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Fostering Social Interaction in Online Spaces

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Abstract: People can derive a great deal of value from social interactions. This paper discusses how one might "seed" online environments to be rich in social interaction. The argument presented is based on an analysis of research on the support of collaboration among distributed work teams. This revealed four elements that may contribute towards for fostering interaction among team members: place-making, common ground among participants, awareness of others, and mechanisms for effecting social interaction. The paper presents techniques that may be used to give expression to these factors in online environments: spatial models of interaction, context, social visualization, and mechanisms/enablers for social interactions. These techniques are embodied in a design for an online environment called ePlace. Lessons acquired from an implementation of ePlace for an online retail site are discussed. The paper concludes with a discussion of future work.

Keywords: Awareness, common ground, context, place, social information, social visualization, space, Web.

1 Introduction

Social interaction can provide a great deal of value to its participants. This holds whether the interactions are casual (i.e., of a single or small number of occurrences) or committed (i.e., of a repeated nature). For example, Mary might ask Jane, a neighbor in a dressing room, which of two dresses she thinks Mary should buy. In response, Jane may make reference to the color of the dresses, noting that one of the dresses works better with Mary's skin tone. This is a casual interaction, in which the two participants have met for the first time and might never meet again. The value that Mary derives from this interaction is Jane's calling attention to a criterion which Mary might want to consider in making her decision.

Mary is likely to derive additional value if Jane is someone who has come to know her through repeated interactions, perhaps spanning an extended period of time. Such a longer-term acquaintance or friend might point out that given Mary's lifestyle, she is not likely to have many occasions to wear the sequined evening gown, even though the color is certainly flattering to her skin tone.

The elaboration provided by Jane in these two situations is one of many ways in which value can be provided through social interaction. Others include sharing experience, endorsing behavior, surfacing tacit knowledge, sharing information, recommending options, and providing companionship or support.

The value that may be derived from social interaction should hold in the online world as in the physical world. However, given the paucity of social information in online environments, including the inability to see who is around, little of the value is currently enjoyed by participants in online spaces.

This paper examines four elements that may foster social interaction in online environments. They are derived from CSCW research that has demonstrated their importance for fostering social interaction in the physical world. These are a sense of place, common ground, awareness, and interaction mechanisms. We then identify computational techniques that can be used to give expression to these four elements in online spaces. They are: spatial metaphors and properties, sharable/spatial/semantic context, social visualization, and interaction enablers. We present an embodiment of these four techniques in a design for an online environment called ePlace. We continue with a discussion of lessons learned from an implementation of ePlace for an online retail site, and close with discussion of future work.

2 Four Social Interaction Elements

CSCW research has established the importance of social interaction for both the social and production

aspects of work (Kraut et al, 1990). In efforts to create computational systems to support distributed work groups, designers have developed tools to support the production and the sharing of work artifacts as well as tools to support serendipitous meetings. Collectively, they are part of a suite of tools in a media space linking distributed team members. Studies of media space use have revealed four important elements for supporting work groups: place, common ground, awareness, and interaction mechanisms. We examine how each supports distributed work groups and discuss their role in supporting online groups.

2.1 Place-Making

Studies of media spaces and MUDs reveal the importance of designing interactional settings flexibly. This enables participants to adapt and appropriate the technology for uses that emerge from the use situation and to evolve social practices or norms through long-term use of the technology (i.e., place-making according to Harrison and Dourish (1996)). For example, in the PARC media space, cameras and microphones could be freely repositioned and refocused to transform a space to support a different conversational setting than was intended by the designers (Harrison et al, 1993).

The importance of the notion of place is its role in encoding the cultural and social understanding of the behavior and actions appropriate to an environment. It is the sense of place that provides a shared understanding of appropriate use and behavior as well as a social interpretation of the cues in the environment. For example, being in a church tells us that raucous behavior is inappropriate.

In online worlds, where newcomers and regulars frequent, a sense of place could be a powerful agent for enabling new participants to appreciate an online environment. As Harrison and Dourish (1996) point out, places evolve through the participation of people; they cannot be *designed in*. However, they can be *designed for* by creating seed environments that make it easier for their inhabitants to appropriate and evolve them into meaningful environments (i.e., places); well architected physical environments like plazas are proofs of this (Whyte, 1988). Such environments beckon people, have a greater likelihood of unplanned, informal encounters or the staging of them, and are sociable environments.

