Supporting Social Awareness on the World Wide Web With the Handheld CyberWindow

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ABSTRACT

For various reasons, the World Wide Web is an appealing platform for CSCW systems. Web-enabled handheld computers will raise further opportunities, enabling a *continuous* network connection. The Web is becoming a global nervous system, providing support for all kinds of real-time signals. A permanent flow of messages will help us stay aware of our social environment. But to create a smooth bridge between the real world and cyberspace, we need novel interaction techniques for communication devices. We present our current effort in this direction and illustrate our discussion with the CyberWindow prototype. This handheld device conceptually connects the real world with cyberspace. It first allows people to maintain awareness about the activity occurring on their Web site, by means of natural sounds and speech synthesis. It also allows visitors of a site to more easily engage a communication process with the information publishers.

Keywords

Audio user interface, handheld computing, social awareness, World Wide Web

INTRODUCTION

The World Wide Web is receiving a growing attention from the CSCW community. BSCW [2], Futplex [8] and GroCo [15] are a few examples of Web-based collaborative systems. Among other reasons, the Web is attractive because it is based on open standards. Software implementations are available on a wide range of platforms, which ensures easy access, at low cost and across an organization's boundaries. Dix [4] provides with a discussion on this issue.

Web-enabled handheld computers should further stimulate this interest. In a ubiquitous computing environment, they will contribute to offer a *continuous* network connection, fostering a range of unforeseen applications. Today, the Web is still close to a huge document repository, where information is accessed by *intermittent* connections. Collaboration is essentially asynchronous and people rarely meet each other. But tomorrow, the Web could evolve to become a global nervous system, to which everyone would be smoothly and permanently connected. Not only will synchronous communication be possible. We believe that the medium will be used to carry a vast diversity of real-time signals, helping us to maintain awareness about our environment. Instant messaging systems, such as ICQ [18], are a first step towards this vision. These applications allow users to know when their acquaintances are on-line and to send them brief messages. They would greatly benefit from the widespread use of networked handheld devices, users being on-line and reachable most of the time.

Of course, people are already collaborating on the Web. Electronic commerce and distance education are not visions of the future any more. But despite relative success, the Web is still far from a real social space. It seems that a major problem lays in the very strict separation between our physical world and the emerging informational universe. As we are able to hear somebody entering our office, we should be able to hear somebody entering our home page. With this concern, ubiquitous and mobile computing environments are very promising. Once the semantic link between physical and virtual spaces is established, they will make it possible to *constantly sense* the activity occurring in cyberspace.

In this paper, we first look at the notion of social awareness on the Web and review some related work. We then describe our approach to that problem. In particular, we focus on the role of handheld computers, which are envisioned as a smooth articulation point between the real world and cyberspace. We argue for the need of appropriate interaction techniques and look at the metaphor of glass windows. We illustrate our ideas with the CyberWindow prototype system, which allows people to maintain peripheral awareness about the activity on their Web site. The system integrates handheld computers wirelessly connected to the network. Natural sounds and speech synthesis are used to *sense* Web visitors in the real world. Figure 1 proposes a sketch of what could be a wearable CyberWindow. Our first prototype, however, uses more conventional palmtops computers.

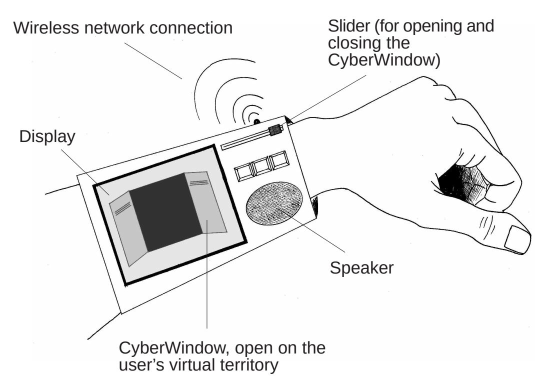

Figure 1. Tentative sketch of a wearable CyberWindow

SOCIAL AWARENESS ON THE WEB

Awareness is a well-known issue for CSCW systems. Although various kinds of awareness have been identified, Dourish [5] provides with a general definition : "awareness is an understanding of the activities of others, which provides a context for your own activity". The difficulty of maintaining awareness contributes to make remote collaboration very difficult. Systems like media spaces [3] or AROMA [11] have addressed this issue, making it possible to monitor what is happening at a remote location.

