Awareness Tools : Lessons from Quake-Like

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Abstract

This paper presents a study that aims to review the awareness tools provided by video games to support team-play and team collaboration/communication. It also focuses on the use of these tools in groupware. A content analysis of gamers interview, the games observation and the game guides reading have revealed that, awareness tools used in games, support mainly location, presence, identity, action and event history. Communication tools like chat are also provided. From the tools that are reviewed here, there are several that might be useful in groupware : those which allow participants to gather in order to perform a task, those which provide direct vocal communication, those which allow users to configure their own awareness tools, etc. Video games also provide indication about the quality of the information that the awareness tools should offer. They must be accurate (a system should provide awareness tools adapted to the task) and as responsive as possible in order to minimize the user's cognitive load.

Keywords

HCI, awareness, collaboration, information visualization, game design.

1. Introduction

Awareness has recently become a new research field particularly for CSCW (Computer Supported Collaborative Work) and CSCL (Computer Supported Collaborative Learning). Being (and also remaining) aware of others is as important in everyday life as in groupware. In multi-user workspaces, Awareness Tools (from now on called AT in this text) enable the users to offset the lack of social interactions. They also provide a more efficient team collaboration by showing information about presence (is anyone in the workspace?), identity (who is that?), location (where is an individual?), action (what is somebody doing?)…

Nonetheless, we should keep in mind the fact that video games have explored this area much earlier. Many electronic games have developed their own solutions to support awareness of others.

This research aims to review all the tools that enable collaboration in video games and to find constant design patterns that can be used to design CSCW/CSCL. As it is a broad area, we have focused exclusively on one category : action games and mainly first-person-shooter games like Quake III, Counterstrike or Deltaforce2. Unlike console games, where all players are looking at the same screen, the above pc-based games have to provide tools to show awareness information.

In order to reach that goal, the methodology used was a qualitative analysis based on three sources :

- Gamers interview
- Games observation
- Tactical/Strategical guides

To begin, this paper presents a short summary of the awareness theory and its implications in quake-like games. Afterwards, it proposes a review of the tools that support awareness of others in these games. Finally, it discusses the relevance of transferring these tools to CSCW/CSCL.

2. A framework of awareness

A descriptive theory of awareness has been clearly developed by Gutwin and Greenberg (1999). A brief summary of their work is presented below to introduce the concept of awareness.

2.1 Awareness of others

When people work together in a shared environment (virtual or not), they need information about the action and the intentions of their team-mates. This knowledge of other, result of the interaction of the participants and their environment, is named "awareness". Gutwin and Greenberg (1999) state that awareness :

- is knowledge about a state of the work environment in a limited portion of time and space.
- provides knowledge about changes in that environment.
- is maintained by all the interaction between the team-mates and the environment.
- is a part of an activity (completing a task, working on something…)

Therefore, awareness is a process that sums up the knowledge extracted from an environment and updates it thanks to the interaction between the participants and their environments.

2.2 Workspace Awareness

Gutwin and Greenberg (1999) make the distinction between *informal awareness* and *workspace awareness*. The first involves knowing who is where, whether people are busy and what kind of activity they're engaged in. Workspace Awareness is one kind

of awareness that people maintain when they work in a group (Greenberg, Gutwin, and Cockburn, 1996). It can be defined as : "the up-to-the-moment understanding of another person's interaction with the shared workspace […] It is awareness of people and how they interact with the workspace, rather than awareness of the workspace itself" (Gutwin & Greenberg, 1999). The shared workspace (virtual or not) is a place where people work together to complete a task. Thus, awareness knowledge is made up of all the elements (perceptual : sound, motion, etc.) that are generated by the interaction of the participants in this workspace.

Elements of workspace awareness can be divided into two parts : those related to the present (cf. Table 1) and those related to the past (cf. Table 2).

Category	Element	Specific questions
Who	Presence	Is anyone in the workspace ?
	Identity	Who is participating ? Who is that ?
	Authorship	Who is doing that ?
What	Action	What are they doing ?
	Intention	What goal is that action part of ?
	Artefact	What object are they working on ?
Where	Location	Where are they working ?
	Gaze	Where are they looking ?
	View	Where can they see ?
	Reach	Where can they reach ?

