
Learning the Land: CSCW in the Arctic

Aaron Genest and Sriram Subramanian

Human Computer Interaction Lab
Department of Computer Science
University of Saskatchewan
176 Thorvaldson Building
Saskatoon, SK S7H 5C9 Canada
aaron.genest@usask.ca, sriram@cs.usask.ca

Abstract

Interactions between researchers and northern communities involving geographical information are a crucial part of northern research in Canada. Currently, such interactions are mediated with paper-based maps and transparent overlays, a method that is time consuming and awkward, and that often loses critical interaction data. However, people in northern communities are often unwilling to use computers and projection technologies that would enhance such interactions. We conducted interviews with four researchers with extensive experience in northern research to determine the requirements for a new tool that would assist with geographical representation tasks yet remain palatable to community members. The result is a tabletop interface design modified for increased tracking of user interaction, durability, portability, and small interaction areas, that retains the look and feel of paper-based interactions. The tabletop will display GIS software with simple navigation and map modification controls.

Keywords

Tabletop Interaction, CSCW, Map Interaction, Northern Research, Arctic, Traditional Ecological Knowledge, GIS

ACM Classification Keywords

H.5.3 [Group and Organization Interfaces]:

Computer-supported cooperative work.

Introduction

Much research in the northern territories of Canada involves eliciting Traditional Ecological Knowledge (TEK) from community elders. Geographical information is a key component of TEK and almost every TEK session uses paper-based maps for illustration and transparent overlays for recording map interactions. However, paper-based maps pose several challenges for researchers, such as difficulties with anticipating and printing the necessary paper maps, observing and recording community member's interactions with maps, and effectively archiving new geographical information after the session is complete. Unfortunately, community elders are mostly non-interactive with technology (e.g. watching television or attending PowerPoint presentations), thus new technologies that require explicit interaction will not be readily patronized by the community. Furthermore, due to factors including age and culture, elders are unlikely to use new technologies of any kind. Thus, any improvement on the paper-based interaction paradigm must satisfy researcher's needs for a simple map navigation interface as well as greater ease and accuracy in recording interactions while maintaining as low a technological profile as possible.

We interviewed four researchers in biology and veterinary medicine whose primary research takes place in the north with community members to determine the most effective mechanisms for presenting and eliciting geographical information during northern research without altering the existing interaction paradigm. All researchers agreed that little should be changed about the feel of the current interactions. Thus, it was important to create a tool

that felt similar to the original paper-based map interactions yet provided additional functionality.

We created a design for a tabletop system to support these requirements (see figures 2 and 3). Comprised of modified Geographical Information Systems (GIS) browsing tools, a tabletop application provide the additional flexibility desired by the researchers while retaining a similar interactive feel to the paper-based technology. Additional discrete components to monitor user interaction (such as cameras) further enhance the capabilities of the tool without interfering with the traditional interaction metaphor. The interviews also suggested restrictions not normally incorporated in tabletop displays, such as extra durability and portability, reduced control spaces so community members will not accidentally invoke map navigation commands, and user differentiation without onerous devices. All of the changes were required to reduce the level of explicit technological interaction necessary to run the system, emulate as closely as possible the already existing technology, and survive the harsh conditions for transport and storage present in the arctic and sub-arctic.

Previous Work

Although TEK is recognized as an important source of data for research[1], there has been little examination of the technological process of extracting the geographical components of TEK. Most technological geographical literature focuses on map use for tourists (such as [2]), planning tasks with explicit collaborative interactions (as in [3]), or geological exploration (as with [4]). Furthermore, since 3D representations are thought to be more effective for communicating with users inexperienced in a domain[5], almost all current



Figure 1: Typical TEK session. Researchers and community members around a paper map overlay with transparencies.

geographical representations are moving to three dimensions[6].

We identify two conceptual prototypes that will allow improved TEK elicitation: one with 6 degrees of freedom and three-dimensional representations (6D/3D) and the other with 3 degrees of freedom and two-dimensional representations (3D/2D). The 6D/3D design was loosely based on the Chameleon[7] and would have used gestural and location awareness advances pioneered with Soapbox[8] and by Microsoft[9] to permit 6D navigation with a tablet PC. Ideally, a direct mapping between user movements and map navigation could have allowed simple, but individual exploration of a hybrid 3D/2D geography extrapolated from GIS data as suggested by Brooks and Whalley[6].