2.2 Common Ground

Common ground refers to the shared understanding that collaborators possess which enables interactions to proceed smoothly. In conversations, it enables conversation partners to be assured that their message has been understood as intended. In group work, it is important for building and sustaining group identity, for establishing cooperation, and for promoting successful interactions that support group work among team members. The process of establishing a common ground draws upon a set of shared beliefs, experiences and knowledge.

It is easy to overlook the critical importance that common ground plays in supporting interaction if one bases one's analysis exclusively on what is germane to work-group settings. There, much can be taken for granted because team members have a great deal in common. They share, to some degree, not only organizational structure and goals, but team and project goals as well. This allows interactions to typically function as intended.

Clark and Brennan (1991) point out that the communication medium (e.g., e-mail, telephone) impacts effort required in grounding conversation successfully. However, differences between work groups and online groups are not due primarily to the medium, but the familiarity that people have with each other. Interactions among online participants exist along a continuum of familiarity, from one-of interactions through to deeply committed ones.

In online worlds like those supporting communities of practice, a significant amount of common ground exists because of common professional backgrounds and interests (Wenger, 1999). However, where there is diversity and heterogeneity among people present in an online space, many of the things taken for granted about common ground in organizational work groups do not hold true. What needs to be established under such circumstances? Consider again the shopper talking to her neighbor in the dressing room: what would have motivated her to ask a stranger for advice on her purchase? If she is a middle-aged woman, would she be more likely to strike up the conversation with a teenager or someone she judges to be in her own age bracket? Probably the latter. People infer common ground on a variety of social cues, from appearance, to behavior, to activity. Any of these cues may function to suggest shared experience or background among individuals and may therefore support a foray into interaction.

2.3 Awareness

Awareness refers to the knowledge of the presence of other people, including their interactions and other activities (Dourish and Bellotti, 1992). People awareness tools, like Portholes (Dourish and Bly, 1992), and workspace awareness tools, like Piazza (Isaacs et al, 1996), enable group members to be aware of, for example, when people are around or if documents have been modified. This knowledge provides people with a context for their own actions which they may use to guide their actions in situations related to group work (Gutwin and Greenberg, 1998). It plays a role in supporting both formal and informal interactions underlying the social and production aspects of group work (Kraut et al, 1990).

This concept plays many of the same roles in the online world that it does in the world of distributed work groups. For example, people need to know that others are around if they are to attempt to interact with them. For another, it would also be useful to know if they are willing to be interrupted. However, the online world poses additional demands on awareness that are beyond those considered for work groups. Most significantly, many people present in an online space are strangers to each other. Which of these unknown people should one be made aware of and how this should be done are open questions.

Tools like Odigo (www.odigo.com) and Gooey (www.gooey.com) attempt to address these problems. They use presence at a Web site as a pretext to connect visitors present at the same site. Odigo users can also fill out personal profiles which may provide cues to others with similar interests or goals. However, in a popular online space, presenting all the people at the site can be overwhelming and not useful. Furthermore, one may be more interested in individuals not because of their interest profiles, but perhaps because of a common context inferred from similar activities. However, Odigo and Gooey do not resolve a person's location to an individual page which could give a better indication of their focus or activity.

2.4 Interaction Enablers & Mechanisms

As discussed earlier, awareness of others is a precondition for interaction. However, CSCW research has documented that simply being aware (e.g., a colleague is present) is not sufficient; one needs interaction enablers to capitalize and act on this awareness (e.g., talk to colleague) (Dourish and Bly, 1992; Isaacs et al 1996).

Studies of work groups have noted the importance of the social aspects of work for maintaining the integrity of a group, including recruiting and socializing new members, keeping members committed to common goals, and keeping members satisfied with group membership. Much of the social interaction occurs through informal encounters, rather than planned, formal encounters such as meetings. Consequently, interaction mechanisms that support spontaneous interactions are important elements in a shared environment (Dourish and Bly, 1992; Harrison et al. 1993; Isaacs et al 1996). Because distributed teams often span multiple time zones as well as multiple locations, interaction tools also include asynchronous ones, like email and annotation capabilities.

