Finding the Minimal Information Set for Assisting Navigation in Multilevel Indoor Spaces

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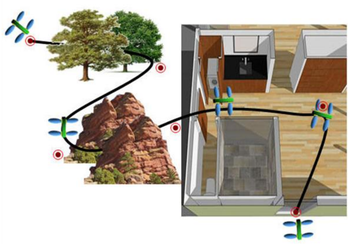
I. Motivation

Several surveys indicate that around 87% of people's activities occur in Indoor spaces.

This research focuses on the **human interaction with the indoor navigation systems**. The high level question in this topic is :

"*What is the best way to display multilevel building information on personal digital assistants (PDAs) to help people's navigation in multilevel indoor spaces*?"



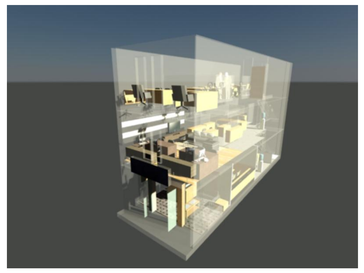
The outcome of the research is important as it will help design a more user- friendly interface for real-time navigation on PDAs.

II. Goal and Hypothesis

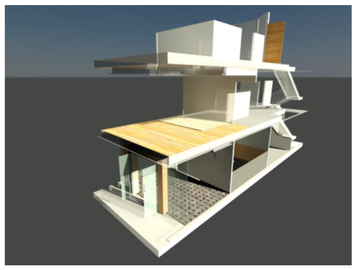
The high level question can be sub divided into two questions:

1) What is the best display mode for conveying spatial information? There are two options.

- "Real world-based 3D model" (RM): Based on a photorealistic virtual building
- "Layer-based 3D model" (LM): only models a sketch-map representation of each



"Real world-based 3D model" (RM)

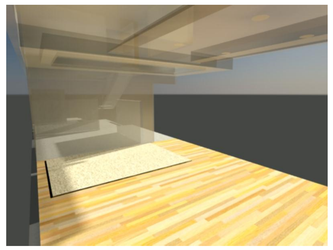


"Layer-based 3D model" (LM)

2) Does viewing perspective of the information shown on the PDA effect navigation performance? Options:

- "First-person and heading-up view" (FHW):
- "Third-person and heading-up view" (THW):
- "Third-person and North-up view" (TNW):

FHW based on RM



FHW based on LM

There are two tasks:

- Task I = Wayfinding Task. Ss take advantage of PDAs to get the survey information of the environment.
- Task II = Navigation Task. Ss navigate from A to B with the assistance of the PDAs.

Hypothesis: *Ss' navigation performance in the LM will be as good as in the RM conditions in both tasks. And in Task I, TNW will be the most efficient display measure, while in Task II, FHW will be the most efficient display measure. THW is predicted to show intermediate performance in both tasks.*

III. Method

The tasks will be conducted in a virtual environment (VE) and employ a simulated PDA. We will take advantage of a Head-Mounted Display (HMD) to create a fully immersive virtual reality system. 3D Models will be edited in 3DS Max 2011 and then converted into the VE platform.

Each foot of the Ss is affixed with a LED to track their foot steps and orientation during navigation. The LED sensor gets the user's real time 3D position using a 4-camera tracking system.

Head-Mounted Display (HMD)

PPT tracking system

IV. Experiment Design

Eighteen subjects will take part in the experiments. All Ss run in the LM and RM model conditions on both navigation tasks. We divided the subjects into three groups according to the three viewing perspectives?. Each group takes part in the experiment based on only one view perspective to avoid learning effects.

Ss will use the information on a simulated PDA to navigate in the VE. There is a practice phase and test phase in all experiments. In the practice phase, Ss are taught to navigate in the VE to get familiar with the environment and learn how to use the foot step recorder. In the test phase, Ss are guided by the PDAs to navigate in each condition.

In task I, they are guided by the PDA to walk around the environment. Next, they are asked to point to specific salient landmarks that they previously experienced. Directions are recorded. And then Ss are required to walk back to the start point. Navigation time and distance are recorded.

In task II, subjects are required to navigate from A to B via guidance provided by the PDA. Navigation time and distance are recorded.

References

Wiener, J. M., Büchner, S. J. and Hölscher, C. (2009), 'Taxonomy of Human Wayfinding Tasks: A Knowledge-Based Approach', Spatial Cognition & Computation,9:2,152 — 165.

Mike Worboys, Slides at the 2010 UCSB Dangermond Lecture

http://nav.spatial.maine.edu/

Acknowledgments

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