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A mindset for user-centered spatial applications

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Places are spatial locations that have been given meaning by human experience. The sense of a place is its support for experiences and the emotional responses associated with them. This sense provides direction and focus for our daily lives.
Physical maps and their electronic decedents deconstruct places into discrete data and require user interpretation to reconstruct the original sense of place. User centered mapping is an approach that preserves sense of place rather then requires the user to recreate it from disparate data. Instead of attempting to collect this discrete data, the focus becomes on observing mechanisms that already encode sense of place directly. This approach allows the construction of representations showing places that are similar semantically and those that conform to specific user objectives without requiring cognitive interpretation from a user.
To accomplish this, user centered mapping focuses on attempts to understand place in the way a humanmight by analyzing existing accounts of place, such as business listings or blog entries as well as ongoing affordance to support certain kinds of events or visitors. It produces a semantic description of a place in terms of human action and emotion, and with regard to an understanding of the cognitive needs of the user in question.

Background

Places are spatial locations that have been given meaning by human experience. The sense of a place is captured in its support for experiences and the emotional responses associated with them. This is a model of place grounded in practical use. Describing a place is an experiential claim (Tuan 1977). This sense provides direction and focus for our daily lives, telling us where to go and what we might find there when we arrive.
Representing this has been a difficult proposition. Sense of place is inherently subjective. A person who enjoys loud music might think of a concert as a fun and exciting place, but that is not the same perspective every person would share. This concern has removed human accounts of place from visualizations of spatial information.
While a sense of place may be somewhat subjective, factual elements of a spatial location are not. Geographic information systems approaches, which include newer web maps, look at a place and reduce it to base spatial data. At its most detailed, this information is a deconstruction of the original place, neither as complete nor as flexible as the representation a human uses but free from subjective impressions (MacEachren 2004).
The difficulty is that this information must be rerepresented to the user. Looking at a map, a user sees only a collection of data plotted on a coordinate space. Some basic relationships may be developed visually, such as land usage and elevation forming the base of a perspective contour map, but interpretation and synthesis is left to the user. This produces layers of discrete information that can often be reduced to the observation of digital pins on a static image. Professionals, looking to discover meaning and draw conclusions on their own are capable of doing this, but a typical end user has some work to do (Traynor and Williams 1995).
A map is a useful construct for us, because it represents a fixed view of spatial information that everyone can share. Individual mental maps of space tend to not look like this; rather they are focused on relationships between

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discrete spatial objects (Hayward et al. 1995). As applications focused on understand and using spatial knowledge grow in size and depth new methods of organization and visualization must be considered.

Main contribution

User centered mapping is a theoretical approach to constructing spatial applications that attempts to reconcile the mechanics of cognitive spatial encoding with spatial information search.

The overriding philosophy in this approach is to preserve the initial sense of place rather then rely on user interpretation to recreate it. This not only allows a more complete semantic description, it allows the system to answer meaningful questions. You cannot ask a traditional map, 'what is a fun place to be right now?' These are exactly the kinds of questions you would ask a human friend familiar with an area. This approach presents a system that preserves sense of place, rather than require the user to recreate it from disparate data in order to compliment common tasks.

To accomplish this, we can attempt to understand place in the context a human might by using computer reasoning to analyze existing accounts of space. The intuition is that humans making use of a place already have some insight into what this sense is. As a place is written about the semantically relevant information is encoded with regard to the writer and the audience. Similarly, by watching the kinds of events held at a place and the people who attend it the system can observe what kind of affordances a particular place offers a particular type of activity or person who engages in that activity (Jankowski et al. 2001).

This information is modeled in a loose graph of semantic objects where each object represents a place that has been analyzed for meaning. This information can then be represented based on the needs of a particular user. This promotes a distinct social message: The user is the focus of the map, and the map is aware of the user.

A spatial object is anything that could house spatial information or other objects. This allows us to consider different levels of granularity in our model. Each node in the graph represents a spatial object and all of the spatial information contained therein. Edges represent some degree of connectivity and the method of connection. Each edge also has the capability to be weighted based on user task or interest. A building with great importance to a user's task would have the edge connecting it to the user's current location weighted heavily.

