

CHICAGO LIGHTHOUSE FOR THE BLIND'S TALKING MAPS

Steven Landau, Touch Graphics, Inc.
Zachary Eveland, Touch Graphics, Inc.
Mohamed Ali, Chicago Lighthouse for the Blind
Heamchand Subrayan, IDEA Center, University at Buffalo

INTRODUCTION

Chicago Lighthouse for the Blind (CLB) is a large two-floor facility near downtown Chicago. It houses a variety of functions, including a clock factory staffed mostly by blind workers, a school for multiply-disabled children, a low vision clinic, radio station, classrooms, dining facilities, offices and other spaces. In 2010, CLB commissioned two talking map kiosks (Figs. 1 & 2), one for each floor, from Touch Graphics, Inc., a New York City-based company that has worked on a variety of public maps that include access features [1]. These units provide multi-sensory information about CLB's layout, function and occupants, so that many constituencies would find them useful in learning their way around more rapidly and pleurably than alternative methods (including a human guide, indoor GPS and trial-and-error). This paper will describe the units' physical design, technical specifications, and interaction scheme. Finally, we will outline our plan for evaluating the system with a group of human subjects in upcoming trials.

BACKGROUND

When arriving at an unfamiliar public building, most people need way-finding and orientation information about the facility delivered in a way that they understand [2]. Depending on the purpose of their visit, people want to know what is around them, and how to find things in the most efficient way. People may want to consult an alphabetical listing of departments or staff members to find a place or person they know by name; others will want to know the location of elevators or restrooms, and others may want to get a sense of the overall size and shape of the facility, or to pre-plan an exit route in the event of an

emergency. Modern building lobbies are equipped with directories that show lists of destinations or floor plans. These can be mounted to walls or displayed on freestanding pedestals or kiosks. In recent years, building directories have included interactive features, such as touch screen maps and scrollable indices.



Figs. 1 & 2: First & Second Floor Talking Maps

Most existing building directories are not usable by people with visual impairment or other condition that makes it hard or impossible to read print text or interpret maps or other graphics[3]. According to NIH, 25.3 million Americans reported that they have trouble seeing, even when wearing glasses or contact lenses[4]; this figure includes the (significantly smaller) number of individuals who reported

that they are legally blind or unable to see at all. Given the relatively low incidence of these conditions, it is hard to justify adding accessibility features just for this group, especially if these end up diminishing usability or convenience for the much larger group of potential users who demand displays that feature only standard print graphics and text. But in facilities where larger percentages of users can be expected to have temporary or permanent disabilities that interfere with their ability to see print or interpret maps, it is easier to justify the expense of installing special purpose systems. Chicago Lighthouse is an ideal laboratory for this investigation because of the large population of people in every category of visual impairment and other disabilities that work or visit there. Other suitable environments for systems like this include veterans' care facilities, rehabilitation centers, schools and university campuses, and geriatric centers. The authors do not suggest that the access features demonstrated here are suitable or necessary for building directories in most public spaces; but if building owners see that access features like those demonstrated here are not difficult or expensive to implement and maintain, we may begin to see more public accommodations that support universal access.

Capacitive touch sensing

The Chicago Lighthouse Talking Maps rely on capacitive sensing to detect touches on the tactile surface of the maps. This is a well understood technology, first employed in 1919 in a musical instrument called *Theremin* [5]. However, the potential of capacitive sensing in human computer interaction is being investigated only now. We have seen a variety of new devices that incorporate various forms of capacitive sensing, including a cell phone that can tell in which hand it is being held [6] and an interactive surface that uses a mesh of wires embedded in a plywood table [7] to detect a range of gestures. All of these devices rely on the same general method of measuring the capacitance between one or more probes and electrical ground [8]. Since capacitance is strongly affected by the proximity of objects to the probe, the presence of a user's hand, finger, or other body part can be readily detected. As the capacitance is additionally

affected by the size and dimensions of an object in close proximity to the probe, small variations caused by changes in pressure applied by a sensed body part can also be detected.