It is interesting to look at how the Web relates to awareness. A first perspective is to consider the Web simply as an implementation support. In NYNEX Portholes [6] or @Work [13], Web pages are used to display live images from distant locations (usually the workspace of colleagues). In other words, *the Web is used to carry information that reflects activity occurring in the real world*.

But another viewpoint is to consider that *the Web itself is a space where social activity is taking place*. People are coming and going, ordering products, answering questions, etc. This raises two interesting questions. First, how could we make "nearby" Web users aware of each other. Second, how could we make people in the real world aware of what is happening in their on-line territory. The first question has been addressed in various systems [7],[10],[12],[14]. The Internet Foyer [1] and in some respects the Dangling String from Jeremijenko [16] and the Tangibles from Ishii [9] are looking at the second one.

In Figure 2, we propose a classification of the previously mentioned work with regards to the two spaces i) where the activity is captured and ii) where it is reported.

	System captures activity occurring in the real world	*System captures activity occuring on the WWW*
Activity is made explicit on the WWW	NYNEX Portholes @Work WebCams	CoBrow Awareness on the WWW MetaWeb GroupWeb
Activity is made explicit in the real world	Media space AROMA	Internet Foyer Dangling string Tangibles CyberWindow

Figure 2. Classificiation of related work

Bridging the real world with the Web

The problem we are focusing on is to create a bridge between the real world and the Web, allowing events occurring in one dimension to be propagated in the other. With this aim, we propose to adopt a strategy in three phases :

1. Develop mechanisms to capture and notify activity on the Web. This means for example monitoring and interpreting HTTP requests and designing proper user interfaces to "look" into real world spaces.
2. Provide with solutions to capture and notify activity in the real world. This essentially implies the use of sensors such as cameras, microphones and location tracking systems. It also suggests the use of displays, speakers and tangibles to materialize cyberspace.
3. Find out ways for defining semantic associations between on-line and real-world spaces. We need a way to know *whom* we should notify when a given URL is accessed. Although this is out of scope for this paper, let us mention that the emerging standards for metadata on the Web [17] will provide with an appropriate infrastructure to solve this problem.

The need for new communication devices

Handheld computers are of prime importance in this vision of a ubiquitous World Wide Web. Communication devices are fundamentally important, because they represent the connection point between two dimensions. On one hand, they have a physical existence and are able to produce sensorial manifestations, sounds and images for example. On the other hand, they have a computational existence as they are running software. A device provides therefore a path for the signals exchanged between the physical and computational dimensions. Moreover, unlike conventional PC's, handheld devices have the big advantage to easily maintain this link as the user changes his location.

To illustrate the role of mobile devices, we compare in Figures 3 and 4 two types of interaction, as they occur in a co-located situation or over the distance. We also examine what devices are supporting remote interaction. In Figure 3, the *active* interaction consists in attracting a person's attention before addressing him a message. In a co-located situation, a person generally says a few words (like "Excuse me…") and when eye contact has been established starts speaking. Mobile phones enable this kind of interaction over the distance : a person dials a number to attract someone's attention and, when contact has been established, starts communicating.

The *passive* interaction depicted in Figure 4 is common in co-located activity. People continuously receive audiovisual clues helping them to monitor the status of others. Just by glimpsing from time to time, they are able to tell what is the activity of others. Unfortunately, we do not know yet of any device supporting this kind of interaction over the distance. Media spaces are looking at that problem, but the infrastructure is often bulky and therefore prevents people from using it on the move.