Table 1 : Elements of workspace awareness relating to the present (from Gutwin & Greenberg, 1999)

Category	Element	Specific questions
How	Action history	How did that action happen ?
	Artefact history	How did this artefact come to be in this state ?
When	Event History	When did that event happen ?
Who (past)	Presence history	Who was here, and when ?
Where (past)	Location History	Where has a person been ?
What (past)	Action history	What has a person been doing ?

Table 2 : Elements of workspace awareness relating to the past (from Gutwin & Greenberg, 1999).

In physical environments, workspace information is gathered thanks to :

- Visible activity appears to be an essential flow of information. Auditory sign may also be useful. It can be the posture of the other person's body in the workspace, the movement of a limb, the sounds in the environment, etc.
- The manipulation of the workspace artefacts provide visual or acoustic information. This mechanism is named *feedthrough*.
- The conversation and the intentional communication are also significant (hearing someone's conversation or asking a question like "what are you doing ?").

All this information allow a collaboration between the participants by simplifying communication, coordinating the action and the activities, anticipating events, providing assistance, coupling peers, etc.

2.3 Awareness in real-time multi-user virtual environment

Real-time distributed groupware like shared editors, group drawing programs or multiplayer games allow people who are not in the same place to work together at the same time. These programs provide a shared workspace : a closed environment where the participants can see each other, communicate or manipulate artefacts. In this area, people perform tasks like constructing new artefacts (e.g., architects may draw or design), exploring (finding items), manipulating artefacts, writing texts, etc.

In this kind of environment, there is a lack of awareness information. Workspace Awareness is much more difficult to support in virtual environments : "In face to face interaction, people can generally see the entire physical workspace and all the people in it; in groupware, they have only a small window into the virtual space" (Greenberg, Gutwin and Cockburn, 1996). The interaction between the participants and the virtual workspace generates also less information than in a physical one. The input and the output of a computer provides indeed much less information than the action in the physical world. That's why groupware provides AT to overcome these limitations. AT are much more used to "recreate the conditions and clues that allow people to keep up a sense of a workspace awareness" (Greenberg, Gutwin, and Cockburn, 1996). The little information that is left by the participants is gathered, arranged and distributed to the group. Thanks to AT, participants can receive information that can answer the questions presented in Table 1 and 2. An example of AT is the radar view : a miniature overview of the workspace that locates the team-mates in the virtual environment.

This study will now focus on one category of multi-user virtual environment.

3. First-Person-Shooter Games

In quake-like games, the action takes place in a shared area, namely the “Arena”. This arena may be closed (Quake, Unreal…) or very open space (Delta Force II). This arena may also be reactive (if somebody shots in a wall, an impact will appear) and contain lots of items like ammunition, weapons, life supplies, armour and bonuses (like the “quad” in quake III, a time-limited bonus that increases the weapon strength). Bumpers and teleporters exists only in science-fiction games like Quake or Unreal Tournament.

The players perform their action in real time. It is necessary to mention that bots (characters of the game played by an AI) can compete with other players.

The background of these games are mostly military on the one hand (Delta Force) and science-fiction (or fantasy) on the other (Quake, Half-Life, Unreal, etc.). There are mainly seven tasks to be performed :

- Deathmatch : each player has to kill the highest number of others in a defined amount of time. There is no team-play.
- Team deathmatch : teams fight each other. The winner is the team who has killed the highest number of opponents.
- Capture the Flag : two teams are opposed, the purpose is to capture the flag of the opponent team.
- Domination : a team has to defend a defined area.
- Rescue hostages
- Assassination.
- Bomb defuse : a team has to defuse a bomb in the opponent zone.
- Sometimes, few games (like DeltaForce) propose campaigns or more complex missions.

Confrontation appears to be the main goal in all of these “tasks”. All of them, require a strong collaboration between players (except for the deathmatch) and AT are provided to enable team-play.

The interface shows the 3D environment through a HUD (Heads-Up Display) worn by the character in the game. This HUD allows the player to see the arena and useful information like his health, his ammunitions, his current weapon, AT and so forth… The HUD is a metaphor of the physical hardware used in military aircraft that displays information. It enables the pilot to look at important indicators without moving his head. Screenshots 1 and 2 illustrate two different examples of an HUD.