System Description

The Chicago Lighthouse Talking Maps are multi-sensory displays that overlay information in a variety of complimentary formats, including clear visuals and tactile graphics, touch-triggered audio labeling, and speech and text captions (fig. 3). Way-finding information is displayed graphically through the raised line and textured map, but speech-based turn-by-turn directions are also available for those who prefer to conceive of the spaces around them in temporal or sequential terms. Rather than interfere with one another, these multiple information streams and interpretations appear to be mutually reinforcing.

The talking maps are housed in custom stainless steel enclosures (figures 1 and 2). These consist of upper and lower boxes, with vertical posts that brace the enclosures to the floor and that act as cable ducts. The upper enclosures house the computer, video projector, speakers and other things, while the lower enclosures have touch-sensitive maps mounted on their sloping top surface, and the electronics necessary for sensing map touches inside.

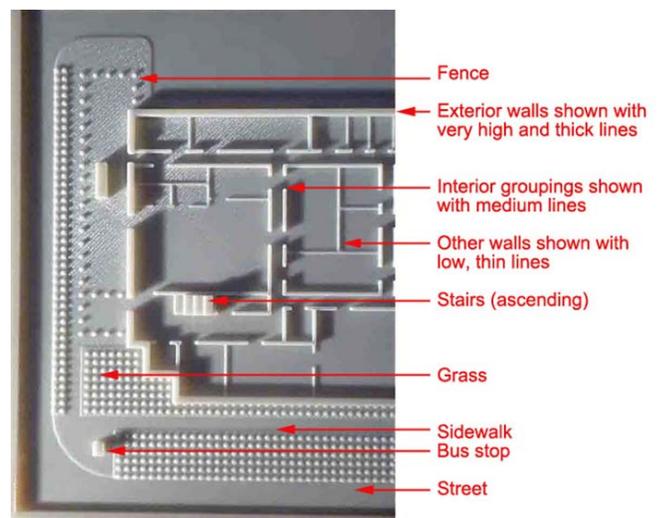


Figure 3: Detail of tactile map.

The Map

Each talking map unit includes a hard plastic tactile map that measures 40 x 20 cm (fig. 4). A 1 cm aluminum cube shows the position of the kiosk on each map, and serves as the *You Are Here* marker, the most prominent, easy-to-scan-for feature on the map. Moving out from this station point, the tactile reader encounters various raised lines and surfaces. A simple vocabulary of textures and symbols depicts interior and exterior walls, partitions and fences, grass and pavement. Three-dimensional symbols represent special features, like ascending and descending stairs, compass rose, and scale bar. The maps are produced in high strength ABS plastic, output from a 3D printer as a grid of eight 6" x 8" tiles (fig. 3) that are assembled to create the complete picture.

The map is painted in two layers: electrically conductive paint¹ is used to delineate each of the sensitized zones, and then a durable, washable light gray top coat is added to provide a matte, monochromatic surface for touching and for receiving visual images projected from above. Thin, shielded cables are connected from below to each of the sensitized zones on the maps (fig. 5). These cables are then grouped into bundles of 10 wires each, and each bundle is connected to a USB *TouchSensor*, a self-powered USB device designed by Touch Graphics under contract as an Industry Partner to the RERC-UD². The device returns a stream of touch data on up to 10 (non-contiguous) conductive surfaces. Multiple *TouchSensors* are connected to a PC, which assigns a virtual serial port to each one. Then, a program written in Adobe *Director* polls data coming from the devices to determine whether any region is being touched by skin. Touches to any number of regions can be

¹Conductive paint used was Silva-Spray brand from Caswell Plating. This is a suspension of silver particulates in an alcohol-based paint base.<http://www.caswellplating.com/kits/silvaspray.html>

²Rehabilitation Engineering Research Center on Universal Design, IDEA Center, University of Buffalo School of Architecture. 2009
<http://www.ap.buffalo.edu/idea/home/>

detected at once, and harder presses on the surface of the model produce consistent, measurably stronger effects. There is no detectable delay between touching a surface and receiving feedback, so the experience of using the maps feels immediate and natural. The surface feels strangely alive, and you begin to forget that there is a computer involved in the interaction as you begin to explore.

