

# Mirrors of the World – Supporting Situational Awareness with Computer Screens

**Gerrit C. van der Veer**  
Open University Netherlands  
Heerlen, the Netherlands  
gerrit@acm.org

**with Olga Kulyk and Dhaval Vyas**  
University of Twente  
Enschede, the Netherlands  
{o.kulyk, d.m.vyas}@utwente.nl

## ABSTRACT

In this paper we develop a notion of support for social and situational awareness. Our initial ideas are based on the metaphor of using a mirror to see what you are not looking at. We provide two studies that, for different contexts, apply the metaphor to develop design ideas that fit the context of use.

## Author Keywords

Social Awareness Support, Situational Awareness Support, Displays.

## ACM Classification Keywords

H5.2. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

The use of information technology (IT) is spreading rapidly. Especially in complex situations and in complex task domains IT is applied to support, both, social and leisure activities, and work. In both types of applications, the functionality of the systems is what they are designed for in the first place. However, if the situation is really complex, the availability of relevant functionality does not solve all problems. The users of IT remain human, including the well known restricted capacity of working memory, processing, and attention. This frequently results in a problem of being aware of what is / has been / may next be / going on in the context, including the presence of other people, of availability of objects, history of changes in the situation, and intentions of others towards the future.

We will focus on the concept of awareness, and on envisioning directions for supporting this by applying state of the art IT. We start by providing some observations from our educational practice in distance education. After that we will introduce the mirror as a metaphor for supporting awareness. Next we will analyze some empirical work done as part of PhD projects on, resp., a case of a social office culture, and a case of a complex collaboration. In our conclusion we will reflect on the applicability of our metaphor.

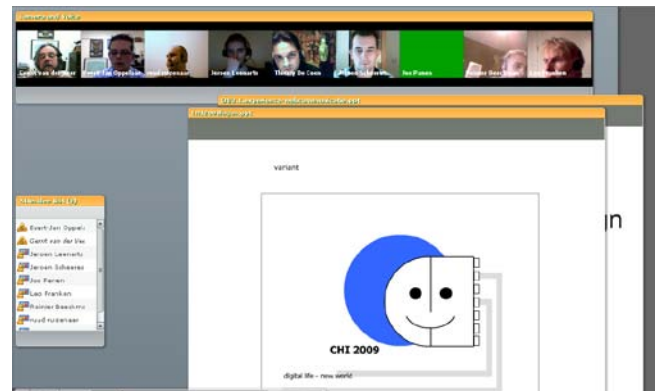
## OBSERVATIONS IN DISTANCE EDUCATION

Our students in the Dutch Open University are adults who mostly have a family and nearly all have full time jobs.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI 2009, April 4–9, 2009, Boston, Massachusetts, USA.  
Copyright 2009 ACM 978-1-60558-246-7/09/04...\$5.00.

On average they can spend only 15 hours a week on their study. They are located all over the Netherlands, the Flemish speaking part of Belgium, and other places where some people speak Dutch (Luxembourg, Denmark, and former Dutch colonies like Suriname). They take classes by going to websites, working from readers and books, and by using Internet laboratories that we develop for them. Sometimes they attend lectures where they interact with their teachers, increasingly through the internet (see Figure 1, this screen is identical for the teacher and for all the students) and only in exceptional cases by meeting in the real world.



**Figure 1. Snapshot of a meeting during a Visual Design course.**

Many teachers, even if they are seated in front of their PC with webcam, earphones, and mike, do not like to talk to a machine. We have the need to check whether my audience is still with us, by eliciting reactions. So we make a joke and then we see 8 or 9 smiles. This helps us to find out whether everybody is there.

With this tool the teacher (and everybody in the virtual class) can see whether the small mike icon below each small face is green. So we know who is making some sound, like who is talking, who vocally agrees, or who is trying to draw attention in order to interrupt.

This requires only simple technology. We do not bother about lip sync video. You just see a face moves, you see the green mike and you hear the talk, and this helps all participants, each of the 8 or 9 students as well of the teacher in such a course. The icons in front of the names in the participant list (left in Figure 1) indicate who is able to upload PowerPoint presentations or other objects, and who is allowed to change the configuration. This type of teaching is very interactive. It makes all participants aware

of what is going on in class, even if some are as far as 500 kilometers away from some of the others, and mostly none is in the same room as anybody else.