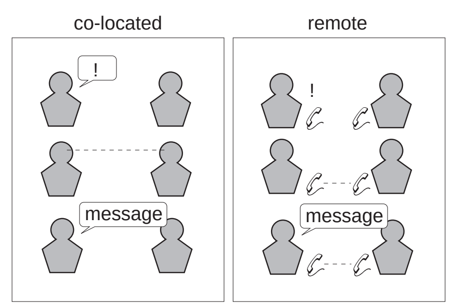

Figure 3. Requesting a person's attention

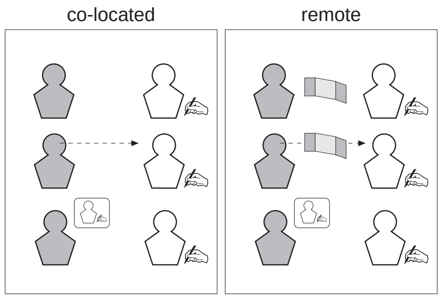

Figure 4. Monitoring a person's status

Web-enabled handheld computers appear as good candidates, as they allow users to receive a continuous flow of messages. Yet the question to know how we should interact with these devices remains.

Interacting with virtual windows

Communication devices should allow us to *glimpse* at and *hear* about the activity of our peers. Activity taking place in the real world but also in cyberspace. With this idea, a glass window appears as a very nice interaction metaphor. When talking about ubiquitous computing and calm technology [16], Mark Weiser explains how inner office windows allow a multitude of small clues to reach the periphery of our attention, helping us to stay aware of our environment.

Windows have many valuable features, we would like to briefly mention three of them. First, a window is a connection point between two spaces. For example, a window connects the inside of an office with the outside. But a virtual window could also connect a physical and a virtual space, for example someone's home page with his living room. Second, a window offers a simple way to filter the amount of information transiting between two spaces. When closed, it blocks most of the signals ensuring a low disturbance. Third, a window originates a communication area. As people in each space approach the window, they are able to talk to each other. A virtual window could allow people to approach your vicinity and to talk to you across the network.

THE CYBERWINDOW PROTOTYPE

To illustrate our ideas, we have implemented a prototype that we called the CyberWindow. The goal of the system was to give people some real-time and informal feedback about the activity on their Web site. It was also to allow the visitors of a Web site to more easily engage a communication process with the information publishers. Space prevents us to give all implementation details, reason for which we will limit the discussion to a general overview and to some user interface issues.

System overview

The overall system is depicted in Figure 5. People moving in the real world are equipped with handheld computers, wirelessly connected to the network. Namely, these are Toshiba Libretto palmtops (see Figure 6) with a 10T infrared Ethernet connection assured by the Victor VIPSLAN-E system (see Figure 7). The software running on these devices includes a TCP/IP client with a user interface based on the window metaphor (see Figure 10) and integrates a text–to–speech engine.

Every person carrying a CyberWindow is constantly linked to a region of the World Wide Web and is notified of events occurring in that virtual space. Web visitors generate two categories of events :

1. First, each HTTP request is captured by a Monitoring Agent and notified to the relevant CyberWindows. This means that the visitors are not aware that they generate events and corresponds to the situation where one sees somebody behind a glass window, although that person did not necessary have the intention to be seen.

1. Second, special Web pages allow visitors to see the virtual side of the CyberWindow. A Java applet (see Figure 9) is used to communicate with the person who is "behind" the CyberWindow, in the real world. This corresponds to the situation where one approaches an open window and starts talking with the people on the other side.

An important component of the architecture is the Window Server, a TCP/IP daemon that can be running anywhere on the Internet. It accepts connections from the software running on handheld devices, from the Web Monitoring Agent and from the Java applets. It links them together and allows them to exchange messages.

