Proposal: **Modifying Route Map Visualizations for Easier Mobile Usage**

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Wayfinding tasks are something that people do daily, although a lot of the areas navigated are familiar to them. Sometimes we need help to find our way to someplace new. People have long relied on maps to support this task; these days these maps are mostly digital and have integrated route-finding algorithms.

I have been an avid orienteer for many years, a sport that involves running while navigating with a map and compass. I am aware that most advanced orienteers develop some form of simplification of the map, pulling out features that are salient for the current navigation task as well as what they expect to see in the near future. Essentially, more information is needed at decision points, as well as near the location you are trying to find. This is done visually, on the fly, and doing so effectively is a part of the challenge of the sport.

To some extent this use of more information in some places, and less in others is a form of distortion. Kopf et al. [2] created software that runs with Bing maps, and creates a destination map. To facilitate finding the destination, the area surrounding it is enlarged and the detail is kept, whereas the areas leading to it are simplified and shrunk.

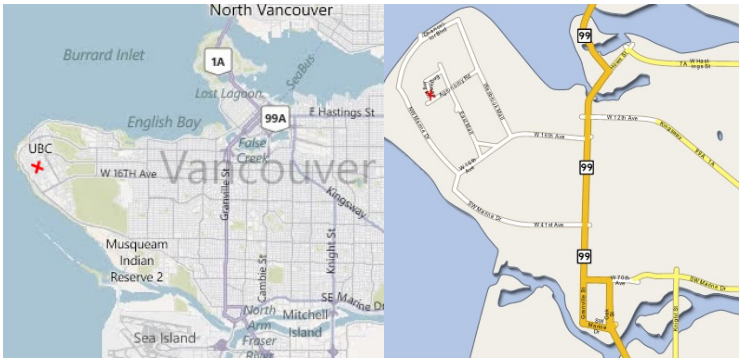

Figure 1: *The image on the left is the undistorted map from Bing maps with the location of the Computer Science X-wing drawn on. The image on the right is the destination map created by the software described in [2].*

This example makes more sense for use when driving, or generally traveling longer distances that are easier to simplify. When walking the simplification of the map would need to be different, as there are more visual cues to use and less reliance on roads and road names.

Use Case

For my project I want to create a mobile application that will support these more complicated walking wayfinding tasks, or more specifically: route finding and following while moving. The start location can be assumed to be the user's current location (but for preplanning purposes it might be useful to have an option to set the start).

An example abstraction can be seen in figure 2, where the user has arrived at UBC bus loop and wishes to walk to the Computer Science x-wing. The non-simplified version would be hard to read on a small screen, a problem that is only amplified when the user starts to walk.

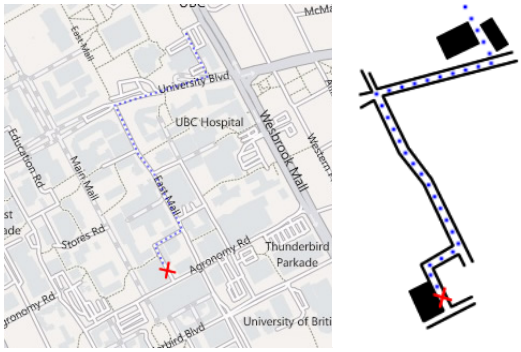

Figure 2: *The image on the left is the Bing map with the location of the Computer Science X-wing drawn on and a route from the bus loop. The image on the right is a mock-up of a simplified route map.*

There are two main visualization problems to tackle:

1. Small screen issues, such as awareness of items off the screen
2. Route map graphics, such as the level of simplification or scale

The destination is likely off the screen for most of the wayfinding task, and this is the piece of information the user might most like to know about. For this task I will have to decide if arrow or ring [1] visualizations will be more effective (for a simplified example see figure 3). The arrow could be augmented with a distance to the destination to give context, whereas the ring inherently gives a sense of how far away the location is. Alternatively, focus-plus-context could be used to give an overview of the route as well as show the section of the map that is needed currently. However, giving context without sacrificing valuable screen space, such as through the off screen location visualizations, may be a better tradeoff.

The map simplification will be difficult, and generalizations, such as needing more information near turning points or when not following larger roads, will likely need to be used. The goal is to simplify the map graphics so that when the user glances at the screen while walking it is cognitively easy to pull out the information they need.

Scenario

The user takes out their touchscreen cell phone and inputs their destination. They then follow the route using the provided visuals, and the map updates as they move towards their destination.

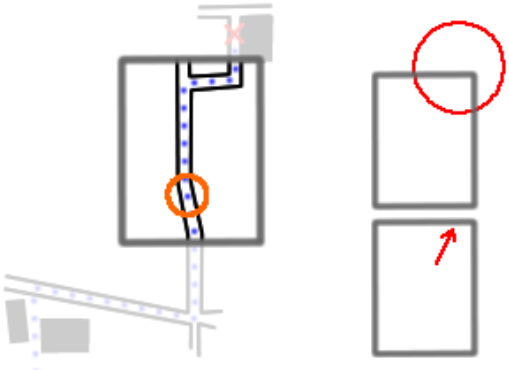

Figure 3: *The image on the left is a mock-up with a 'your are here' circle to support the egocentric frame of reference. Additionally a screen outline is shown as an example of how only a section of the map would display. The image on the right shows two options for off screen visualization of the destination.*

An egocentric frame of reference is generally assumed to be more natural, and as people tend to describe a scene from their viewpoint [3]. Since smartphones now have location capabilities it is easy to add a *'you are here'* highlight, as well as orient the map to the surroundings (so that the buildings on your left are on your virtual left in the map). Most avid orienteers find it natural to read a map path-out/up, so that where you are is closer to your body and where you are going is further away. An arrow may be needed along the path of travel, to eliminate confusion about which direction to go. The orientation will be easily facilitated with the described location capabilities, although some lag may occur due to the position updating. Additionally, if the user gets off the specified path, the route can update and give the new map information needed.

Implementation approach

To make use of the native services on the mobile device, such as gps coordinates, the application needs to be developed in the native environment. Therefore I will not be using a web based application, but develop in the Android environment. I will be using the pervasive Google maps [4] and its route finding capabilities, and modifying the returned result to change the visualization.

Interaction

The touch interactions of drag to pan and pinch zoom are inherent to the map navigation. However, once the destination is chosen the map should have a preset scale for the surroundings and continually update so the salient part of the map is visible, based on the user's location. The scale may need to automatically zoom in as they approach the destination, in order to effectively show the more detailed information. The user might still want to modify the scale, so the standard interactions will continue to be available.

Milestones

- Set up a basic google map route finding application for Android
- Figure out how to modify/filter the map data
- Explore and implement algorithms for route map simplification
- Explore and implement different map legend graphics (that mesh well with the chosen forms of simplification)
- Refine the interaction with the application
- Pilot on a small set of users

Bibliography

1. Baudisch, P., Rosenholtz, R. (2003). *Halo: A Technique for Visualizing Off-Screen Locations.* In Proceedings of CHI 2003, 481-488.
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3. Tversky, B., Hard, B. (2009). *Embodied and disembodied cognition: Spatial perspective-taking*. Cognition, 110:1, 124-129.
4. Loading a Maps API site in a Native Android Application: http://code.google.com/apis/maps/articles/android_v3.html