This is the type of awareness support tools that we really need for distance education. Some teachers tend to make the use of video cameras compulsory, though even cheap and slow cameras can do the job. Teacher as well as students need to see that everybody is alive and with the group. This has nothing to do with large screens. In fact nobody in this teaching situation uses a large screen. In extreme cases, a student in fact used a mobile telephone, participating from a weird location like an airport!

Another aspect of the tool turns out to support awareness as well: after one student discussed her design, the final PowerPoint sheet is still visible, supporting awareness of what has been presented before. As soon as another student has been allowed to upload his PowerPoint, all participants are aware of the next product to be discussed.

It turns out the way of use is rather personal. We have observed some of our teachers do not like cameras for the students. They feel distracted by multiple moving images. They in fact prefer to “talk to machines” where their own video image is their only visual feed-back.

Our students are working through their curriculum in social isolation. They have a strong need to be aware of what their colleagues are doing, and they are aware of this need. Their context is radically different from students and teachers in classical educational situations who meet each other in offices, class rooms, and coffee corners. Students of Institutes like the Open University hardly ever meet their “group”. They might have a single physical meeting once a year.

In addition, because of the restricted time available for their study, they take rather long for working through their curriculum. Consequently they might meet someone and only after two years physically meet her or him again. But they want to be aware what the others are doing. Our students have developed their own tools for supporting their awareness. Figure 2 shows such a tool for finding a possible study buddy.

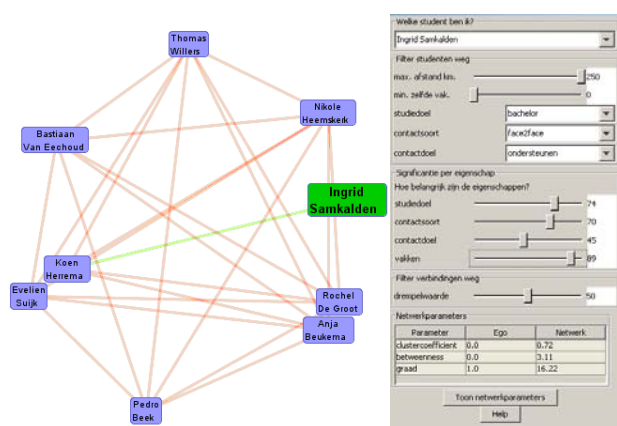


Figure 2. Snapshot of a student-developed find-a-buddy tool.

Suppose Ingrid is working at a course and this one is really hard for her to study on her own. She would like opportunities to discuss topics or concepts with somebody

who understands her situation in this course, and she is prepared to spend an hour driving by car. So with the slider of the tool she sets the distance limit to 100. She also aims at finding a colleague who works at least on some courses she is taking as well.

Maybe for Ingrid agreeing on the goal of the study is not very important but the contact is: she really likes to talk to somebody. If a setting does not work (not enough potential buddies remain) she may change the criterion of being active in so many identical courses. With this tool a student may identify potential study buddies by varying different parameters, like how far is my buddy from me, on how many courses is my buddy working at the same time as I am working on these, and so on.

It is just an illustration of a simple awareness support tool our students develop themselves, strictly based on public domain and open source software, and made available for their colleagues (and in fact for anybody who is interested). The computer science students at the Dutch Open University developed several awareness supporting tools along these lines, like a tool to visualize the relation between authors of, and the elements in, a Wiki that a group of students maintains, and the relation between Wiki elements, or between authors in respect to commenting on each others' products.

Students in this educational context need awareness support. Current technology brings screens to provide a base for this support. Consequently we consider screens from the past that provided awareness support long before computers were the main source for feeding screens

### OLD WORLD SCREENS – MIRRORS AS METAPHOR FOR SUPPORTING AWARENESS

Large screens often are, and always have been, walls, i.e., part of the space. Consider the Hall of Mirrors in the palace at Versailles (Figure 3). This is probably one of the largest “tiled” screens in our world.