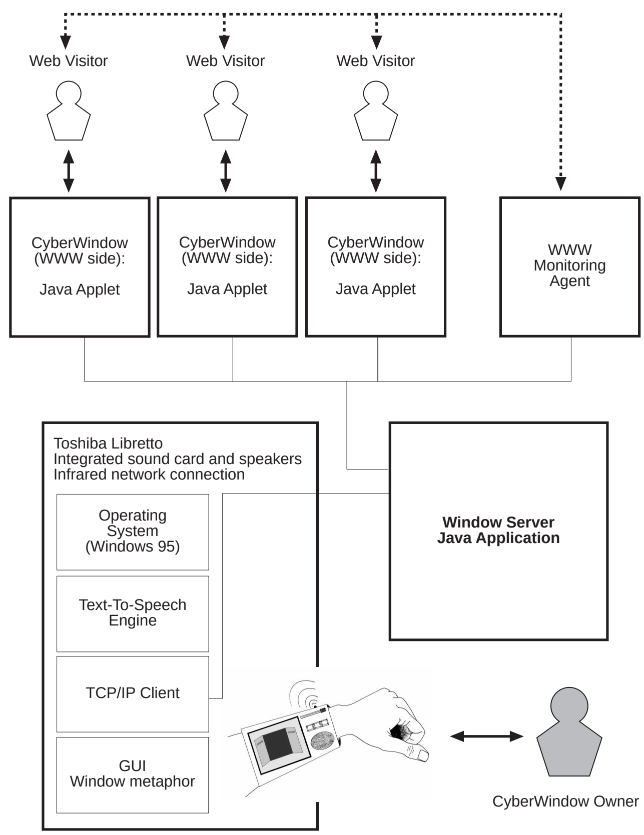

Figure 5. System overview

Figure 6. Toshiba Libretto palmtop computer

Figure 7. Infrared wireless LAN system

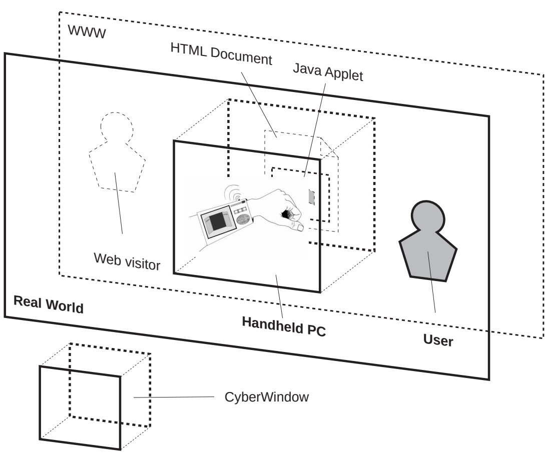

Figure 8. The two sides of a CyberWindow

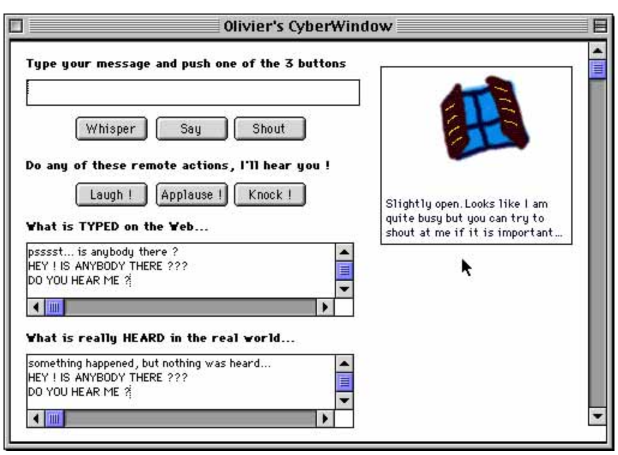

Figure 9. The "WWW" side of the CyberWindow

User interface

It is important to understand that each CyberWindow has two sides. Figure 8 shows how somebody visiting the Web site sees one side and how the person carrying the handheld device sees the other. We have designed a different user interface for each of these sides, which we now briefly describe.

