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# A Cue-based, Integrated System for Supporting Social Awareness

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# A Cue-based, Integrated System for Supporting Social Awareness


## Abstract

In this work, we are considering various ways of providing social awareness in such working places that are flexible in terms of schedule and working methods. We are following a number of experiences from IPLab and CID, coming from both methodical research and workplace organization measures. Our contribution attempts both to bring solutions to the problems that were found and to propose totally new approaches. We claim that a highly flexible awareness system, based on passively collected awareness data, which we call cues, and on multiple ways of displaying a unique set of awareness information (inferred from the cues) is likely to overcome past systems' liabilities. We also consider alternative input devices for collecting (actively or passively) awareness information. Some of them are output devices too.


## Introduction

Awareness is of an important concern lately in the CSCW research. In an early contribution on this issue, Dourish and Bellotti [Dourish 92] define it *as understanding activities of others, providing a context for your own activity*. As a primary distinction, awareness information can be either *explicitly generated* or *passively collected and distributed*. While Dourish and Bellotti assume a concrete *object of collaboration* and consider awareness in that context, one can focus on the awareness about the social situation of the co-workers. S*ocial awareness* was under the focus of the @work project at IPLab [Tollmar 96].

The @work system went through a number of prototypes, informed by participatory design workshops and by feedback to the already existing system. The last version of the system is seaminglessly integrated with the lab's web pages. It collects information explicitly from two sources (web and telephone PDE) and presents it on web (a public version and one for lab members only), PDE and as a response to a UNIX command.

The web version of the awareness presentation resembles an older social awareness tool at IPLab, the sign-in board. We consider this tool of great importance, since it was shown that people trend to value physical systems and representations very much [Bellotti 97]. Practically @work brings an electronic form of the sign-in board to the web and the telephone PDE. But the two systems (@work and the sign-in board) are separate and most likely to present different / inconsistent information.

A relevant fact is that some co-workers preferred not to use the sign-in board, but to write on small boards near their doors, since they were closer (good for writer) and physically related to them (good for the readers), or simply to leave a (sometimes recycled or

prepared) post-it. These "ad-hoc systems" provided yet another alternative for the sign-in board and its web-PDE version.

As with many other collaborative systems [Grudin 88], the sign-in board and @work were used by most co-workers in the beginning, and then let down by some users, while still being used by the others. This unfortunate distribution of collaborative information, through usage of various separate systems by different persons, for various reasons ranging from technological limitation to personal preference, can decrease the potential of collaboration by loosing valuable information from users which can make some or even all the different systems fail. In this paper, we are trying to give some answers to this phenomenon (the unfortunate spreading of collaborative potential) in the particular case of social awareness.

## Cues

Our approach is to construct a picture about the social situation of the co-workers from a variety of little pieces which we call cues. A cue is a passive or explicit way of collecting awareness information in an *integrated* system. Different persons can choose to provide different cues to the system, and can fine-tune which cues to be presented to whom. Each cue comes with a software driver and sometimes with a physical sensing equipment. Due to technological limitations, a cue might not be available for all platforms, but the system allows for other cues to provide similar information.

In these terms, @work provided two forms of explicit cues (information set by phone and by the web). Also, IPLab did not have an integrated social awareness system, since the "competing" sign-in board and the door-boards were present. In our view, a certain cue should not be used if it cannot be integrated with the others, to form an integrated system.

Another problem we see is that explicit cues are creating an undesired workload on the co-workers since they need to be set manually. For this reason, we are giving very much attention to the passively collected cues. We found passive cues coming from surprising sources, such as the lecture's schedule as a cue about the social situation of a teacher. This leads to a category of passive cues that extract information from other information systems while they are used for other purposes, with social awareness coming as a side effect.

An important category of passive cues is provided by alternate input devices. Location-aware devices [Beadle 97] can be important cues. Other simple devices attached to different physical things in the office or other individual or group working places can give valuable information as well.

Another category of cues that popped up while people were using @work is that of passive cues that turn into explicit ones by entering a minimum amount of social awareness data "on the way" while performing some other action. The classical example is having the possibility to lock the screen (a passive cue) by more than one command, each of which indicates why the person actually leaves the console (go to lunch, teaching, meeting, home, etc.). The effort of choosing from a number of buttons instead of pressing a single one (lock screen) was found as minimal by the co-workers who used it. An important observation is that not all co-workers had this facility in their desktops, and this is in line with the cue flexibility we propose.