Figure 3. Hall of Mirrors, Versailles [1].

For thousands of years people have been spending effort and money to put mirrors in their environments: their homes, their private parlors, their barber shops and their palaces. Even if these hand held mirrors and the mirrors

on walls are in most cases not the main focus of the actual work or tasks people are involved in, they reflect all kinds of data to support what people are at the moment engaged in, and they provide information, and support visions, experience, and emotion.

The main issue of a mirror, and for our discussion the real metaphor, is the fact that the mirror allows you to **see what you are not looking at** (see figure 4).



**Figure 4. A mirror shows what you are not looking at.**

Mirrors have always been used to provide opportunities of, and cues for, social or situational awareness:

- "I can see what you are experiencing" and "You can see what I am living through";
- "I can see what you are (have been) doing";
- "I can see how I will appear to others" (a lady painting her face;
- "If I do not shave they will take me for a terrorist".

Car side mirrors are being used for being aware of

- Potential dangers;
- Where other traffic is currently situated;
- Whether other people (e.g., pedestrians) have decided to cross the street; etc.



**Figure 5. A mirror with to-do notes.**

Mirrors are being used for fun, like the "fairground" type distorting mirrors, or when looking at one's face in a reflecting curved surface. Mirrors have been used as "busybodies" - almost identical to current side mirrors in cars - by Dutch people living in apartment buildings, fixed next to their front window, to see who is at the door, or what the neighbors are bringing home, whom the daughter is talking to at the street corner, or whether somebody is approaching the door for whom they will pretend not to be at home.

Mirrors in people's homes naturally attract both the inhabitants and visitors to look in them. In the Victorian era some people used to put the visiting cards they received from their visitors, in the frame of their hall mirror. Robertson [2] in his comedy script put a stage direction "the mirror stuck full of cards", and one of the actors is supposed to say: "I see by the cards on your glass that you go out a good deal". Certainly, some people carefully selected which of these cards should be displayed to their visitors in order to make the intended impression. Still, in the 20<sup>th</sup> century in certain social settings, people would use the central mirror in their living room to stack the



Christmas cards they received, either to show off the quantity, or to remind themselves of their relations, or both. Since Mirrors are used anyway, people keep the habit of using them as a placeholder for memos to-do notes, and post-it stickers (Figure 5).

To summarize: mirrors have been used for all kinds of awareness support. People use mirrors to support their own awareness, and they use mirrors to manipulate other people's awareness.

The next sections will discuss two studies where modern technology supports awareness in complex settings. In both cases we are not focusing on new functionality to support the main work being done, but on providing proof of concept regarding the additional value of visualizations for, respectively, social awareness in an office culture, and situational awareness in a multidisciplinary team. In both cases, visualization using (often large) displays that are available anyhow, can be of help [3].

#### A CASE OF SOCIAL AWARENESS SUPPORT

Intending to support mirroring oneself to others, we aimed at an artistic approach to support current cultures with new technology. This project was running in a department of a Dutch university. There was a culture of, in some way, showing off to each other, and, in addition, the official management of the department wanted to show off certain things to the population of the department. We intended to find out how we could support this in a playful artistic way [4]. We started to look at the actual workspace [5]. Workspaces reflect their history: they show what has been going on, who has been here. If you have been to the coffee room and you walk away you leave behind a room that tells a lot about what has been happening. In addition, it shows what has not been happening. Look at the pigeon holes in the department coffee room (Figure 6).



**Figure 6. Pigeon holes in the staff coffee room.**

The pigeon holes tell us that several people have not been there in the last couple of days. In fact some people have, in addition to their hole, a big pile of incoming mails on top of the cupboard. These colleagues have not been there for a couple of weeks. And people are aware. If they want to know if somebody has returned from a holiday or sabbatical, they sometimes go to the coffee room and inspect the status of the pigeon hole of that person.



**Figure 7. Shelves with printer output.**

Elements in a room may reveal what activities have been performed like the content of the shelves in the department's printer room tell their story: The computer support people supply a cover sheet with the name of the individual printing account. Each day they put a pile of printing sheets of a different color in the drawer for the cover sheets for the printers. One can find out who has been printing, and who did not pick up his prints for 4 or 5 days. People know this, and they conclude on people's activities and presence, based on this. This information is there for everybody to see and to understand and interpret and this triggers encounters and communication (Figure 7 and 8).