On the Web site, visitors can go to a special page and load the Java applet that is illustrated in Figure 9. An icon indicates the aperture angle of the CyberWindow, as specified by its owner. This gives an idea about the availability of that person and if it is appropriate to disturb him/her. A text field is used to enter short messages, which can be "whispered", "said" or "shouted". Note that a whisper will only be heard (i.e. rendered by the text-to-speech engine) if the window is wide open. The visitor can also perform a few remote actions (laugh, applause, knock) that will result in sounds being generated in the real world.

The user interface on the palmtop is shown in Figure 10. Our main concern with this prototype was to design a non-obtrusive tool, which would provide the user with some informal information without requiring the center of his attention. Clearly, the user should be able to concentrate on his/her main activities while being notified by background signals. It should also be very easy for the user to filter the amount of notification events, depending on his availability. This has motivated our choice for a mainly audio interface. Moreover, we have preferred to use natural sounds (e.g. bird songs, dog barking, etc.) rather than usual "beep's".

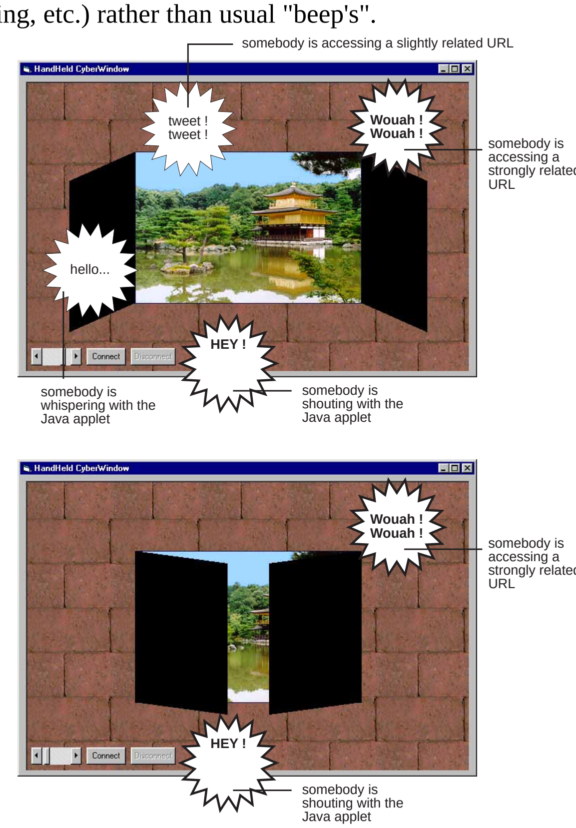

Figure 10. The "Real world" side of the Cyberwindow

The main reason for this was again our strong desire to gently integrate the communication tool in the user's environment. Another reason is that it is possible to use a vast variety of distinct sounds, which can then notify different events. We have used this feature in the prototype by defining levels of interest for a given URL. For example, one is i) very interested by accesses to his personal home page, ii) slightly interested by accesses to his department's home page and iii) not interested at all by accesses to another department's home page. Access to a highly relevant page is then notified by a low pitch sound (such as a dog barking), access to a little relevant page is notified by a high pitch sound (such as a bird song). This is easily interpreted by the user, who can discern between important and not important events. Moreover, by changing the aperture angle of the window, the user can decide whether all sounds, low pitch sounds only, or no sounds at all are generated.

CONCLUSION

We have argued for the need of creating a smooth bridge between the real world and cyberspace. As social activity is increasingly occurring on the Web, it is important to develop mechanisms for maintaining awareness about what is happening in one's on-line territory. We have explained the role of Web-enabled handheld devices with this aim, in the sense that they provide people with a continuous network connection. We have discussed the need of proper interaction methods for these devices and illustrated our ideas with the CyberWindow prototype. This system relies on the window metaphor and uses a combination of natural sounds and speech synthesis to *sense* Web activity. Although we still have to conduct a proper user study, early reactions are very encouraging. Our future work will therefore focus on an extension and refinement of the system.

