

eGrid: Supporting the Control Room Operation of a Utility Company With Multi-Touch Tables

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ABSTRACT

This work presents eGrid, a software environment designed for utility companies to enable the collaboration of control center team members in their daily tasks of analyzing and managing the electrical grid of a city. Despite the recent advances in geospatial data analysis applications, the need still arises for the design of innovative applications which facilitate the collaboration of control center team members in discussing problems and finding solutions, eliminating the headache of synchronizing paper maps frequently to reflect the changes made daily in electricity circuits. eGrid utilizes multi-touch digital table-top hardware to allow multiple users to interact concurrently with domain specific geographic information system (GIS) using finger touches and natural hand gestures. It is an advanced prototype of an actual application of tabletop technology in a non-trivial domain. The development of eGrid shows strong buy-in from the intended end-user community.

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General terms: Design, Human Factors

Keywords: GIS Map, Geospatial data, Digital Multi-touch Surface, Multi-user, User Interactions design, Gestures

INTRODUCTION

For so many years, industries that are heavily reliant on geospatial data have been working with paper maps unfolded on tables. Some of these companies are still using paper maps to analyze huge amounts of data despite the current availability of GIS for storing and managing geospatial data. Data management tasks using these traditional methods are asynchronous and very tedious. Delays in updating these maps can pose a safety risk for field workers who may be guided based on outdated information.

A GIS is used for capturing, storing, managing, analyzing, and displaying geographically referenced information. Some electrical utilities have their own GIS data which includes details of their circuits, power-lines, etc. GIS ap-

plications are typically used to create interactive queries, analyze spatial information, edit data, and present the results of these operations. However, some control center teams in electricity companies still prefer to use printed paper maps on tables to discuss and analyze snapshots of the data. Most GIS applications are focused on supporting a single user and since these teams typically work collaboratively, they tend to prefer using printed maps instead. Printed paper maps are convenient when multiple team members are working together to achieve a certain goal since they are large enough for everyone to comfortably see the details, subgroups can work on different maps concurrently and everyone has concurrent access to editing these maps using regular markers.

Multi-touch digital tabletops are suitable for displaying and managing large GIS maps for collaborative purposes. These tables have a number of potential benefits, such as encouraging co-located groups to collaborate and providing a large surface area which is convenient for displaying and interacting with data. This work presents eGrid, an innovative and convenient digital tabletop environment, designed specifically to address the needs of co-located control center teams in electricity companies. eGrid allows users to browse through, analyze and annotate GIS maps, facilitating collaboration with no need to use printed paper maps.

RELATED WORK

DTLens, designed for the Diamond Touch table [1], allows browsing geospatial data on a horizontal digital surface. Other research efforts analyzed interaction styles trying to find the most intuitive gestures which can be used on tabletops. A study by Wobbrock et al allows users to define their own gestures for a number of tasks. [4] The design of eGrid uses some of these gestures to manipulate geospatial data with multi-touch hand gestures.

Research in GIS interfaces has traditionally been focused on desktop and internet based GIS systems. However, some research efforts were invested in designing new innovative interfaces such as using multi-touch hand gestures along with feet movements to navigate geospatial data on a vertical screen [3] and designing multi-modal interfaces to GIS data using hand gestures along with voice to navigate the maps for emergency applications. [2]

DESIGNING EGRID

eGrid is designed and developed using an agile development process, which started by sketching and creating in-

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teractive demos. They were useful in brainstorming interface ideas but of little use in getting feedback from users for gesture-oriented applications. Interactive prototypes were developed next; allowing eGrid to gain increased customer interest. Iterating to enhance the design of the system was guided by demonstrations to industrial sponsors. The design has been changing continuously to include new features in response to the feedback received during demos.

The early prototypes of eGrid were developed for the Microsoft Surface[®] table, which supports a large number of concurrent touches. However, eGrid needs to be deployed on a larger table to comfortably support the collaboration of multiple users. Therefore, the latest version of eGrid was designed to be flexible and can be deployed on any digital table supporting Windows 7.

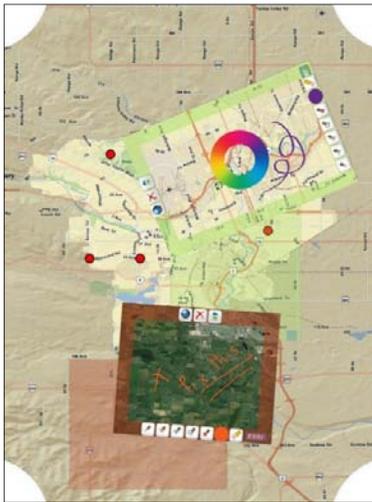


Figure 1: A snapshot of eGrid

The user interface of eGrid has the following components:

Background Map. A GIS map of the city of Calgary is the background of eGrid to help users keep track of trouble ticket locations and provide an overview on the state of the electrical grid.

Corner Menus. To access common application tasks, quarter pie corner menus were chosen. They consume a small area at each corner of the screen and are easily accessible by any user. Touching any corner menu expands it to a slightly larger menu showing a group of icons for functionalities, such as browsing the trouble ticket list, editing preferences or exiting the application.

Trouble Ticket Pins. Trouble tickets define service outage locations and the details of the outage report. They are represented as pins placed on the background map, are georeferenced and can have different colors representing levels of severities and priorities. Touching any of them displays a small window showing a summary of the trouble ticket report.

Map Windows. Giving users the flexibility to work on multiple different maps at the same time or work on one big

map tries to mimic the environment of the control center in which users have the flexibility to work on multiple printed maps. In addition, collaborating teams often toggle between a number of different modes of collaboration and this design avoids imposing any specific mode. To achieve this flexibility, individual map windows were designed. Each of them has a semi-transparent frame and a map area in the center. To help the users keep track of the location of the data with respect to the background map, shadows for all opened map windows are displayed on the background map. The shadow for a map window is a semi-transparent rectangle which covers the area of the background map that appears inside of its corresponding map window and the color of the shadow is the same as the color of the frame of the map window.

Changing the location of the map window on the table, its size and orientation is done using touch interactions and simple hand gestures. To increase the flexibility of concurrent users working on different maps, eGrid allows every map window to have its own state and tools. The tools allow users to change the transparency and visibility of map layers and to add annotations to the map.

CONCLUSION

The advances in multi-touch digital tabletop technologies open the door for its adoption in a wide variety of collaborative industrial settings. Our research focuses on studying the usability and software design guidelines for eGrid; a multi-touch tabletop application for accessing and manipulating GIS data. eGrid is designed to support the operation of collaborative teams in the control center of a local electricity company, helping them browse through maps, find problem areas, discuss trouble tickets and find solutions.

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