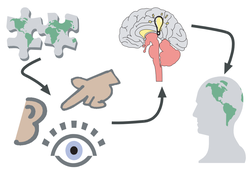


Spatial and Map Cognition
Research Lab
Department of Geography
University of Oregon

Tactile Mapping Software for Blind and Low Vision Science Education

Amy Lobben (PI) and Stephen Fickas (co-PI) (grant #HRD-0533251)

Graduate Research Assistants: Megan Lawrence and Xiangkui Yao

Project Summary

This project will develop a model of environmental and thematic feature perception by blind and visually impaired map users. The project will also provide free, easily accessible, and easy to use tactile mapping software, downloadable from the Department of Geography at University of Oregon website. The software will supply teachers with the tools to create navigation maps for blind and visually impaired orientation and mobility education as well as create tactile socio-economic maps to be used as instructional materials in science and social science education. The Research Goals of the project are to:

1. identify the most important environmental objects that are used during navigation, orientation and mobility by the blind and visually impaired
2. identify how blind and visually impaired map users perceive, categorize and use these environmental objects
3. based on the findings from goals 1 and 2, create and evaluate a library of symbols that effectively represent the environmental objects
4. evaluate the threshold of socio-economic data representation/symbolization on tactile thematic maps
5. create free, easily accessible Tactile Navigation and Socio-economic Mapping software that incorporates research findings from goals 1, 2, 3,and 4

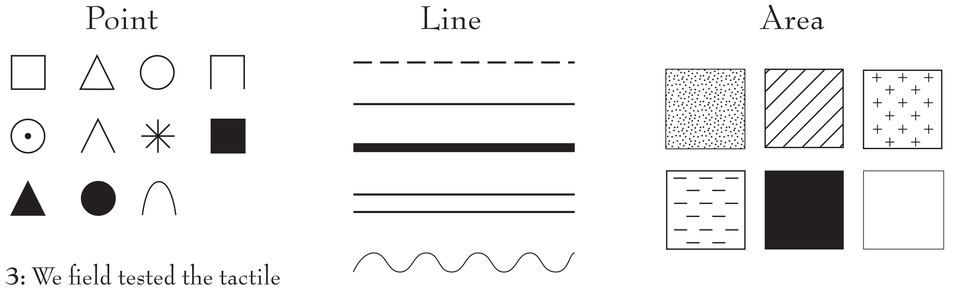
Research Goals 1-4 are investigated through the design of empirical experiments involving human subject volunteers. While some researchers have begun to investigate tactile map design, very little has been reported on tactile navigation map use and environmental perception. Moreover, little to no results has been reported on tactile thematic maps (neither design nor use). The results from the research will build on the limited knowledge base and begin to develop a model of understanding of both the environmental features (important for tactile navigation maps) and thematic value differences (important for tactile socio-economic maps). In addition, the Tactile Navigation and Socio-economic Mapping that will be authored in this proposed project will offer the ability for teachers and parents to create highly customized navigation and orientation maps for specific locations such as school, home, church, neighborhood, or playground. Moreover, the proposed software will allow the mapmakers to insert landmarks that are meaningful to the map reader. But, one of the most substantial advantages of the software is the ability to create hundreds of US socio-economic tactile maps, products that are flatly unavailable in any realistic way (without expensive custom-ordering from a tactile production company).

Standardized Symbol Set Development and Field Testing (project goals 1,2,3)

Step 1: We conducted a nation-wide survey that was administered through listservs and posted onto websites (such as National Federation of the Blind, Associaton for Education and Rehabilitation of the Blind and Visually Impaired, American Foundation for the Blind). Through that survey, we received ~140 responses and identified the most important features for navigation and inclusion on tactile navigation maps.

- Streets = 78
- Buildings = 40
- Stairs = 36
- Entrances = 32
- Water = 31
- Crosswalks = 29
- Sidewalks = 29
- Curb = 28
- Vegetation = 27
- Direction Indicators = 26
- Intersections = 22
- Bus stops = 22
- Elevators = 21
- Street names = 18
- Ramps =18
- Fences = 18
- Railroads = 17
- Parks = 17
- Hills = 17
- Bathrooms = 16
- Grass = 13
- Parking lots = 13
- Art = 12
- Telephones = 12
- Bridges = 10
- Dirt = 10
- Escalators = 10
- Schools = 6
- Terrain Changes = 6
- Public safety = 4
- Lat/Long = 4
- Sounds = 3
- Blocks = 3
- Churches = 2

Step 2: From previous research as well as with the assistance of project consultants, we identified potential tactile symbols that have been shown to be discriminable. We matched the most important enviornmental features from the survey with this set of potential symbols.



Step 3: We field tested the tactile navigation symbols. We recruited blind and low vision subjects and asked them to complete several map reading and navigation tasks. Our objectives were to test the effectiveness of the symbols and how the participants used the symbols and map during map reading and navigation real-world tasks. These tasks included: route planning and navigating in a real-world environment, self-location, identifying distance and direction between map features, survey memory and rotation. Most of these tasks were completed using the map below. The rotation task included instruments such as that shown below right.

Software Developed

After exploring the choices of available open source and commercial software tools for graphic editing, we chose Sketsa (http://www.kiyut.com/products/sketsa/), an SVG editor. Sketsa is developed using Java, based on the BATIK SVG Toolkit (http://xmlgraphics.apache.org/batik/) and Netbeans (http://www.netbeans.org/). The former is a well-accepted java library of SVG. The latter makes the generation of installer, update packages, and extension plug-ins straighforward. Both BATIK and Netbeans are open source.

We tested Sketsa extensively under Netbeans, and fixed bugs in the software.

Project personnel have added the following functionality to Sketsa:

- symbol library plug-in that allows users to select objects they create in the canvas, and save them as library symbols for later use. This is necessary to build up a set of icons that can be used over and over.
- constraint-check tool that verifies that any two objects (icons) on the canvas are more than 0.7cm from each other. This tool uses a Constructive Area Geometry algorithm for computing intersections. This tool was needed to guarantee that icons are placed on a map in a way that they are discernible.
- print and print preview functionalities. Clearly needed to produce the tactile map.
- integrate point-pick tool with symbol library, which allows users to easily customize library symbols by picking and move points on them.
- popup menus when mouse right-click on canvas.

Currently we are working on adding a profile manager that allows different users to have separate accounts and directories so that they can use their personal set of symbol libraries and their own sections of maps.

Figure 1 is the splash screen for our new tool. Figure 2 shows the ability to save a custom icon; once the user chooses a name, it will be added to the list of icons on the top right, available for future use. Figure 3 shows a crucial feature of our tool: the ability to preview what will actually be printed on the tactile map. Figure 4 shows the constraint tool complaining that the user has attempted to place two icons too close together on the map.

Figure 1

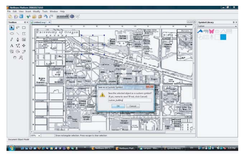


Figure 2

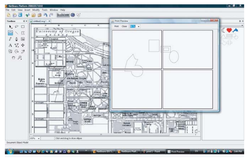


Figure 3

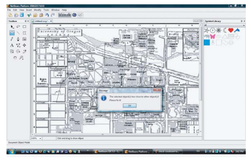


Figure 4

What's Next – thematic map symbol testing and development

We have designed instruments that will be used in an experiment that will identify data classification and tactile symbology thresholds for thematic (socioeconomic maps in this case). Following that experiment, we will design and include hundreds of socioeconomic maps in the devleping software.