The 3D/2D design was loosely based on work done in tabletop and tangible computing by the Center for LifeLong Learning & Design[3, 10]. User interactions would be recorded by modeling video shadows of arms and fingers to permit later reconstructions of interactions[11]. Explicit interactions (map manipulation) would be identified by observing contact with the map as opposed to gestural interaction above the map.

Interviews and Design

As a first step in identifying viable strategies for effective adoption of technology we interviewed four researchers who work regularly in the Arctic and sub-arctic regions. All researchers had at least five years of experience performing field research in the sub-arctic and arctic. Each researcher had different areas of expertise (biologists, wildlife veterinary parasitologists,

pathologists and microbiologists) allowing us to examine different forms of community-researcher interaction. Three researchers had over 20 years of experience and many had administrative experience with portfolios various government agencies in Canada and the United States. All researchers agreed to be contacted again for ongoing requirements elicitation and prototype validation. Several volunteered to field test any resulting system. The researchers interviewed were enthusiastic and interested in new tools for presenting geographic information.

Interviews were semi-structured and took place in public or semi-public casual settings. Audio recordings were made of each interview. Every researcher was asked to characterize their interactions with northern communities integral to their research area. Additionally, they described a typical TEK session, discussed community dynamics, described challenges related to TEK sessions and geographical components of TEK sessions, and explained the physical and social challenges of performing research in the north. Interviews averaged 40 minutes in length. Prior to commencing interviews, we established some possibilities for enhancing the existing interactions based on the literature in tangible, mobile, and tabletop computing.

At the end of each interview, we presented the two potential design solutions described earlier. Researchers were then asked to comment on their appropriateness as a solution.

Answers to the interview questions fell into one of three categories: descriptions relating to the original paper-based technology and the processes behind the TEK

elicitation using the original technology, engineering constraints on any new technology based on the environment and TEK elicitation process, and constraints on new technologies anticipated as a result of attributes of the intended end-user group.

Original Technology

Geographical information is currently presented to community members with paper-based maps generated from composites of aerial photographs, topographical maps, and GIS-stored information. GIS information often contains previously extracted TEK information or empirical research data (such as the results of a radio collar experiment). Most often, maps are printed from GIS, used during a TEK session, then returned to digital format and manually tagged with information extracted from marks made on transparent overlays during the session. Sessions are audio and/or video taped and one or two researchers act as stenographers to record the information necessary for the later semantic tagging of newly created geographical information (usually timestamps and community member names whenever a mark is observed).

However, there are several problems with the current, paper-based technology. Interactions between researchers and community members or between different community members as geography are captured only through audio records and rarely, if ever, encoded into the semantic tags on the completed map. All researchers, however, felt that a record of map interactions would be valuable if there were some simple mechanism for capturing interactions.

Another significant drawback to the use of the paper-based technology is the inability to easily change the

scale or region of the map. If extra maps have been printed, the process of switching maps on the table takes some time and breaks the flow of the interview. Furthermore, anticipating the maps and overlays needed for a particular session is difficult and researchers often perform sessions with less than adequate maps. The entire process of developing and printing maps for TEK sessions is laborious and time-consuming.

Engineering Constraints

The harsh climate of the arctic and sub-arctic combined with restricted transportation options enforce strict constraints on the size, weight, and durability of any new tool. Currently, we have not completely addressed the environmental issues, but they have influenced the rejection of display and interaction options.

User Constraints

Neither the researchers nor the community members are formally educated in the use of computers and researchers report that community elders are not eager to interact with obvious computers. For a variety of reasons, from age to cultural, new technologies are often not used by community elders. For this reason, researchers suggested that the tool must hide as much as of its capabilities as possible from the community members. To this end, recorded user interactions (users pointing or gesturing to locations on the map during a TEK session) will need to be hidden.

All researchers commented that the informal feel of the sessions should be preserved. One researcher commented that sessions were very similar to "sitting around telling stories and pointing at a map."