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REFERENCES

1. Benford, S., Brown C., Reynard, G., Greenhalgh, C., Shared Spaces: Transportation, Artificiality, and Spatiality, *in Proc. of CSCW'96* (Cambridge, USA), ACM Press, 1996.
2. Bentley, R., Horstmann, T., Trevor, J., The World Wide Web as enabling technology for CSCW: The case of BSCW, in Computer-Supported Cooperative Work: Special issue on CSCW and the Web, Vol. 6, (1997), Kluwer Academic Press.
3. Bly, S. A., Harrison S. R., Irwin S., Media spaces: bringing people together in a video, audio, and computing environment, *Communications of the ACM*, Vol. 36, No. 1 (Jan. 1993), Pages 28-46.
4. Dix, A. Challenges and Perspectives for Cooperative Work on the Web, In: Busbach U., Kerr D. and Sikkel K. (eds), ERCIM workshop on CSCW and the Web, Sankt Augustin, Germany, 1996, GMD/FIT.
5. Dourish, P., Bellotti, V., Awareness and Coordination in Shared Workspaces, in *Proc. Of CSCW'92* (Toronto, Canada), 1992, ACM Press.
6. Girgensohn, A., Lee A., Schueter K., Experiences in developing collaborative applications using the World Wide Web "shell", *in Proceedings of Hypertext'96*, ACM Press, 1996.
7. Greenberg, S. and Roseman, M., GroupWeb: A WWW Browser as Real Time Groupware, in ACM SIGCHI'96 Conference on Human Factors in Computing System, Companion Proceedings, p271-272, 1996.
8. Holtman K., The Futplex System, In: Busbach U., Kerr D. and Sikkel K. (eds), ERCIM workshop on CSCW and the Web, Sankt Augustin, Germany, 1996, GMD/FIT.
9. Ishii, H., Ulmer, B., Tangible Bits: Towards Seamless Interfaces between People, Bits, and Atoms, in *Proceedings of CHI '97*, ACM Press, 1997.
10. Palfreyman K., Rodden, T., A Protocol for User Awareness on the World Wide Web, *in Proc. of CSCW'96* (Cambridge, USA), ACM Press, 1996.
11. Pedersen, E.R., Sokoler T., AROMA : abstract representation of presence supporting mutual awareness, in *Proceedings of CHI '97*, ACM Press, 1997.
12. Sidler G., Scott A., Wolf H., Collaborative Browsing in the World Wide Web, *in Proceedings of the 8th Joint European Networking Conference*, Edinburgh, May 12.-15. 1997.
13. Tollmar, K., Sandor, O., Schoemer, A., Supporting Social Awareness @Work Design and Experience, *in Proc. of CSCW'96* (Cambridge, USA), ACM Press, 1996.
14. Trevor, J., Koch, T. and Woetzel, G., MetaWeb: Bringing synchronous groupware to the World Wide Web, *in Proceedings of the European Conference on Computer Supported Cooperative Work (ECSCW'97), Lancaster, Sept. 1997*, ©Kluwer Academic Publishers.
15. Walther M, Supporting Development of Synchronous Collaboration Tools on the Web with GroCo. In: Busbach U., Kerr D. and Sikkel K. (eds), ERCIM workshop on CSCW and the Web, Sankt Augustin, Germany, 1996, GMD/FIT.
16. Weiser, M., Brown J.S., Designing Calm Technology, *PowerGrid Journal*, Version 1.01, July 1996, http://powergrid.electriciti.com/1.01.
17. World Wide Web Consortium, Metadata Activity, at http://www.w3.org/Metadata/Activity.html
18. ICQ Home Page, at http://www.icq.com