*Screenshot 1 : **A** - Weapon Slots 1=Main Gun, 2= Pistol, 3=knife, 4=Grenades 5=Bomb. **B** - A running commentary on who is killing who & with what. **C** - Zone Icon Area (in this case, the buy weapons zone). **D** - Text Message Area. **E** - Your Health 100=Full Health 0=Death. **F** - Your Kevlar Body Armour 100=Excl. Condition 0=No Armour. **G** - Mission Timer, minutes : seconds until round ends. **H** - Rounds of Ammo in the magazine of your currently held weapon. **I** - Total Rounds of Ammo carried for your currently held weapon. **J** - Your current Money Balance (from Counterstrike, taken at the url : http://www.ss-clan.com/cs/index.html)*

*Screenshot 2 :Quake III Team Arena HUD. **1** : Your team. Depending on what you have it set on, it can show an individual teammate and his health, ammo, armor, and combat orders status, or it can list all the members of the team and what their orders are. The small icon to the left below the teammate's picture is his or her orders status. The heart and armor icons show pictorially the status of his health and armor by cycling through colors. The number next to the ammo icon shows how much ammo that teammate has for that weapon, which he's currently using. **2** : Your capture status. This shows what powerups and items you're carrying, if any, as well as if you're carrying a flag or any skulls (and how many). **3-5** : Ammo, Health, and Armor. These are the standard HUD components found in Q3A, but in the stylish Team Arena look. **6** : Game Status. This bar shows the capture limit (white number to the left), Blue's captures, Red's captures, your score in the game so far (white number at the bottom), and the flags' status. **7** : Attack status. This bar shows your current team orders (the icon) as well as your location on the map. (taken from PlaneQuake, 2001).*

4. Methodology

This study employed observation and interview techniques to gather information about the AT. This section describes the participants, the methodology and the sources used.

4.1 Interview/Observation

Ten “hardcore gamers” participated. All were very familiar with computer science and video games (4 programmers, a game designer and 5 computer-science students). Most were familiar with the idea of groupware/CSCW but none have ever used one. Participants were introduced to the study. The study

was divided into two parts : a semi-structured interview and observation.

First, they were asked about all the AT that can support team play/collaboration in "first-person-shooter" they have used. The observer let the participants discuss this and asked questions about other functionalities they did not mention. A list of guidelines were made in order to control this enquiry. These guidelines sum up all the use of the AT : location, presence, action, identity, intention...
Second, the participants were requested to play while be observed. When team collaboration became necessary, they were asked to show the tool used and it's functionality.

4.2 Other sources used

This study focuses on first-person-shooter games. These pc-based games are distributed-display whereas console games are single-display games. The observation of several games was made.

The games observed are : Counterstrike (Westwood Studios), DeltaForce II (Novalogic), Duke Nukem 3D (GT Interactive), Half-Life (Sierra), Gunman Chronicles (Sierra), Doom (id Software), Quake II/III (id Software), Rainbow 6 (Red Storm Entertainment), Unreal Tournament (GT Interactive).

Moreover, another source of information of AT was the above games guides found on the web.

4.3 Criteria to describe AT

A list of criteria will be used to make the content analysis and thus to classify the AT used in games.
Direct AT (like radars, chat, etc.) may be separated from indirect ones. The so-called indirect AT include sounds, skins… that can help the team play but are not tools in the physical sense. Moreover, communication tools can be separated from the others.

In order to discriminate the direct AT, six criteria are used :

- *Content* : which information is displayed (presence, location, intention, etc.). It answers to the question shown in table 1 and 2. It can also be the health level, the player's role, etc.
- *Time Span* : there are two possibilities : acquiring the information about the team-mates or maintaining that information. That leads to the following types :
    - Synchronous awareness : to obtain information about the present.
    - Asynchronous/Longitudinal awareness : to obtain an historical perspective of the information. It can be a sum up of the whole information (collected after a period of time) or a differentiation between recent information and past ones.
- *Mode* : how the user obtains the information. There are three modes :
    - Passive : the information from player A (or from every team-mates) is permanently displayed to player B (or to every one).
    - Active : player A has to activate the AT to obtain information about player B (or the whole team). This information remains displayed until player A deactivates this tools (e.g. with a click).
    - Reactive : player A activates something and information is provided to player B (or to the whole team, or to everybody).
- *Perceptual output* : the information can be visual, a sound, etc.
- *Recipient* of the information (a team-mate, the team or everybody).