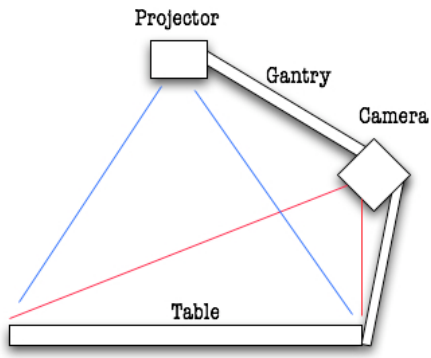


Figure 2: Side view of the projection and user tracking system clamped to the table.

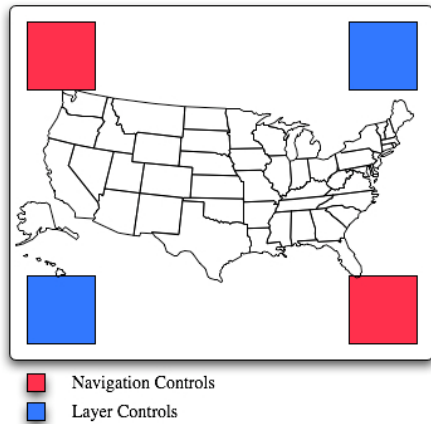


Figure 3: Overhead view of the interface design.

Design Details

DISPLAY

Our design uses a GIS application adapted for tabletop projection to enhance the capabilities of the original technology. This design retains many of the original interaction components of the paper-based system while permitting the increased flexibility desired by researchers. Current GIS applications permit multi-layer visualizations of geographic data at arbitrary levels of detail, a significant requested feature.

CONTROL AND NAVIGATION

The researcher's requirements for navigable maps with dynamically definable detail layers can be met by adapting the navigation and layer selection controls of a commercial GIS application so they are suitable for a collaborative tabletop environment. Navigation and layer selection, more frequently operated by researchers who can be trained to use the system, can be controlled with a gesture-based system using recent advances in visual tracking of bare fingers with video cameras[12].

MARKING ANNOTATION AND HIDING TECHNOLOGY

Tabletop interaction environments can encourage an informal atmosphere, since participants are able to approach the map from any angle, choose to sit or stand during their interactions, and there is no clear position of control.

To reduce the sense of interaction with technology, the majority of the map surface will be unavailable for computational interaction. Navigation controls will be situated explicitly at the edges of the map. The same explicit separation will apply to layer controls. To enhance the informal nature of the interactions, layer

and navigation control boxes will be oriented outwards from the table so that the map may be controlled from any angle by anyone at the table with hand gestures within the control box.

Gestures made to the map during TEK by community members will be recorded by cameras situated over the map but the resulting annotations will not be displayed during the session, but instead available to researchers after the session or on remote connections.

Conclusions and Future Work

There is a need for technological assistance in eliciting geographical information from community members in northern communities, yet technologies that require active participation by community members are unlikely to be readily patronized. To discover the design requirements of such an assistive tool, we interviewed four northern researchers. They recommended developing a tool that permits the same kinds of interactions available on a paper map placed on a table. Further, they recommended that more advanced features (such as 3D visualizations, 6 degrees of freedom, or high levels of explicit interaction) are undesirable for the community members most often targeted for TEK elicitation. Finally, researchers suggested that there are unique environmental challenges for transporting and using technology in the north.

Based on the requirements specified, we designed a tabletop display with the flexibility of commercial GIS display applications capable of recording user interactions with maps. The commercial GIS application will have small, computationally interactive areas for navigation or map modification. To capture the

interactions between community members and the map, the design uses cameras to capture video shadows of arms and hands. Early feedback from researchers suggests that our current design is effective in meeting their requirements.

There remains considerable work in defining and capturing the map interactions between both community members and researchers. Most especially, our primary research to date has involved only the researchers and ignored the community members. Community members will likely have similarly insightful and important insights into the TEK process. A significant portion of our future research will involve both community interviews and direct observation of the TEK process.

It remains to be seen if we can successfully capture the informal gestures used during storytelling with a map with enough precision to be useful to researchers. Currently, we are attempting to classify the gestures used during storytelling interactions with a map.

Citations

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