We consider cues as a strong base for a more successful social awareness system because:

- people are not forced to use a cue that they do not like, for example, because of their particular working style and habits. Instead, we strive to provide a software driver for each person's cues of choice. Discussions with persons to identify good cues about their social status will be an important part of the system design

- clients running on multiple platforms can contribute to the system. There are platforms that provide valuable primary cues (e.g. UNIX) and some people can choose to use them. Sometimes similar (although not identical) cues can be found on other platforms. The lack of similarity (no common protocols for such software cues) is not a drawback since they are similar enough being cues, which is sufficient for the system to treat them correctly. Access to a particular technology is a frequent problem that limits collaboration potential and is reported also for the @work system. Letting different technologies contribute in different ways can be a possible answer to this problem
- if one cue fails to provide information about a person, other cues can substitute, achieving a sort of fault tolerance. A less stronger argument can be made about a cue that provides inaccurate information (inaccuracy detection can be made from other cues)

## Secondary Cues

Processing the above cues (which we call primary since they get information directly from the environment) may lead to the inference of secondary cues.

A category of secondary cues can be obtained by monitoring the evolution of a certain cue coming from a person (individual). Another related category of secondary individual cues is the combination of different cues coming from a person.

A more complex and very useful category of secondary cues is given by the combination of primary and secondary individual cues. For example, combining cues from multiple persons to get to a group cue such as "meeting" or even inferring that it is an "informal meeting" since it can't be found in any agenda (agendas will be exemplified as primary cues).

Some important issues can be raised about the accuracy of secondary cues, since they come from heuristics. We will address this problem in a forthcoming section.

## Cue Design

As a main difference from @work and other systems, a cue-based system will not try to find a “common way“ for all its users. Instead, the design sessions with the users will concentrate on finding the most suitable set of cues for every person.

Letting the user choose and prioritize their cues provides valuable information for those who would make “general“, “common sense“ assumptions otherwise. For example, it is a general assumption that people check their e-mail regularly when they are in office. A recently emptied mailbox is generally a cue denoting an available person, while a full mailbox with mails last read a long ago generally denote an unavailable person. Still, this is not true in some cases. The persons who read e-mail once a day would then not set “mailbox status“ as a cue of their social status.

An important issue will to keep the users aware of new cues that are available to be used for providing better social awareness to the co-workers, and/or encourage them to use the new cues. Another dynamic aspect is the changes that occur in the suitability of different cues for a user.

It is intended that *cue gardening* will take place. In this context, gardening implies both reusing of cues in similar situations as well as monitoring the evolution of a certain cue, attempting to help it “grow“ by improving the related software and/or hardware, promoting the successful and giving up the unsuccessful cues.

Here is a set of considerations that will be made for each cue:

**Availability:** where is the cue available (platforms, locations, people)?

**Combinations:** can the cue be combined with other cues, to obtain secondary cues?

**Priority:** which cue should take precedence if there are conflicts between different cues?

**Privacy:** is the cue invading user's privacy? If the users allow it's use, is there any limitation in terms of details shown to different people accessing it?

**Possible other use:** could the cue provide information to other systems / applications? (E.g. automatic xnlock or location aware cues: route phone calls to the nearest phone).

## Cue Menus

The following is a list of some of the primary cues that the system might have access to. These cues will be presented as a "menu" to the users during design.

### "OS" Cues

This type of awareness cues is provided by the users Operating System (mainly UNIX). It is possible to have cue drivers for them implemented on other systems as well.

- **console login** can give the about location of a person. It is a weak cue since the user may leave the terminal for extensive time without logging out. But combined with the keyboard and xnlock can give very useful information.
- **keyboard** can be used to detect if a user is at his / her computer, for example, if the user used the keyboard during the last five minutes this cue might be recorded as "about office". There are lots of privacy concerns about this particular cue [Tang 94]. Also, generally only information about keyboard usage in a shell is available (while shells are less and less used in favor of file and web browsers, and mail clients).
- **last** command shows the last users on a machine, the console they come from, etc. Provided the physical location of the console is known (using badges to determine it might be a very flexible hassle-free way, especially for mobile consoles like laptops).
- **mailbox** status is an important cue for people who check their mail regularly when they are in the office (exemplified above).
- **xnlock** is a small X windows program that locks the terminal for a time without the user having to logout. When this program is running it usually means that the user is away from his or her terminal. It was shown above how this passive cue could be turned into a more explicit one.
- **ps** and **top** commands list processes on a computer the information available includes, among other things, process startup time. This information can also help to better understand a person's activity, thereby getting more social awareness.

A connected command to the above cues is **finger**. The ambition is for finger to be an outlet (see below) of the social awareness system, so that it presents information which is possibly inferred from other cues than the traditional console login, mailbox status, etc. This information will be consistent with the one presented by the other outlets, and might present different information to different users according to level of awareness.

### Agendas and Scheduling

Such cues can give valuable information on a person's availability.

- Computerized **agendas** can provide lots of information, they have the obvious use of telling where the owner is, also combined with group / badge-cues the system could guess the location and duration of otherwise unlocalized persons at a meeting.
- **lecture/lab/seminar schedule** can bring valuable information about teachers and instructors' availability. This can be generalized to any group activity.
- similar information can come from **room booking** systems

### Physical

These cues come for devices that are *not* traditional input devices (like mouse and keyboard).