5. Results and discussion

This part presents the results of the content analysis. Since the purpose of this study was to review the AT used, no quantitative analysis was applied. Below, there is a presentation of the gamers' vision of collaboration in quake-like games. A review of these tools follows. Finally, the possible use of such tools to CSCW/CSCL is discussed.

5.1 Collaboration in First-Person-Shooter

The analysis of the gamers' interview provide a clear look at their reflections towards collaboration in Quake-Like Games.

According to the gamers interviewed, collaboration is a key factor to win. A majority of players finds that collaboration isn't developed enough between participants, and that there are not enough AT (most regret that only few games support direct communication with a microphone and a headphone).

It is also to be noticed that mostly team-mates who know each other win more than those who don't. It is a problem for on-line games when lots of players don't know each other. In fact, quake-like competition sets up in huge rooms and the teams are gathered in order to allow direct communication; the use of AT is thus decreased. Nonetheless, non-gathered teams exist, mainly on the Internet, and they are obliged to use AT.

In the games observed, the equivalent to collaboration is "team play". It can be defined as "Two or more players acting together against another team […] Team play is fun whether or not there is any coordination between team members. Usually a well-organized team will trap an opposing member between them […] Keeping track of each other on a team is the absolute best way to kill efficiently." (Zdoom, 2001). Thus, collaboration between the team mates allow an efficient confrontation against the other team. The tasks may be divided in a team : there can be a sniper, a scout, a flag defender and so forth. And in order to do that, AT are crucial tools to increase the team synergy.

5.2 The AT

This part presents the AT classified thanks to the above criteria after a content analysis : direct AT, indirect AT, communication tools and "team gathering" tools. The main source used here is the gamers' interview.

5.3.1 Direct AT

Direct AT are not tools, in the physical sense. They are just visual and sound information that bring clues to the players. All this information enforce the immersion in the game environment. Table 3 shows a list of direct AT found thanks to the qualitative analysis.

Name	Output	Content
Avatar's skin	Visual	The team (skin colour), the weapon currently used, it is also possible to configure the skin according to the player's role (scout, sniper…).
Alarm	Audio	An alarm may be triggered when an explosion is imminent (bomb) or when a player enters a specific area.
A player's injury	Audio	A wounded player screams. It may be an indication of location and action since sound is spatialized.
Weapon sound	Audio	Each weapon has a different sound. It can convey information about which weapon (artefact) is currently used in the Arena.
Footstep sound	Audio	Footsteps are a crucial indication of presence, when a player is near and cannot be seen.
Jump sound	Audio	The sound of a jump is a crucial indication of presence, when a player is near and cannot be seen.
Picked up item sound	Audio	The sound of an item being picked up is a crucial indication of presence and action, when a player is near you and cannot be seen .
A running player	Visual	It may mean that the player carries the knife (if he was using a heavier weapon he could not run so fast).
Running noise	Audio	It enables players to give away their location and your direction of travel.
Modified artefact	Visual	Hole in the ground, in the wall, blood marks, dead bodies are clues of action and location history.
Missing items	Visual	Location history, a player has been there few seconds ago.
Artefact movement	Visual	Movement of platform or elevator, opening doors are a clue that someone is nearby.
Artefact movement	Audio	Movement of platform or elevator, opening doors are a clue that someone is nearby.

Table 3 : review of the direct awareness tools.

These findings may suggest that Virtual Environments aim to bring to the players a true imitation of the real world by showing the same clues (noise, artefact motion, etc.). Thus, performing a task in these environment appears natural and intuitive for players as long as it follows the same physical rules as in our real world.

Visual evidences are the most important source of information. Motion, avatars' skin, modified artefacts seem to be valuable sign of action, presence and location. Nevertheless, sound is thoroughly important, as audio device is more and more efficient. The Quake III guides advise the players to "use sound to their advantage". Sounds can give very precise clues (about presence, location and action) since a good stereo sound card can render the spatial properties of a gunshot or the footsteps' noise.

