whereis.com.au, preferring physical documents such as the Refidex (Street Directory) and Yellow Pages. Users within this age group had either limited access to the Internet, were not computer literate, or simply preferred the ability to physically hold documents. As the selected area for the prototype (Ipswich Central Business District, Queensland Australia) has a largely popular heritage trail which is targeted at older visitors to the area, it was important to take computer literacy and digital interfaces into careful consideration.

We also asked how users felt about the visualisation as an intuitive, useful and fun user experience. The below survey (Table 1) indicated to us how many tourists (particularly older ones) had trouble effectively relating 2D plans with 3D landmarks in the real world (Sharlin et al, 2001).

Table 1: User Study Results

Question	Yes	No
Do you ever use a directory listing?	93%	7%
Do you prefer to use a physical or digital map to find a location?	56%	44%
Do you have problems finding the YOU ARE HERE location?	52%	48%
Do you have problems associating the real world location to a map?	56%	44%
After arriving at an area, do you have problems finding a specific location?	52%	48%
Is a map that is easier to read quickly better than a map which is effective?	59%	41%

4. Design Development

Prototyping convinced us that the optimal method of visualising contextual information was through the use of a physical model of the area, with physical representation of each building. This allows the user to see physical dimensions of all parts of the area, as well as obvious landmarks from various angles. Due to their photo-realism and the ability to overlay detailed information, panoramas were chosen to represent descriptive information.

A concept was developed where the user moves a token around the physical model and shown on a screen a digital panorama relating to the location of the token. These tokens show the position that they are facing, which is the same alignment as the panorama. Rotating the tokens allows the panorama to be rotated. The aim of this interaction method was to allow the user to cognitively connect the digital and physical systems through the use of physical interaction and orientation.

To demonstrate this concept, a low fidelity prototype video of how the system would look and operate was created in Google SketchUp (Figure 1). This video was demonstrated to members of the community, members within the academic program (design students), and other people not affiliated with the project.

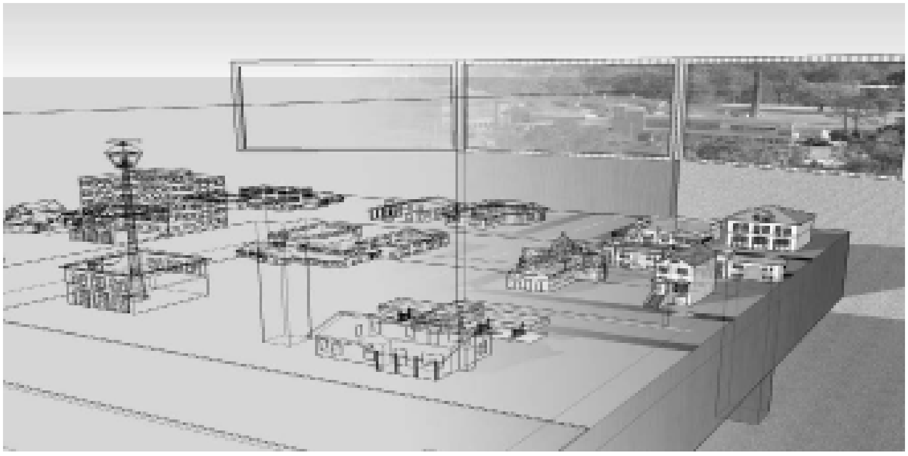

Figure 1: SketchUp Concept

Feedback indicated that the concept was sound, and that it explained how the system would work. However, it was hard to gauge whether the concept would be appropriate in real-life conditions (problems such as durability and whether the users would instantly understand the interaction method). A low fidelity prototype was created to test and assess these potential issues. The prototype consisted of an Ipswich City Council map mounted on foam-core, with a rotation sensor placed on a specific location of the map. Information from the rotation sensor was sent to a Phidget, which then moved a panorama of the location. As users rotated the sensor, the panorama would rotate to match.

A meeting with a prominent member of the business and photographic community was conducted to investigate how someone who knew the area well but without knowledge of the system would interact. It was discovered that users' associated the panorama with the physical location. Many suggestions were made, such as having a round board and targeting it towards displaying more information about individual businesses. We also found that almost all beta testers associated the physical map with the digital panorama, and were willing to interact and play with the system without being asked (even non-computer literate people). Also, feedback suggested the model should be situated on a round board and be able to be rotated for orientation and usability, and that contours should be incorporated into the model, to help associate elevation levels between the physical and digital (elevation was obvious in the panoramas due to the landscape).

Further suggestions included being able to rotate the entire physical model to allow users to view the model from any angle and for better access to all areas of the board, a compass for orientation, business categories that could be overlaid, simultaneous multiple user interaction to enhance collaborative learning (Maher & Kim, 2006), the ability to select multiple businesses to compare against each other, information overlays showing extended information about each individual business and categories for specific types of businesses and public resources to aid in filtering required information.

The final design proposal was to create a physical model of the area (on a round board that could be rotated), with a digital display behind it for the panoramas and additional information. The sides of the round table would feature photos of major intersections. A user could approach the board, and pick a token from the category panel from the side (Figure 2).

Figure 2: Token interaction

Once the user has selected a token, buildings on the table that are appropriate to that category would be illuminated. The user may then place the token on one of the specific locations on the board (clearly marked), which would display a digital panorama of the area. The panorama would be orientated to the same direction as the token is facing, and as the token is rotated, the panorama would adjust itself. Once a specific building is centred on in the panorama, additional information about that building would appear (such as name, street location, opening hours and website address).

