Integrating Visualization Techniques in Groupware Interfaces

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INTRODUCTION

Problems attributed to uncertainty and a lack of visibility about others' activities and behaviors have led designers of multi-user interfaces to develop so-called awareness mechanisms (Dourish & Bellotti, 1992). The importance of maintaining awareness in the virtual environment has been outlined in many studies in CSCW and Human-Computer Interaction (HCI) research areas. According to Gutwin, Greenberg and Roseman (1996), awareness reduces the effort needed to coordinate tasks and resources by providing a context in which to interpret utterances and to anticipate others' actions.

For many years, a significant effort was devoted to explore how computer-based technologies might facilitate some kinds of awareness among and between interdependent actors. These studies tried to solve technical problems related to providing awareness through multi-user interfaces. Unfortunately, however, the expected benefits from these technologies never materialized (Schmidt, 2002). This article focuses on the design of visualization techniques for collective awareness. It proposes a design approach of visualization techniques centered on the semantic of collective awareness and human characteristics (ergonomic design).

The article is organized as follows: First, we present users' needs when interacting through multi-user interfaces. Second, we give an overview of the notion of awareness by reviewing its categories. Third, we present an ergonomic design approach of awareness visualization techniques. We illustrate our approach with examples of techniques from literature and show how these techniques support collective awareness. Finally, we conclude with some future directions.

MULTI-USER INTERFACES: WHAT USERS NEED

Interacting through groupware interfaces seems to become a necessity in the networked economy. Yet for all their power and benefits, groupware systems can't replace the richness of interaction between collocated persons. In fact, groupware users face greater obstacles than traditional workers do. Adequate human behavior requires awareness of the overall situation of the involved persons and work objects. In the virtual environment, users may need to actively monitor others' activities to keep informed about their joint work. According to Wilson (2003), in a face-to-face context, co-workers can depend upon voice levels, smiles and raised eyebrows to determine whether they are being understood. However, the computer-mediated environment does not offer these nonverbal cues—which, in turn, can increase uncertainty about others' activities and behaviors, and one's feeling of isolation.

Computer-mediated communication environments are characterized by limitation in time and space for accessing information and a lack of visibility of the work being carried on by the group. Moreover, it is difficult to convey or discern successful comprehension, current focus of attention or concomitant attitudes and affect (Carroll, Neale, Isenhour, Rosson, & McCrickard, 2003).

To become aware of others' activities, the right type of information has to be available. According to Sohlenkamp (1998), the multi-user interfaces have to support different mechanisms to adequately present events to other users. In this way, information that answer the "who, when, why, where and what" questions regarding state changes are basic requirements that enable users to work together more effectively.

COLLECTIVE AWARENESS: DEFINITION AND TAXONOMY

Collective awareness has been defined in numerous ways, although many definitions do not share a common foundation. Schmidt (2002) argues that awareness is "being used in increasingly contradictory ways … In fact, it is hardly a concept any longer" (p. 287). In this article we adopt the definition of Daassi and Favier (2005): "collective awareness refers to a common and shared vision of the whole team's context, which allows members to coordinate implicitly their activities and behaviors through communication" (p. 2). This definition takes heed of the previous definitions and recognizes both the automated and human aspects of building collective awareness in the virtual environment.

As a consequence of the multitude of definitions, groupware systems addressed several types of awareness. Some of the presented types of awareness means the same requirements and can be coupled. The table below presents the different types of awareness information defined in the literature.

Some authors tried to classify the different types of awareness presented above (see Table 1). In the next table, we describe two taxonomies of awareness.

Having presented an overview of collective awareness, now we focus on technical solutions proposed in literature to guarantee the awareness in collaborative systems. Many efforts explored the use of audio and video to keep users aware of each other. These techniques need appropriate hardware and software. New minimalist and low-cost techniques are proposed. In the remainder of this article, we outline the contributions of visualization techniques in the establishment of collective awareness.

VISUALIZATION TECHNIQUES

Data visualization refers to the process of transforming data values into visual representations (e.g., maps, graphs, 3D scenes, etc.). A review of literature shows the diversity of the designed visualization techniques. In this context, several taxonomies have been proposed to gain understanding of the designed techniques.

These works are useful because implementers can identify visualization techniques by examining the classes of these taxonomies. However, they do not help designers understand how to apply and implement these techniques in the context of collective awareness. Addressing this problem, we propose to focus on visualization techniques for collective awareness and structure them according to the semantic of collective awareness.

In the context of collective awareness, we distinguish two goals for which visualization techniques could be designed. First, they could be used during the interaction process between the user and the collaborative system. The goal is then to enhance collective awareness. As a consequence, the designed techniques should take into

Table 1. The different types of awareness

Type of awareness	Description
Activity awareness	Knowledge about the project-related activities of other group members (Steinfield, Jang & Pfaff, 1999).
Process awareness	A sense of where members' tasks fit into the stages of the project, what the next step is and what needs to be done to move the process along (Steinfield et al., 1999).
Availability awareness	Knowledge about whether others are available to meet or participate in an activity (Steinfield et al., 1999).
Informal awareness	Basic knowledge about who is around in general (but perhaps out of site), who is physically in a room with you, and where people are located relative to you (Gutwin et al., 1996).
Workspace awareness	The collection of up-to-the minute knowledge a person uses to capture another's interaction with the shared workspace (Gutwin & Greenberg, 2004).
Social awareness	Knowledge about the members, and especially about their social situation: what they are doing outside their context of work (Tollmar, Sandor & Schömer, 1996; Gutwin et al., 1996).
Group-structural awareness	Knowledge about such things as people's roles and responsibilities, their positions on an issue, their status and group processes (Gutwin et al., 1996).