5.3.2 Indirect AT

Table 4 shows a list of indirect AT.

Name	Content	Time Span	Mode	Perceptual Output	Recipient	Remarks
Map	Presence/Identity/Artefact/Location/Gaze	Sy	A	Visual	The player's HUD	With the aid of the map, the player can see his team-mate (the symbols differ for those who are dead and those who are alive) and sometimes (it depends on the game played, or if the option has been chosen), the opponents . He can also see a compass and the orientation of the player's weapons. A zoom is possible.
Radar	Presence/Identity/Artefact/Location/Gaze	Sy	P	Visual (transparent overlay)	The player's HUD	The radar map is the same as the above, only smaller, and is situated in a corner of the HUD.
List	Presence/Identity	Sy	A	Visual (transparent overlay)	The player's HUD	A table showing who is playing, the score and the ping.
Number of player	Presence	Sy	P	Visual (transparent overlay)	The player's HUD	The number of players is permanently shown in a corner of the HUD.
Tag	Identity (name)/Health Level/Status (friend or foe)/Location.	Sy	P or A (optional)	Visual (transparent overlay)	The player's HUD	By pointing to a team-mate (or an opponent) a player can attain information about him. The supposed location can also be shown (direction and distance).
List	Action history	Asy	A	Visual (transparent overlay)	The player's HUD	This list shows information about the events (death, flag capture).
CPU message	Action	Sy	R	Visual (transparent overlay) and sound.	The player's HUD and his speakers.	The computer sends message about the events (who has killed who, etc.).
CPU message	Artefact	Sy	R	Visual (transparent overlay) and sound.	The player's HUD and his speakers	The computer sends message about the events that involve an artefact (like who has captured the flag or defused the bomb).
Thermic vision	Location	Sy	A	Visual	The player's HUD	With the aid of this tool, the player can see who is behind a wall for instance.
Infrared Binoculars	Location	Sy	A	Visual	The player's HUD	With the aid of this tool, the player can see when the light is at a low level.
Log, console	Event history/Communication log/Artefact history	Asy	A	Visual (overlay)	The player's HUD	The console sums up all the messages that were sent, the event (death, artefact modification, etc.).
-	Authorship	Sy	P	Visual (overlay)	The player's HUD	The HUD can show to the player the skin of the avatar who wounded the player as well as the name of his weapon.
Script	It depends on the configuration.	Sy and Asy	A	It depends	It depends	Scripts allow players to configure their own AT that display the information they want. Scripts can be triggered by pressing a key configured for their function.

Table 4 : review of the indirect awareness tools. Sy : synchronous. Asy : asynchronous. A : active (players can configure the key they have to press to active this tool). P : passive. R : reactive.

It is important to notice that AT supports above all, team awareness. There is few peer collaboration (only if there are only two players). The performing of the task involves the whole team, that's why there are so few AT that support one-to-one awareness.

Most of the elements of workspace awareness mentioned in Table 1 and 2 are supported by these game AT : presence, location, identity, authorship, action, artefact. Gaze, intention, view and reach are not supported. The only way to have this information is to ask the team-mates by chat or direct communication.

5.3.3 Communication Tools

Communication Tools are the kind of tools that can support awareness. Other functionalities may also exist (fun, discussion, etc.). Table 5 shows a short review of the communication tools.

Name	Content	Time Span	Mode	Perceptual Output	Recipient	Remarks
Team Chat/Talk	Communication tool : any information that can be verbalised	Sy	A	Visual (transparent overlay) : one colour	The team-mates' HUD	The team chat allows the players to chat ONLY with their team-mates
Chat	Communication tool : any information that can be verbalised	Sy	A	Visual (transparent overlay) : a different colour	Every player's HUD	This chat allows every player (friend or foe) to talk to each other.
Player Chat	Communication tool : any information that can be verbalised	Sy	A	Visual (transparent overlay) : a third colour	The player's HUD and the one who is listening	This chat allows players to talk to each other (team-mates only). A semi-structured interface enables a player to choose the team-mate he wants to talk with.
Voice-Over-Net	Communication tool : any information that can be verbalised	Sy	A	Audio (speaker)	Another player	It allows a player to talk directly to another player (with a microphone and speakers).
-	Who is listening, who is talking to who	Sy	A	Visual (overlay)	The player's HUD.	This table can display information about the sound interaction between team-mates.
Bind	Communication tool	Sy	A	Visual (transparent overlay)	The team-mates' HUD	Bind allows a player to send messages to his team by pressing only one key. It can be configured (for example : pressing F1 can trigger the display of "cover me").