3 Sowing Online Places

How do we proceed to take these four elements to create an online social interaction environment? We propose the following "seeds for sowing[1]" an online environment rich in social interactions.

1. Exploit spatial metaphors to frame and interpret social information and exploit spatial properties to guide social interactions in the online space.
2. Expose the spatial, semantic, and sharable elements of a context to foster common ground.
3. Render social information visually to enable participants to become aware of the social activity occurring in the online space.
4. Include enablers and mechanisms for people to chose when and how to interact with others.

3.1 Space to Facilitate Place-Making

As was discussed earlier, a place is important for framing and interpreting social interactions (Harrison and Dourish, 1996). While designers cannot design a place into an environment, they can design for it. Encouraged by the field of architecture where it has been demonstrated that the design of physical spaces has significant effects on the amount of social interactions produced in them, we propose to seed an online environment using space as a model for social interaction (Whyte, 1988). The caveat to doing this is that a space is not a place. A place emerges from a space through the actions and interactions of the people who use the space. Also, we propose to provide enablers and mechanisms for social interactions in the online environment.

What then are the characteristics of space that designers can use in the design of an online space that can create opportunities for social interaction? Harrison and Dourish (1996) point to several properties (e.g., proximity, orientation, and partition) in a physical space that can be exploited in a spatial model for collaboration. For example, our proximity to people, objects and activities influence our activities including talking to people around us. Similarly, our understanding of proximity helps us relate people to activities and to people. For example, we hypothesize that people standing apart from each other are not engaged in a conversation. For another, a room can be used to partition activities and interactions (e.g., an office is for work, a bedroom is private, and a meeting room is for a formal work discussion).

3.2 Common Ground thru Context

Context is an important vehicle for determining one's location in an environment and understanding one's own activities. It is also important for guiding one's course of action and interactions with other people. We propose and discuss, in turn, three resources to be included in presenting a context in an online environment: spatial properties, semantic information, and sharable representations.

In the previous section, we proposed the use of space as a model for interpreting and guiding social

1. We use the metaphor of *sowing* to indicate that such an environment depends on subsequent actions by people.

interaction. Space can also function as a metaphor for organizing, presenting, and interpreting information. We propose to use space to locate where people are and where activities and interactions occur in an online environment (i.e., to represent social information). It is an important resource for common ground because it provides a context for the artifacts and objects used in a collaborative activity. Also, we present semantic information in a spatial way.

A second characteristic that is important for helping to establish common ground is semantic information about the purpose and function of an online space. An analysis of spaces like discussion forums (e.g., Motley Fool), retail sites (e.g., Amazon), and marketplaces (e.g., eBay) reveal that they all have an internal structure organized around categories and subcategories[2]. By exposing this structure and using it as a basis to map social information, we can relate the social information to the purpose and function of the site. StarWalker (Chen et al, 1999) is an example of a system which uses a 3D virtual world to allow visitors to explore a shared semantic space and to collaborate with other visitors. 3D virtual worlds are popular spatial forms for collaborative environments but we suspect, they are somewhat limited in terms of system performance, ease of use, and their ability to scale to large numbers of visitors like those found in some popular marketplaces.

The third characteristic that we may exploit to establish common ground is a sharable context. In a study of people's visual image of cities, Lynch (1960) found that while each individual's city map is somewhat different, they all shared many common elements. This shared public image of a city is used by people to operate successfully in their environment and to cooperate with other people. In addition to being sharable and 2D in form, maps are objects that people are familiar with and can interact with, can be rendered in reasonable time and can be scaled to provide greater detail and information.

3.3 Awareness thru Social Visualization

Social visualization provides users with a vehicle to observe and explore social information and to make inferences for guiding their behavior. It uses abstract media (e.g., graphics) to convey information about the social environment and its participants.