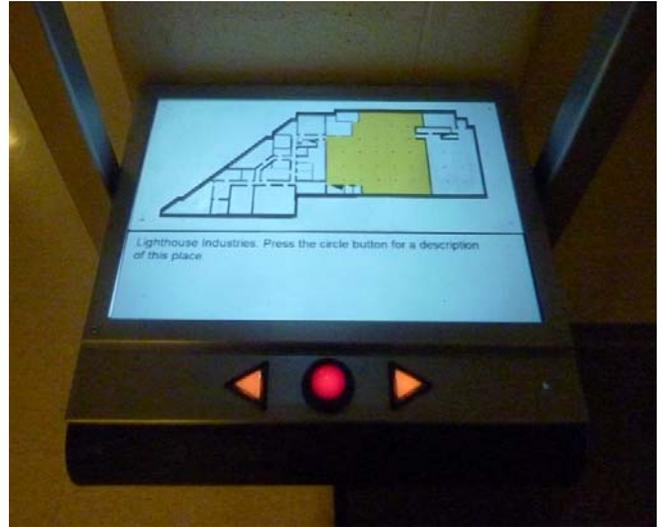


Figure 4: The second floor talking map. The map surface is illuminated from above.

Users interact with the talking maps in two ways: they either touch the map directly to trigger playback of information about any place, or they navigate a menu of options by pressing right and left arrow buttons, and select things by pressing a circle button. The menu choices include: a places index of, staff index, and user settings (touch sensitivity, volume and color scheme). Touching the map provides a more immediate, visceral and satisfying user experience, because of the unmediated, random access of direct touching vs. the linear, restricted structure of button-navigation. While there is some redundancy (and extra expense) in creating and maintaining two parallel information delivery modes (spatial and description-based), our purpose is to build universality by accommodating diversity in learning styles, cognitive ability, and user preferences.

When touching the map, a new user quickly notices that the duration and intensity (pressure) of touches affects playback: if you

touch a region very lightly, there is no response, allowing cursory scans of the surface to check the general shape and size of the map and discover the *You Are Here* marker. If you press a little bit harder, you hear the name of that place. If you maintain pressure after the name completes playing, you hear the description layer, where you are told about specific functions carried out at the place you touched, followed by a third layer that gives detailed walking instructions. For impatient users, it is possible to interrupt playback and move rapidly through the layers by tapping repeatedly on the same spot.

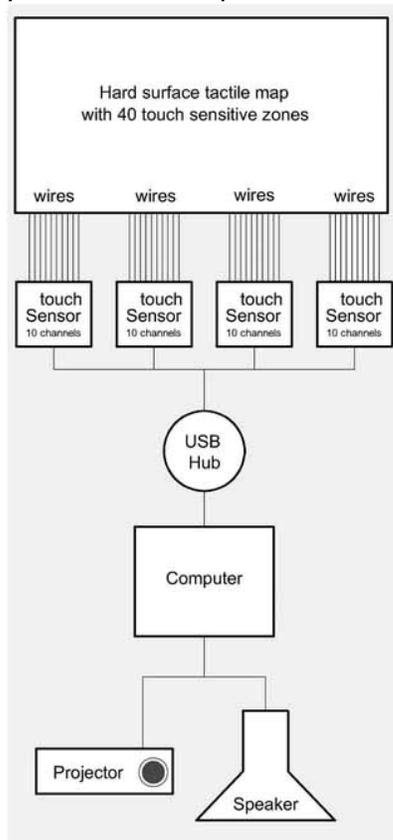


Figure 3: Schematic component diagram.