We are modeling spatial objects as both containers and service providers (Peng 2004). A building may contain a variety of events, people, or other pieces of spatial information. At the same time, it may offer certain services that may be of use in certain kinds of tasks. This can be observed by considering the aggregate of the temporal elements (events and people) over time as a direct model of the affordances this object offers. Observing as many pieces of direct textual description as well as observing the pattern of these indirect temporal markers constructs a general and more objective sense of place. If a more subjective sense of place based on a specific query or user profile is required, this model can adapt to specific circumstances.

Here a user can observe the proximity of place not only in distance but also by context or association. This is possible because underlying the geographic representation is a graph of semantic and contextual associations. This allows flexible movement between different perspectives by changing the edge weights of semantic objects (Janecek and Pu 2002). It is not unreasonable given this model to switch between viewpoints centered around general interest, relevance to a particular task (or paths through multiple tasks) or even traditional spatial viewpoints.

Implications

The primary implications of this approach relate to the changes in information search and an increase in relevance and ease of information acquisition. There are also clear implications towards the specific kinds of representations that can be constructed.

Information search is significantly altered within this

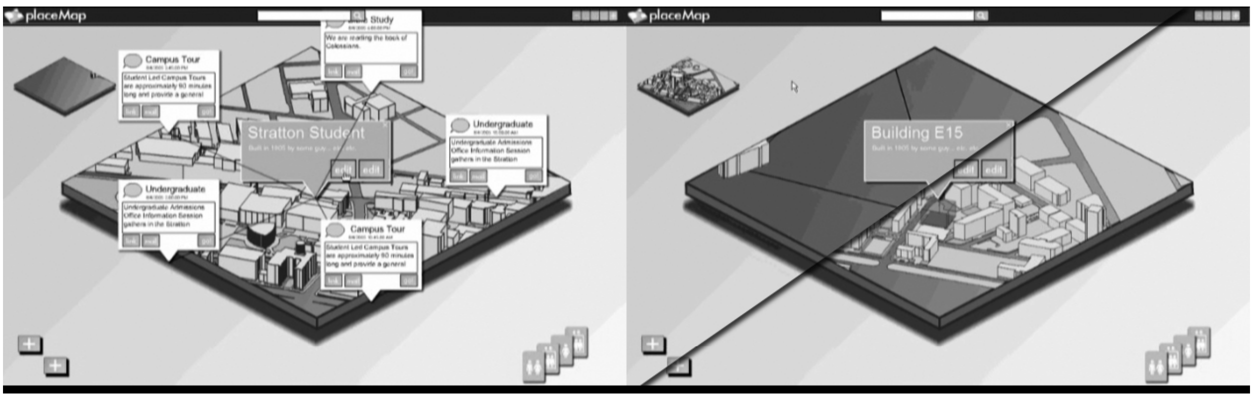

Fig. 1 Holistic event aggregation and multiple views as shown in the PlaceMap application developed within this model

model. This is mostly the result of decreasing the cognitive load and narrowing the search space. Rather than determine a place's affordance for a particular kind of task or activity, a user is able to directly evaluate existing perceptions of that affordance. Information acquisition is often richer, more continuous, and conducted by a larger number of agents than traditional GIS models (Aggarwal and Yu 2000) (Fig. 1).

Interesting new visualizations also become reasonable, such as the use of distortion of physical space and size. It may seem as though distortion is destructive in the presentation of spatial information. In fact, this can be an effective technique for organizing and highlighting information and the graph structure of the model supports this.

A subway map is a perfect example of a map targeting existing perspectives of affordance (Vertesi 2005). The user can travel only between discrete points. There is no need here to consider the geographic position of the destinations—the only concern is the relationships between the spatial information (Rivest et al. 2001).

Rather than faithfully reproduce a map, one could use a distortion-oriented system to emphasize the connection between parts of the map. It is reasonable to make use of a degree of interest function to determine the amount of distortion or other visualization adjustments. This concept relies on some sort of base measure of interest for a node, based on contributions depending on distance from the focus (Churcher 1995).

When presenting a user-centered map we use these techniques to draw attention to spatial objects that are more likely to be interesting or appropriate to the user's task. Interesting buildings will be larger or closer and uninteresting buildings will be smaller or farther. These are approaches that are difficult, if not impossible, to consider in traditional approaches.

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