Table 5 : review of the communication tools. Sy : synchronous. Asy : asynchronous. A : active(players can configure the key they have to press to active this tool). P : passive. R : reactive.

Quake III binds and scripts appear to be the most interesting features of Table 4 and 5. Binds enable participants to trigger the display of a pre-written sentence in the team-chat by pressing only one key. Players can configure their own binds. Mostly, there are simple commands (to talk to another participant), group commands (to talk to the team) and answers (as shown in screenshot 3) or exclamations ("Fuck ! We're lost !").

Screenshot 3 : Radio commands from CounterStrike (simple, group and answers).

Scripts are more complex tools. They can trigger a combination of several things by pressing one key. For instance, it is possible to set it on for jumping, changing the current weapon and fire by pressing only one key. Following this simple idea, one can configure it to display on the HUD awareness information (like who is in the arena, his map's location, his current weapon and his health level). Nonetheless, it requires programming skills to write a script. The player who wants to create a script has to find the correct variable he wants to display and to change it in the right script file. That's not easy for occasional gamers but possible for hardcore ones who build their own scripts. In Quake III, there are scripts that cut the map in quadrants. They defines the location more precisely. These scripts can locate participants (team-mates or opponents) in this squared map.

5.3.4 Gathering a team

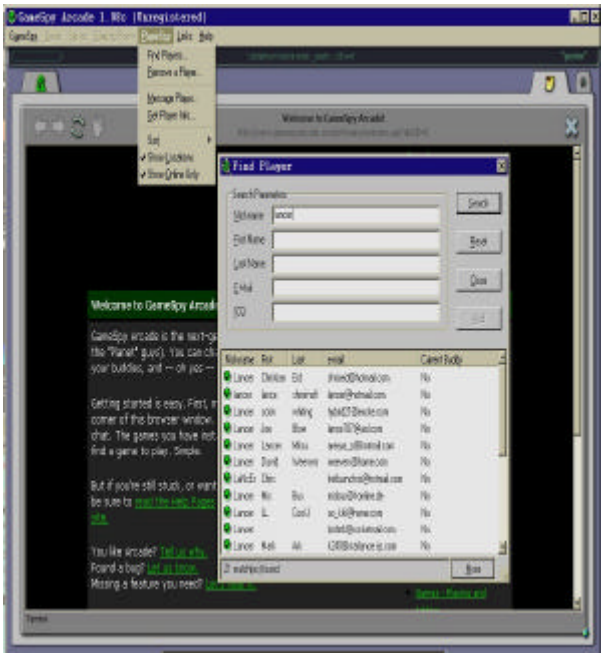
Before entering the Arena, a crucial problem is to gather a team (Calica, 1998). It is very easy if the participants are in the same place and if they know each other but that's not always possible. Internet offers a new opportunity to gather team-mates from all over the world. Calica describes three ways to gather a team (Calica, 1998) :

- "Next on the Bus" : the arena is filled by people in order of appearance.
- "Pick-Me Style" : participants are waiting to be picked by pre-constituted groups (friends gather themselves in a group and wait).
- "Wander and Team" : it means start playing and if the player finds someone he likes, he plays along with him. Meetings can lead to a team.

In order to have a fairly good team synergy, the players need to have an equivalent skill level (but there can be a more experimented guide, playing the role of coach or leader). They also need to know each other before entering the Arena. In that way, chatting before playing can be useful. General chat, one-to-one chat, small group chat and forum are the common communication tools employed to develop on-line communities (Michael, 1999). All these tools can be useful during the game (as shown in Table 5) but also before the game : to create a team or a community. Quake clans are made up of hardcore gamers who have their own website with lots of information provided regarding their attitude, their strategies, their favorite map, etc. It creates a true team spirit.