**Figure 8. Piles of messages trigger discussion of people's absence.**

Another element of the Dutch culture is people decorating workspaces to share personal experiences.



**Figure 9. Announcing a baby.**

Figure 9 is an example: when a family has given birth to a baby, the parents announce this by having funny, or religiously inspired, birth cards pinned on the door of the coffee room or on a note board, and one can read (in this case in Dutch) the name of the baby, its weight and other details, and time slots to visit the proud parents. In the same culture, a color (in this case the blue baby pant) indicates the gender of the baby.

Workspaces are “designed” to by some people to make others aware. Figure 10 shows the door of a department secretary. She sticks notes on her door when she is temporarily absent, like the enlarged note announcing in two languages that she is currently to the main building. On the inside of her door there is a growing collection of reusable notes, in several distinctive colors (which mainly helps her to quickly select one from the relevant category). This is designed for awareness, by the individual employee.



**Figure 10. Elly's collection of “out of the office” notes.**

As part of a PhD project, Vyas [4, 5] developed an idea for an artistic addition to the shared environment of the

workspace. The functionality was developed by involving the inhabitants of the work space: We talked to people and showed scenarios to them. This part of the project included three phases.

In the first phase individual people were walked through different scenarios, indicating what kind of information could be represented on a large screen in a public space, and whether it was on the screen all the time or it moved and the temporal sequences of what was shown. E.g., if you wanted people be aware of the birth of your baby, should you show the picture all the time, should the picture move, come back after 5 minutes, and should you keep it there for weeks or just one day, etc. People were in a very free way asked what they would like, and how they would interpret it.

The second phase consisted of group sessions where people were looking at new version of the scenarios and discussing this. In fact this design was a dynamic awareness wall:

- Showing where the crowd is: the common places like the coffee room and the print room where people could go for having a coffee or collecting their prints, and (in addition) could meet and talk, or get information that could support their awareness of what is going on in the department.
- Showing the current state in shared spaces. E.g., once a day one of the secretaries puts new (physical) mail in the pigeon holes. People could find out if the mail was already distributed, and if there was something delivered for them.
- Showing what people wanted to show: (a) Personal information: “I got my drivers license”; (b) Professional information: “I had a paper accepted”; and (c) Official announcements and information: “the dean of the department announces that there will be a new Masters program next year, the program is accepted by the Authority of University Education”.



**Figure 11. A prototype dynamic awareness wall.**

The third phase consisted of a proof of concept of the design: A large projected dynamic image in the shared workspace (actually the coffee room) was installed and left alone and we did an ethnographic study, see Figure 11. People were just confronted with it. No official



explanations were provided. We wanted to find out what people said about it, and how they gave a meaning to the moving images were things were moving with different speeds. Actually, the speed was related to the amount of crowd in a certain place. That is the current state. It is proof of the concept: yes, we can show all this awareness support in a casual way, and we can allow people to input things by sending a notice that for a couple of days will move across the screen. Some people understand and interpret and some people see funny things they do not understand.

### **SUPPORTING SITUATIONAL AWARENESS IN A COMPLEX TEAM COLLABORATION CASE**

This example is part of a PhD project that concerns a collaborative environment that had just been implemented, and that is used by multidisciplinary teams that do genomic research on cancer etc. [6, 7]. There is a large variety of screens: large screens, a tiled display, personal screens, and even a traditional white board. People are walking around and pointing to visualizations (Figure 12).



**Figure 12. E-BioLab, MAD/IBU, University of Amsterdam.**

Multidisciplinary teams consist of biologists, statisticians, and computer scientists. Each of these speaks their own professional language, even though they all speak English and sometimes Dutch, they do not normally understand each other. Each discipline has their preferred types of representations that do not match the other one's, and they have to collaborate in very complex experiments. The biologists cannot work without the statisticians. The statisticians would not know how to do the statistics if the biologists could not answer their questions. As a collaborating team they need simultaneous representations for various disciplines, and they use multiple displays and interaction devices (Figure 13). In this context they frequently lack awareness of who is in control of shared displays, and what is going on at displays that are being used by "another" discipline. They are working together and they really have problems.