One objective of social visualization is to make particular social cues salient to viewers so as to create user awareness of the people, artifacts, activities and interactions. We call this an identification function. For example, Chat Circles (Viegas and Donath, 1999) uses colored circles to represent individual participants and changes in size, brightness, and locations of circles to reveal clusters and flows of conversation at a chat site. The second objective of social visualization is to provide mechanisms that enable users to analyze and see trends and structures in the data. For example, the PeopleGarden system (Xiong and Donath, 1999) uses a flower metaphor to create a data portrait of newsgroup users and a garden metaphor to create a portrait of the newsgroup's social environment. The visualization enables users to explore which participants get involved, how much interaction occurs in a newsgroup, whether members embrace newcomers, who the experts are, and whether the newsgroup has a democratic voice.

3.4 Mechanisms for Social Interaction

Enablers and mechanisms for social interaction are needed in online environments. While synchronous and asynchronous conversational mechanisms like chat, instant messaging, and discussion fora are commonly used, they are not the only forms of social interactions that people use to draw value. In some cases, actions of an individual may be more meaningful than talk. For example, one may want to vet the source of some investment advice by ascertaining whether the advice giver went long (bet for) or short (bet against) on the recommended investment.

Other forms of interactions like social navigation have shown that visitors can derive value from artifacts and traces of social activity like read/edit wear and footprints (Ackerman and Starr, 1995, Hill and Hollan, 1992; Munro et al, 1999). These techniques provide information that can serve as guides for one's activity based on an understanding of the activities of others. Amazon's book recommendations can also be a source of valuable information. However, the problem with these techniques is that a consumer of this information really has very little information about these other people. This hinders their ability to make a decision using the information. We are not suggesting that it would be useful or practical to reveal the identities of these people, but it may be beneficial to have additional clues about the makeup of the group of people aggregated in the traces.

4 ePlace

ePlace represents a design realization of an online social interaction environment based on the just-described four elements that support social interaction. It was designed to support three large classes of Web sites: 1) transaction-based sites like retail and auction sites, 2) group support and discussion sites such as health care and investment discussion fora, and 3) social and entertainment sites such as a game sites. In the following description of ePlace, we make reference to a commercial site, known as ShopIBM, which is the first testbed for the implementation of ePlace.

2. While the structure may not be strictly hierarchical, it can be reduced to one. A hierarchical structure is simpler to grasp compared to a graph-like structure.

4.1 Spatial Metaphor and Properties

ePlace's spatial representation is provided by a 2D interactive site map that supports geographic connotations of an online space. These connotations enable users to exploit spatial properties like proximity and partition in the representation.

The site map is built from Lynch's five elements that characterize contents of city maps: districts, edges, nodes, landmarks, and paths (Lynch, 1960). Districts delineate two-dimensional extents containing Web pages having some common, identifying character (e.g., semi-circular regions or pie segments). Edges (semi-circles and arcs) demarcate two disjoint districts and are used to distinguish and accentuate the districts. Nodes locate the placement of a Web page in a hierarchical structure. Landmarks highlight notable information such as transactions, people, objects, activities and interactions. Paths mark the movement between nodes by one or more users. Figure 1 shows the ShopIBM site map along with some of the map elements just described.

Prior efforts differ from ePlace in three ways:

1. use a graph, node-link, or 3D network structure
2. either support user exploration of a site or administrator's management of the site
3. do not support shared, collaborative activities

4.2 Spatial, Semantic, Sharable Context

ePlace maps the hierarchical structure of a Web site onto a semi-circle, with each major category mapped to a pie segment. The sub-rings represent depth of hierarchy and pie segments represent principal branches in a tree hierarchy (see Figure 2). All Web pages in the leaf nodes of the hierarchy are mapped to the inner-most ring. The parent of the leaf nodes are mapped into the middle ring. All non-leaf nodes that are not parents of a leaf node are mapped into the outer-most ring. This design permits an alternative mapping scheme; one that maps leaf nodes onto the outer-most ring and the non-parents of leaf nodes onto the inner-most ring. In early user feedback sessions, the choice was largely split. We will finalize the mapping choice after formal usability studies.