System Maintenance

Because room assignments change periodically, and staff come and go, we provided a simple means of updating the system so that data supplied is always current. We created two online spreadsheets where data on places and staff members is stored, with editing privileges assigned to a designated staff person at the Chicago Lighthouse. When changes occur, that person is responsible for

updating the spreadsheets that are hosted on Google Docs. Any changes are automatically imported into the program each day as the system reboots itself, and the corrected information is then available to map users. Also, each talking map maintains a log of all interactions, and this log file is sent via email to the company each day. We monitor systems events remotely, and alert IT staff at Chicago Lighthouse if we observe things requiring on-site maintenance. By ensuring that the system provides accurate, reliable information, and quickly repairing malfunctions as they occur, we strive to build confidence among the user community that the talking maps are reliable and the information provided is trustworthy.

Ongoing evaluation

The Chicago Lighthouse talking maps have been operational since February of 2011. The development partners are planning a series of on site user trials in May of 2011, with findings to be shared at the International Best Practices in Universal Design conference in Toronto, Canada, in June. Working in partnership with staff from the Director's office and personnel from other departments at the Chicago Lighthouse, we will recruit up to 50 participants, representing various user constituency groups, including: Lighthouse employees and contractors with and without visual impairment; members of local chapters of national blind consumer organizations such as NFB and ACB; and children and adults who use services provided at CLB, such as the Adult Day Program, Low Vision Clinic, and retail store. Our goals in evaluating the system are:

- To see if using the talking maps help users find people and efficiently and enjoyably, as compared with other way-finding strategies.
- To determine if repeated map explorations promote route-learning and comprehension of the building layout, overall shape and size.
- To see whether sighted users find the talking maps useful, or if they would prefer information to be delivered in more traditional (visual only) formats.

If the outcome of this study shows that multi-sensory public access systems like the talking maps are helpful and fun to use, there may be opportunities for installations in related facilities, including schools for the blind, rehab and veterans facilities, and some important public or ceremonial spaces. The technology appears to be very robust and inexpensive, so if these tests demonstrate that they are effective, we may find that other organizations will commission one or more talking maps building directories.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. Janet Szlyk, President and Executive Director of the Chicago Lighthouse, for bringing this project to CLB and for her participation and encouragement throughout the development process. We also thank Dr. Karen Gourgey of the Computer Center for Visually Impaired People at Baruch College, City University of New York, one of the originators of the concept for a talking kiosk, and a long time supporter of this work. Finally, we acknowledge Dr. Edward Steinfeld, Director of the IDEA Center and the RERC-UD at the University at Buffalo for providing ideas, guidance and resources that have made this and related projects possible.

REFERENCES

- Video of the talking maps at Chicago Lighthouse can be seen at www.touchgraphics.com/research/ChicagoLighthousekiosk.htm
- [1] Landau, S. New York City's growing network of talking kiosks, Access and the City Conference, Dublin, Ireland, 2008.
 - [2] Golledge, R. Way-finding behavior: cognitive mapping and other spatial processes. Johns Hopkins University Press. 1999.
 - [3] Vanderheiden, G.C. (1997). Cross Disability Access to Touch Screen Kiosks and ATMs. In M.J. Smith, G. Salvendy, & R.J. Koubek (Eds.), *Design of Computing Systems: Proceedings of the Seventh International Conference on Human-Computer Interaction* (pp 417-420). New York: Elsevier, 1997.
 - [4] Pleis J.R., Lucas JW. Provisional Report: Summary health statistics for U.S. adults: National Health Interview Survey, 2008. National Center for Health Statistics. Vital Health Stat 10(242). 2009.
 - [5] Glinsky, A. *Theremin: Ether, Music and Espionage (Music in American Life)*. University of Illinois Press, 2000.
 - [6] Wimmer, R. & Boring, S. HandSense: Discriminating different ways of grasping and holding a tangible user interface. Proceedings of the 3rd International Conference on Tangible and Embedded Interaction, Cambridge, UK. 2009.
 - [7] Rekimoto, J. SmartSkin: An infrastructure for freehand manipulation on interactive surfaces. Conference on Human Factors in Computing Systems, Minneapolis, 2002.
 - [8] Wimmer, R., Kranz, M., Boring, S. & Schmidt, A. A capacitive sensing toolkit for pervasive activity detection and recognition. Proceedings of the Fifth Annual IEEE Conference on Pervasive Computing and Communications (PerCom'). 2007.