Few games support this. Nevertheless, there are gaming environments (common to several games) like Gamespy's Arcade. Planetquake (2001) states that "…it allows you to keep track of all of your pals. Once you've selected someone to be part of your friend (buddy) list, Arcade will keep track of them for you. You can find out what servers they've joined simply by scanning the server list for the "Buddy Spied" icon (a small magnifying glass). When you've found a server marked with the "Buddy Spied" icon, you can right click on the server's listing and obtain the list of players currently gaming on it. This will enable you to see exactly which one of your friends is connected to the server."

This tool named GameSpy (made by Arcade) enables players to find players, to create their own friends list, to sort it, to obtain information about them (e-mail, homepage, hobbies, ICQ#, etc.) and to chat with them. Screenshot 4 shows the Gamespy's interface. And, it also shows if the user is on-line or not.



Screenshot 4 : Gamespy's interface. The "find player" window allow the player to find a "buddy" (a friend) by giving his nickname, first name, last name, e-mail or icq number. The Playspy's menu enables the user to sort his friends, to find them, to send messages, to obtain information about them or to remove them.

5.4 From Quake-Like to CSCW/CSCL

5.4.1 Awareness categories supported in games

All the categories of awareness shown in Tables 1 and 2 are not supported by the video games observed.

There are true signs of presence, identity, action, artefact, location, event history. However, the only possibility to obtain information concerning intention, gaze, view, etc. is to ask another player by using a communication tool.

This may be explained by the fact that gameplay (e.g. strategy and tactics for accomplishing the goals of the game) may suffer if too much information is provided to the players or if there are tools that gather useless information. For instance, when someone connects to a quake arena, he's a spectator and can display the view of all the players to see what they're currently looking. A participant, in the arena, cannot do that. "What You See is What I See" is not supported, rather "What You See Is What I Do" is. AT may be employed only if they can be useful for the task. That's why several games provide radar that only shows the team-mates and not the opponents.

5.4.2 AT learning in games and groupware

Unlike groupware, video games are easy to pick up and allow people to do complex things activities without effort. The use of AT seems very natural and intuitive for players. As it follows the same logic and the same rules as the real world, there's no constraint, performing the task does not result in frustration. Groupware lacks fun, the key factor of a successful game (Holmquist, 1997).

In quake-like games, a military metaphor is applied. The user interface is based on a military aircraft helmet. The HUD appears very intuitive for gamers who are immersed in the video-game culture (games, movies, wearable technology, sci-fi stories, etc.).

Hence, Groupware Systems need to be fun, maintaining the proper paradigm to be efficient and they need to be "user-friendly" like video games. It is more difficult as there is no "groupware culture" unlike in video-games.

5.4.3 Lessons from Quake-Like's AT

Video-games' AT have already been transferred to groupware. The most common is Radar Views. It enables users with information about where and how others are interacting with a document or a workspace (Gutwin, Greenberg & Roseman, 1996). These radar views are passive and synchronous AT. For example, they can show where users are located in a limited section of the virtual environment, or in which part of a shared whiteboard participants are looking. Transparent layers also provide miniaturized overview of the entire workspace (Cox, Chugh, Gutwin & Greenberg, 1998) as in Duke Nukem 3D. A transparent overview layer can show where are artefacts and people. These layers are different from radar views because they show the whole environment (whereas radar shows only a limited portion) and are mainly active.

Although there are already these examples above, several new ideas have emerged, thanks to this study. First this part focus on the means used to provide information.

A tool for gathering a "task-team" : as video games provide tools to gather a team for playing (as seen in 5.3.4), one can imagine a similar way for people who wants to work on a same task. So it could for instance be useful to improve the "knowledge management" within a company. Such a tool could allow employees to solve a problem in concert. Each participant stores his profile (name, e-mail, skills, interests, previous work, completed project, etc.). And when somebody wants to work on a specific task, he can employ this tool to find the right people to team up with. The research of the conducted team-mates could be on the basis of their profile. Like in video-games a list of "favourite" team-mates could be useful.
This tool may also be interesting in project-based learning to improve collaboration between students and mainly in distance learning. In projects that involve peers, it could be a means to find an accurate partner according to his skills and to his preferences.
Furthermore, this kind of tool might also support just-in-time learning : contacting the accurate person increases the chance to find the right answer to a question.
In all these cases, the designer should keep in mind that he has to build a profile adapted to each application. Gathering students on a project does not require the same information matching as gathering a team of musicians for a web jam-session.