Goal of this study is to support multidisciplinary teams in collaborative environments. So far two concepts for situational awareness support have been developed and assessed in a real life situation: the Memory Board and Highlighting on Demand:

The Memory Board automatically stores & visualizes the history on a shared display. This is something the individual users do not have to do, a tool has been

developed that will automatically keep track of the changes and of who did what. This awareness support tool allows team members to retrieve annotations made on previous visualizations (Currently they frequently forget what has been shown and decided in a previous session, and, consequently, they disagree among each other on decisions taken and on who is responsible for implementing these).



**Figure 13. Multiple displays and devices.**

This enables sharing, and thus supports coordination mechanisms and shared situational awareness. In addition it provides awareness of who is currently in control of any display, and who is manipulating and annotating the visualizations. This helps to solve control conflicts about annotating the visualizations and manipulation of shared displays.



**Figure 14. Highlighting on demand.**

Highlighting on Demand actively focuses attention on changes in visualizations (highlighting) and on relations between visualisations. In future we intend to enable this on a shared large display, where currently the system only enables a scientist to highlight part of a tiled display using a slider on a personal interaction device (e.g., a TabletPC, see figure 14).

So far this is proof of concept, but certainly not the final solution we envision. We are currently assessing shared situational awareness of team members.

## CONCLUSIONS

We showed how our mirrors metaphor inspired the initial design for awareness support by providing visual representations in people's work places. We elaborated these ideas for two types of context: a social cultural university community, and a multidisciplinary team collaboration case. Our study, so far, only provides proof of concept: Yes, it can be done, and, yes, people seem to understand what it is supposed to bring them. Proper assessment, as well as the development of a thorough taxonomy of awareness support tools will have to follow.

## ACKNOWLEDGMENTS

We thank our Open University students, the staff members of the Vrije Universiteit Amsterdam, and the members of the experimenting teams in the e-BioLab.

## REFERENCES

1. Wong, J. downloaded from VirtualTourist, June 29, 2009,  
<http://members.virtualtourist.com/m/p/m/2b1eb2/>
2. Robertson, T.W. SOCIETY. A comedy in three acts. New York: Robert M. De Witt Publishers, 1865
3. Kulyk, O., van Dijk, E.M.A.G., van der Vet, P.E., Nijholt, A., van der Veer, G. (2009) Situational Awareness Support to Enhance Teamwork in Collaborative Working Environments. In: *Handbook on Socio-Technical Design and Social Networking Systems*, B. Whitworth and A. de Moor (Eds.), Hershey PA, 635-649.
4. Vyas, D., van de Watering, M. R., Eliëns, A., van der Veer, G. C. (2007). Being Social @ Work: Designing for Playfully Mediated Social Awareness in Work Environments. In: *Home Informatics and Telematics: ICT for the Next Billion*, eds. Venkatesh, A., Gonsalves, T., Monk, A., Buckner, K. IFIP 241, Boston: Springer, 113-131.
5. Vyas, D., van de Watering, M., Eliëns, A. & van der Veer, G.C. (2007). Engineering Social Awareness in Work Environments. *Universal Access in Human-Computer Interaction*, Part II, HCII 2007, LNCS 4555, Springer-Heidelberg. 254-263.
6. O. Kulyk, G.C. van der Veer and E.M.A.G. van Dijk (2008) Situational Awareness Support to Enhance Teamwork in Collaborative Environments. *Proceedings of the 15th European Conference on Cognitive Ergonomics*, J. Jorge (Eds.), ACM, New York, 18-22.
1. Vyas, D.M., Kulyk, O., van der Vet, P.E., Nijholt, A., van der Veer, G.C. (2008) Structures of Life: The Role of Molecular Structures in Scientists' Work. *Proceedings 15th European Conference on Cognitive Ergonomics*, Sep. 16-19, Madeira, Portugal, J. Jorge (Eds.) vol. 369, ACM, New York, 58-61