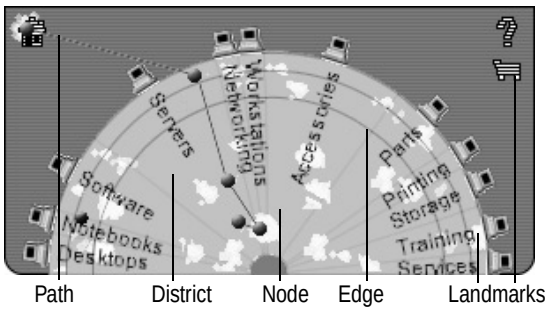

Figure 1: ePlace site map and elements from the ShopIBM implementation. The pie segment for each major category occupies an area proportional to the Web pages at the Web site.

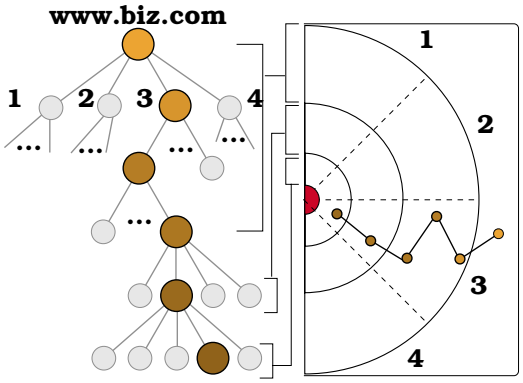

Figure 2: Mapping of the internal semantic structure to the spatial representation.

Distance between pie segments or node locations convey information about the relationship between the items. Specifically, related categories (i.e., pie segments) are placed in close proximity to each other and related Web pages are clustered within a district. An analysis of the ShopIBM site led to the placement of the desktop category next to the notebook category rather than next to the storage category (see Figure 1). Proximity is important for enabling site participants to make use of semantic similarity to establish common ground with other participants.

Also, the spatial representation of the semantic structure of Web pages contributes to rooting in a semantic context a person's location and her activities. The relationships that are expressed in the category structure enable the visitor to draw certain inferences about relationships amongst the users of those categories. Thus it makes available a semantic component which has been shown to be important for helping people to establish common ground. We intend the ePlace map to be a sharable representation, in time; much like city maps are (Lynch, 1960).

4.3 Social Visualization

The site map displays people's presence, activities, and interactions within the same representation used to locate the Web pages. The presence and location of all the visitors to the Web site is rendered using crowd landmarks. Specifically, the number of individuals located collectively at the same Web page location is determined by the system and is represented using dots with different intensities (see Figure 3 or Figure 4) or a cloud pattern with different opacity (see Figure 1). Visitors and buddies appear as people landmarks designated by colored circles located at the Web page that they are viewing. Users identify, through a user preference, which people they want to be notified about. A business may also use such people landmarks for their own representatives like a customer support person.

Landmarks around the perimeter of the semi-circle represent major categories of the semantic struc-

ture which remain permanently visible. Other services that do not have a hierarchical structure are represented outside of the semi-circular area (e.g., see shopping cart and house in Figure 1). Temporal activities and events occurring at the site, like featured auctions or the Web page with the most visitors at the present time, are represented by transient landmarks. Finally, social interactions like a chat between a service agent and a customer are represented by a different landmark with a different marking (see Figure 3a where star icon represents a CSR).

Past actions and interactions are represented using paths. For example, paths are used to represent a user's own traversals as well as the well-trodden paths of a group of users (see Figure 4a and c). This information is overlaid on top of the user's site map.

A tool-tip-like function allows users to roll-over the landmark to obtain additional information. For example, positioning the cursor over the CSR landmark in Figure 3a reveals that the CSR is in conversation with another customer and two other customers are waiting to talk to the CSR. Clicking on a non-crowd landmark transports the user to the Web page designated by the landmark.

An important ePlace design goal is to provide a representation that enables a user to explore his environment. Tools are made available which provide the functionality described above, but it is up to the user to make various parts of the representation visible. They may shift between a context view and a focus view, for example, to identify the locations of individuals, to determine whether they are available for interaction. They may show or hide additional details, like the category labels for a pie segment (see Figure 1 where text labels like Servers in ShopIBM are currently visible). These features allow the user to control the complexity of the representation.