5. Technical Development

We examined EZIO, Arduino, Phidgets, and modified keyboards as interface devices (Table 2). Phidgets proved to be the most suitable technology due to their ease of use and reliability. A Phidget interface kit (8 digital in, 8 digital out, 8 analogue in) was purchased with 8 rotational sensors.

Table 2: Input/Output Technologies

Technology	Reliability	Extendibility	Ease of use	Availability
EZIO	Medium	Medium	Medium	High
Phidget	High	High	High	Medium
Arduino	Low	Very High	Low	High
Keyboard	High	Low	Medium	High

The Phidget interface kit's digital out ports were used to illuminate the buildings through LEDs, while the digital in ports were used to detect the presence of the token on specific areas. The category selections were detected through custom-built pressure pads (using aluminium foil and foam). The interface device was initially to be a modified keyboard; however the keyboards available could only detect three keys simultaneously. Arduino technology was used next in the prototype, however due to reliability issues an EZIO board was used for the final implementation.

The interface to operate both the physical and digital board was built with Adobe Flash 8, due to its advanced scripting language and support for vector graphics (Figure 3). Adobe Director was initially selected due to its QuickTime VR support; however Phidgets do not support Director's scripting language.

Figure 3: Final Digital Panorama Example (Flash)

Information overlays of descriptive information were stored in a MySQL database for extendibility, and integrated into the interface through PHP. As Flash is not compatible with EZIO technology, information from the EZIO board was sent from Director into the same MySQL database as the information overlays. Audio was felt to be an important aspect of the user experience, however due to time limitations could not be integrated.

The model was created on a base of 3 pieces of medium density fiberboard (MDF). Between them was placed a rotating tray similar to those found on restaurant dining tables (known as a "lazy Susan") to allow the tables to be spun (Figure 4). The top piece of MDF served as a base for the model.

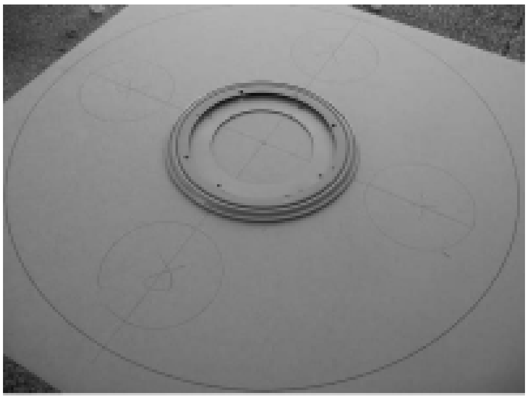

Image 10: A Lazy Susan attachment allows the model to be spun

Figure 4: A Lazy Susan attachment allows the model to be spun

A USB cable was threaded through the Lazy Susan and the MDF directly in the center to limit cable twisting. The Phidget board was placed between the middle and upper pieces of MDF. Cardboard sheets of each contour were created from a vector image of the area, and then cornice cement was placed over the cardboard for a smooth finish. Each building was created with foam-core, and lights were attached under buildings that represented each specific category.

The user tokens were created through garden tubing, plastic caps and lead weights. The tokens were designed to look like columns, and colour coded to match their respective category. Monopoly tokens were attached to the tops of each token to show orientation of the token and to aid in visual recognition (from feedback we found that the original tokens originally did not appear movable to the beta testers).

6. Evaluation

Image 1: Lazy Panorama Monopoly Table

Figure 6: Prototype at Exhibition

Final evaluation was conducted through observation of students, academics and members of the community interacting with the system at an Exhibition held at the end of the project (Figure 5). We discovered that while users appreciated the project (through experimenting with the system and playing with the tokens to see what would appear); the method for placing the tokens on the model became cumbersome.

Despite this, many users understood how the system operated with basic instruction (through a poster that explained). The success of the system was noted during the Exhibition when users who had previously tested with the system, returned to show their place of business through the use of the panoramas. It was noticed that returning users had a high recognition level of how the system worked.

Overall the project has shown that combining physical and digital mediums for information directories is a successful method to visualise both contextual and descriptive information. While the concept has been shown to be valid, the construction and implementation of such a system is difficult due to construction and technical limitations. The fundamental problem is finding a token interaction method and material that allows users to easily move tokens around a model without interference from the interface. Seamless interaction with the tokens (through advanced monitoring techniques such as camera tracking) may provide better user experience.

7. Conclusions and Future Work

Users could cognitively connect the digital and physical mediums through user interaction of a token; however the recognition of the tokens could have been improved. Users came back after the testing to show their friends and families where their businesses were, so we believe this hybrid multimodal project has appeal to the public.

Possibilities for future work on a similar project might include audio into the interface, evaluate the effect of features such as contours and coloring, compare the effect of abstract versus realistic models on wayfinding, closer examination of gender differences or differences between spatial designers and the general public, and comparing the effectives and usability of a physically augmented model to 3D printing or a purely virtual table.

In short, there are many issues in adapting real-time land modeling on tabletops for urban and architectural visualization (Piper, Ratti & Ishii, 2002), but our multimodal prototype indicates to us that such devices can offer distinct advantages over two-dimensional maps and plans. The next major research stage is how to provide a product that can adequately and intuitively cater to the differing contextual needs and cognitive mapping abilities and experiences of the general public.

Acknowledgements-to be added

We would like to thank the participants in the survey, the Ipswich City Council, and staff and students of Interaction Design, School of ITEE at the University of Queensland, for their advice and encouragement.

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