Awareness Approaches of E-Collaboration Technology

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INTRODUCTION

Early field studies in collaborative work have shown that actors are capable of aligning and integrating their activities with those of others in an apparently seamless way (e.g., Heath & Luff, 1991). This is accomplished through the use of information gathered by overhearing others' conversations or surreptitiously monitoring their ongoing activities. To represent these practices of paying attention to what is going on in the environment, the term *awareness* was subsequently adopted (Schmidt, 2002). Researchers have dedicated much time to the study of how e-collaboration technologies might create some level of awareness between workers. Systems have been designed to enhance collaboration through the provision of information to create or maintain awareness of the working group. Even though different approaches have been introduced to address awareness, its creation and maintenance, researchers agree that most collaboration demands knowledge of others' activities (Dourish & Bellotti, 1992), and many have argued extensively that awareness is crucial for groups when performing their joint activities (Gutwin & Greenberg, 2004).

DEFINITIONS AND IMPACT ON COLLABORATIVE ACTIVITIES

Situation awareness research focuses on each individual's capacity to perceive elements and the cognitive processes involved in maintaining awareness of the environment. Endsley (2000) defines situation awareness (SA) as the process of perceiving environmental cues, interpreting their meaning and projecting their status in the near future. This information is used as a basis for individual decision making while working. Dourish and Bellotti (1992) define awareness as an understanding of activities of others, which provides a context for one's own activity. This information ensures that individual contributions are relevant to the group's activities, and enables individuals to assess others' actions with respect to group goals and work progress, which in turn allows individuals to adjust their behavior or take action according to the situation. Elaborating further on those concepts, Gutwin and Greenberg (1996) define workspace awareness as up-to-the-moment understanding of another person's interaction with the shared workspace. It is knowledge about the group's working environment, which creates an understanding of people within a workspace. These two definitions specialize the SA definition by defining the environment as a collaborative workspace, where information about other's activities and status is an important asset.

Rodden (1996) describes awareness as the overlap between nimbus and focus. Nimbus is the information given out by each element in space that can be perceived by others and focus describes the elements at which a user directs his or her attention. Thus, the awareness of individual *A* towards individual *B* is the intersection between the information being given out by *B* (*B*'s nimbus) and the information *A* is interested in (*A*'s focus). This model details how information to maintain awareness is obtained and shows that attention is a key aspect in the process, as it is affected by each individual's focus of attention and each element's provision of information.

In a collaborative environment, awareness involves knowledge about the people one is collaborating with

(presence, identity, and authorship), the activities they are working on (actions, intentions and artifacts manipulated) and where (location of work, gaze direction, view and individual reach). Historical awareness information also includes action, artifact, and event history and should be provided in asynchronous work situations (Gutwin & Greenberg, 2002). This framework provides a starting point for designers to think about awareness elements and what information to provide in given situations.

In collocated environments, awareness information (i.e., information to maintain awareness), is gathered mainly through (1) intentional communication (i.e., communication intended by the sender, such as conversation and gestures); (2) consequential communication, or information transfer that happens as a consequence of the individual's activity within the environment, obtained by observing others' actions or body positions; and (3) feedthrough, which is the mechanism of determining a person's actions through cues given by the artifacts they interact with in the environment, such as position, orientation or movement (Gutwin & Greenberg, 2004).

Ethnographic studies have determined that awareness allows group members to manage the process of working together and is necessary for coordination of group activities (Dourish & Bellotti, 1992). Being aware of others' activities in a workspace allows participants to better understand the boundaries of their actions, which in turn helps them fit their own actions into the collaborative activity stream. This also enables groups to better manage coupling levels between their activities, helping people decide who they need to work with and when to make the transitions from looser to tighter coupling (Heath & Luff, 1991).

Furthermore, awareness simplifies communication by allowing individuals to reference the shared environment and elements within it: When discussing shared artifacts, the workspace can be used as a communication prop (Brinck & Gomez, 1992). This makes awareness an important building block for the construction of team cognition (Gutwin & Greenberg, 2004) and an enabler of shared understanding that allows individuals to get a better sense of the work that is being performed by others (Gutwin, Greenberg, Blum, & Dyck, 2005).

AWARENESS IN E-COLLABORATION APPLICATIONS

Maintenance of awareness is facilitated by physical proximity: it is possible to perceive a large amount of information simply by walking around the office, overhearing others or engaging in brief coffee break conversations (Kraut, Fussell, Brennan, & Siegel, 2002). Providing awareness information in e-collaboration environments, however, is far from simple, especially when participants are distant from one another. Input and output devices generate less information that face-to-face situations and users' interactions with computational workspaces also generate less information that physical environments (Gutwin & Greenberg, 2004). Given these limitations, a number of applications have been designed to provide awareness-enabling information in e-collaboration applications.

Early awareness work was heavily geared towards the use of video to support personal awareness and informal interactions. Experiments with the CRUISER (Root, 1988) and Portholes (Dourish & Bly, 1992) systems revealed that the possibility of easily engaging peers generated a number of new, spontaneous interactions. Through these systems, users could explore the virtual workplace, gaining awareness of their peers, which strengthened the sense of community between them. Negative reports involved the fact that everyday activities were not very exciting (users had to wait for a long time until something interesting happened), which led to loss of motivation to use the system. These early systems showed that awareness promotes group integration and helps people identify the right moment for starting a conversation by checking on their counterparts' availability. These systems continuously provide current identity and presence information, plus location and information on a member's actions (as it was possible to view whether one was answering the phone or chatting to a colleague).

The MAUI toolkit (Hill & Gutwin, 2004) is a Java-based toolkit that provides awareness-enhanced interface components for the construction of synchronous multiuser applications. These interface components (buttons, menus, windows) enable users to see when other users access them in their clients, providing current identity and activity information. User feedback on the interface widgets was positive, although they were concerned about the level of distraction caused by the added notifications.