One of the uses of the visualization provided by ePlace is to enable visitors to a Web site to identify other visitors in the context of their activities. For example, a user might observe a cloud indicating a group of people in the section on notebook computers. The user can drill down into the view to look for machines with a particular set of characteristics to identify the individuals who are viewing pages related to a particular model of notebook computer. By rooting individuals and their activities within the same context used to represent the purpose and function of the site, the representation provides an incipient common ground that may be leveraged by visitors. As we argued earlier, this is crucial for motivating interaction between people who probably do not know each other.

4.4 Interaction Mechanisms & Enablers

Users can initiate synchronous interactions with other users by selecting the desired interaction from an interaction menu; the menu is brought up by right-clicking over a landmark icon for a person. A context-sensitive interaction menu lists the relevant interactions appropriate for the selected landmark. For example, Figure 3b shows a user right clicking on a landmark representing a customer service agent and selecting the 'Speak to CSR' option to get in line to talk to the agent. Another scenario of a possible social interaction is a user who decides to participate in an ongoing auction by right-clicking over the transaction landmark to initiate the interaction.

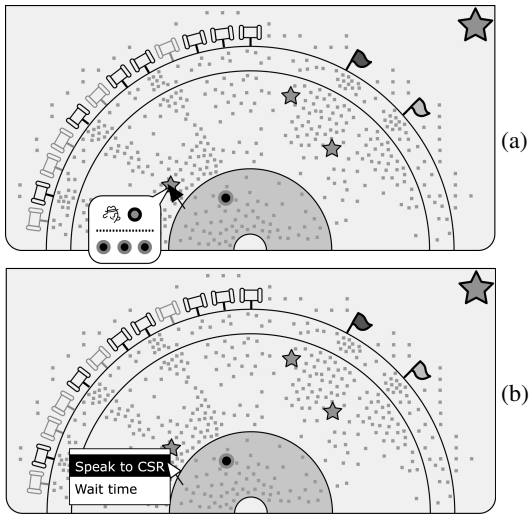

Figure 3: In this design sketch, a user identifies a customer service agent who is most likely to help her with her inquiry (one located in the same topic area) and (a) determines the number of people ahead and (b) decides to line up to talk.

Asynchronous interaction is an important component of ePlace because it enables a user to explore what has happened at a site earlier and use this to guide his own actions. Users may look for and follow the well-trodden path which exists from any place they visited (Figure 4d). This path is the common path taken by others that began based on similar steps taken by the user. This form of asynchronous interaction exploits social navigation; navigation guided by behaviors of others (Munro et al, 1999). Once the paths or footprints are visible, the user may examine footprints or well-trodden paths from any of its nodes (Figure 4b and c).

The user can use the tool-tip function over any of the footprints and paths to obtain additional information. For example, Figure 4d shows the user examining the group makeup for a particular footprint.

5 Implementation Details & Issues

The ShopIBM implementation of ePlace consists of two components: a social server and a site-map client. The ePlace server monitors and collects the social information visualized by the ePlace site map

client. Social interaction capabilities like chat and social navigation are handled by the social server. The site map is implemented in Java and runs on browsers that run the Java 2 plug-in. It is downloaded to the users when they visit the ShopIBM site and remains visible while the user is at the site. Its content is updated dynamically, automatically, and periodically by the ePlace server.

We reconstructed the internal organization of ShopIBM from its electronic catalog information. Then, a hierarchical organization[3] was extracted from this internal structure guided by the 14 principal categories of products found at its Web site (see Figure 1). This hierarchy was used to create the ShopIBM map and to map Web page references to a location on the site map. Several Web pages were static and this was kept by the server in a separate table along with their assigned positions on the map.

We examine three issues with implementing the first version of ePlace for ShopIBM. This is intended to demonstrate the technical feasibility of implementing ePlace.