Scripting : Quake enables players to write scripts in order to trigger events by pressing only one key. Such a functionality might be interesting in groupware in order to let the users configure their own AT and triggering the display of the information they want. However, the system must provide an accurate interface to enable an easy configuration. In Quake, this configuration is really difficult for beginners as they have to find variables, which script to modify, etc. A semi-structured interface with a list of information to be displayed might allow participants to construct their own AT. The use of **transparency** can also be very interesting to display this information by the user-configured AT. Transparent overlay is also a great contribution to video-games ergonomics, like quake-like chat or Duke Nukem 3D transparent map.

Auditory cues (non-speech audio) : footsteps, jump noise, weapon noise convey information about action and location. It can be useful to deploy non-speech audio to increase awareness. The fact that these audio cues are less distracting and require few attention (McGrenere, 1996). An example is a match between a sound and an artefact. When a participant uses an artefact, a specific sound could be activated. If the environment is made up of virtual rooms, footstep noise can be deployed to warn the user that somebody is approaching him. However, there must be a control or a limitation, otherwise participants will be overwhelmed and annoyed by noises. Perhaps, the system should limit that sound to a close area of the workspace (if there are virtual rooms for instance). One may pay attention to the cognitive overload that can occur in such a situation : too much perceptual signal can bother the performing of the task.

Direct communication (with a headset) can also be a useful widget but only if it is really needed in the task.

Otherwise, like non-speech audio cues, it can be very annoying. There is also a problem of interface like in video games : the user has to choose the player he wants to talk to. This can be done with a semi-structured interface. If the system allow a direct communication with all the participants, it will be a tremendous cacophony. The number of people speaking must be limited.
The sound may also be spatialized : the volume may depend on the distance between the participants in the virtual workspace.

Moreover, video-games provide ideas about what kind of information can be displayed.

Accurate Information : video game AT show only the useful information that can help participants to perform a task. There is no sense to show cues of location history : a log of the player's location is utterly useless in such games. But it can be useful in CSCL to see if a peer has already visited a virtual room (i.e. if the task involves a trail in virtual place like libraries, simulation rooms, etc.).
In this way, virtual multi-user environments (games or other) may also have to minimize the overhead encountered when showing information. That's why video games show only accurate information and let participants trigger further ones. Quake-like games are very fast, players cannot afford to pay attention to cues of lower priority.

Reactive information : participants have to be explicitly aware of an action undertaken by another player due to the cues left in the environment. It is the role of the system to gather information left by the participants and to transform it in useful information. For example, the modification of an artefact may indicate the team-mates' location. In this case, participants need not to specify where they are in the virtual environment. That's why reactive AT are crucial : it minimizes the player's duty since he does not have to give this information to others.

Work progress : since there is an AT that shows the game progression (the score, the number of captured flags, the number of defused bombs), groupware can employ an equivalent indicator of the work progress. In CSCL, this kind of information may be very important for student tracking. A visualization tool to show physically on the screen the work progress is useful. This kind of tool can calculate this progress : for example, if the students have to write a ten-page paper, when they have written 8 pages, the system shows a progress of 80%. The interpretation is left to the user of the tool (they have to be informed that this percentage is calculated on the basis of the pages already written).

6. Conclusion and further directions

This study has shown that gamers manage to work together without the regular body language vocabulary. Virtual Environment bring them substitute tools to perform their tasks. In this way, first-person-shooter games provide a wide variety of tools to maintain workspace awareness.

These tools do not support all kind of awareness but mostly presence, identity, location, action, action history and used artefact.

Among all the tools found in the games thanks to the qualitative analysis, several ones may be useful in groupware : those which allow participants to be gathered on a task, those which enable direct vocal communication, those which allow users to configure their own AT, etc. Video games also provide indication about the quality of the information displayed. It must be accurate (a system should provide AT adapted to the task) and as responsive as possible to minimize the user's cognitive charge.

We may now study the functionality of such widgets by quantitative experiments during controlled problem solving tasks. Their usability may also be discussed. The issue of privacy may also be addressed as Shoemaker notices (Shoemaker, 2000).

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