5.1 Awareness Data Collection

Social information needs to be harvested from a number of sources (e.g., server logs, intermediary monitor between client and server) because it is not always available in one place. For example, a server log contains information about the Web pages that users visit. In order to map their location, the system needs to refer to the internal structure to find its location in the hierarchy. Even if the information could all be gotten in one place, the quality of some information may be poorer than if it was harvested from a different location. The choice of the source is dictated by a number of considerations: availability, accessibility, architectural design of Web site, impact on performance, impact on security, and buy-in by a business. For example, when an intermediary monitor is injected between the user and a secure Web site, it must be able to decipher the data and it must continue to secure the information exchanged between the sites. The ShopIBM implementation harvests data from server logs, intermediary monitor, and the electronic catalog.

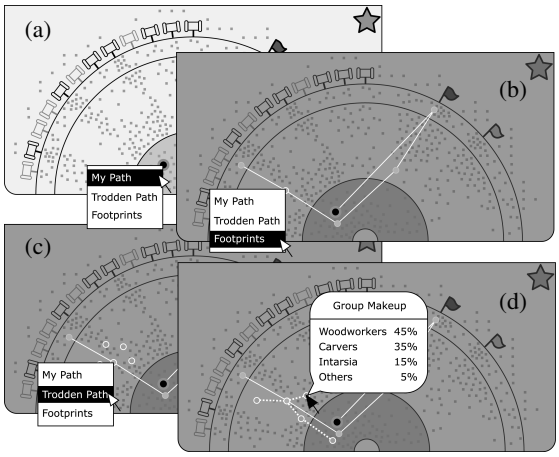

Figure 4: In this design sketch, the user (a) calls up his history path, b) requests the footprints from one of the nodes, c) inquires about well-trodden path from one of the nodes and d) examines the group makeup for a particular footprint.

3. Our goal was not to get an accurate externalization of the structure but to provide a visual spatial representation to relate the social and the semantic elements.

5.2 Server-Client Communication

For a high-traffic Web site, it is important to transmit the social information to the client in an efficient manner. Much of the processing and analysis is handled by the social server. Initially, the client receives the information in order of importance (e.g., the user's location, buddies, hotspots). Periodically, the client requests updates from the ePlace server; again delivered in priority order. In order to have an interactive visualization, we ensured that the client could receive all the data it needs in a few seconds so that updates could occur every five to ten seconds.

5.3 Social Visualization

An issue with the placement of active Web pages exists because there is insufficient resolution to represent all Web pages. We chose to represent only a subset of the Web pages on the map; the ones where there is activity. If this subset could not be visualized, various heuristics were used. For example, only the most active pages and pages of importance to user were represented. Several Web pages are clustered in one logical location using a hash function keyed on the Web page identifier. This ensures that the placement function preserves its location in a spatially consistent way. Collisions are resolved using a heuristic to identify an available adjacent location.

6 Future Work

We have informally evaluated the ShopIBM implementation with a large number of colleagues (70-100) and various internal and external customers. People were generally very positive about the basic idea of being able to "see" other visitors to the same Web site. People were able to understand the basic functionality (the category structure, the ways of representing people and activities, the use of the histories and the synchronous communication capabilities) following a short verbal description. This is consonant with the way we would expect this tool to be used if deployed by a Web site.

Our goal is to deploy the ePlace tool on an existing Web site. We have several pieces of work to do before we can do this. First, we want to explore

under what circumstances people would find social interaction in online environments compelling. For example, would this be most successful if deployed in an environment characterized by repeated interactions among a set of largely stable participants? Our technical feasibility demonstration implementation with the ShopIBM retail site is likely characterized by casual visitors and therefore may not be the optimal type of site on which to test this question. We expect to carry out this investigation through a series of "what-if" discussions driven by scenarios that capture some of the significant dimensions that may affect people's preferences.

A second important issue concerns the usability of the ePlace representation and the functionality it makes available. We are currently experimenting informally with various alternative implementations in response to questions and suggestions from our users. We will undertake a usability evaluation of what we identify as the best alternatives.

The initial feedback we have received about ePlace supports our argument that spatially organized social visualization techniques, coupled with awareness and communication tools, are a promising path to explore for developing online environments which will support social interaction. We are currently exploring ways of augmenting the environment to enrich its social environment further. For example, ePlace represents interaction and setting information to a greater extent than person information. We are also exploring ways in which other techniques, such as social filtering, may be used to provide social information for enriching the online environment.

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