- **location-aware badges** [Beadle 97] can give accurate location information in a setting. Various secondary cues can be inferred from this, such as meeting detection. An early system is Olivetti's ActiveBadge [Harper 93]. There are privacy issues connected to this [Pier 91] and complex solutions were provided such the ones in the Smart Badge [Beadle2 97].
- **infrared-capable PDAs** (such as Message Pad, or Palm III) can be used both as location-aware devices and as remote control-like explicit cue entering devices.
- **physical office cues** come from sensors in the physical office, for example, lights (on / off), doors (open / closed). These cues must be adapted closely to the individuals since people use them differently. For example, a person might use the blinds on their window towards the corridor when they are busy and don't wish to be disturbed. With a simple contact, this information can get in the system as a cue and get displayed in many other outlets than the actual physical one, together with their meaning ("do not disturb") which might not be obvious for everybody (especially for outsiders) otherwise.
- **sign-in board (common and personal)** may be fitted with sensors for text recognition, or just writing image recording [Mackay 98] that can be accessed from the system. A personal sign-in board may also be fitted to a user's workplace (especially if the user seldom passes the offices common sign-in board). The personal board may also be fitted with switches for classical states, for example "out for lunch", "on lecture", "at other workplace" etc. **Smart post-it**s can be used as an alternative. They can be made of a usual post-it showing a certain message having some index information attached to it, so that the post-it can be detected by some form of sensing while posted on the door, and its message shown in the other outlets.

### Social Context

Information about different aspects of the social context can lead to important cues.

- **Visitors.** A person with visitors should probably not be disturbed. To determine if a person has visitors guest-badges can be used.
- **Groups** are an important source of information. As pointed in [Tollmar 96], *virtual networks* of co-workers trend to be formed. We will call the groups, and consider them as reflecting either the different ongoing activities at the working place, or common interests. In combination with other cues, groups can, for example, tell a member of a spontaneous meeting of the rest of the group. Using group cues is no easy task since people usually belong to several overlapping groups. Groups can automatically extracted from, for example, mailing-lists, or afs-groups, they could of course also be entered explicitly into the system. Another idea is to have the system itself making

and maintaining mailing lists in a very user-friendly manner for the actual purpose of extracting group information. Finally, group information can be set explicitly.

### Traditional Explicit

The primary idea behind this system was to give as much and accurate information as possible without putting any load upon the user, but sometimes the user might want to enter information explicitly. The traditional explicit cues used in @work are:

- **web interface** with forms to allow users to set their social awareness information
- **telephone PDE** which is set by the phone keypad through numerical codes

## Outlets

One important feature of the cue-based system is that it is not solely used from computers but that information is presented in other ways if possible. Therefore we use the term outlets instead of output (which usually refer to computer screen output). Another reason is that new outlets can be added in a flexible manner, in the same way cues can be added.

Different considerations already made for cues are relevant to outlets as well. Personalization, flexibility, gardening, consistency, multiple platforms, fault tolerance are all viable for outlets.

### What do Users Want to Know?

The initial design of the outlets will make them able to respond to requests like:

- Is X here today?
- When will X be here?
- Where is X right now?
- Notify me when X is free!
- Which is the most appropriate way to reach X? (one can eventually offer the appropriate tool, e.g. placing a phone or a terminal near the sign-in-board and having one-click dialing or e-mail addressing)

### Physical Outlets

The sign-in board will be the main outlet to people from outside the work-site. A problem with today's sign-in board is that only a fraction of the people pass it on the way to their work room, our electronic version could be replicated, thus allowing more people to naturally pass it. Personal sign-in board may also be placed just outside work places.

### Considerations for Software Outlets

We have thought about three different ways of presenting information:

1. The system tells users what it believes to be accurate.
2. The system tells users what it believes to be accurate, but the user may see the cues on which the system made the assumption.
3. The cues are presented to the users who then have to extract the wanted information.

Our choice is the most flexible, number 2. In case a secondary cue heuristic did not provide the correct result, the system could accept corrections and possibly learn form them.

The system should also be able to give different information to people depending on the their location. For example, user at a remote site would get “X is at a meeting until 14.30“ while a local user might get “X is at meeting with Y, and Z in room 4783 until 14.30“.

Another important feature is to point out changes of status of people. This is no simple task, how can the system know what the user has already knowledge of without the user having to explicitly tell it (thereby increasing user work load). Also some systems are not automatically updated (the web) and some may be used by several persons, which makes it hard to show individualized information (e.g. a common sign-in board).

### Importance of the Awareness Information

A problem with @work is that it considers all co-worker’s importance as being equal for a certain person and displays them in the same way for everybody. This is obviously not appropriate. People are usually interested in co-workers who are part in the same virtual network. Other people’s information is rarely used.

In terms of the Aether model [Sandor 97] being in the same group (virtual network) should therefore automatically increase the awareness level between two persons. Rating persons based on the awareness level with the user can provide “cleaner“ display.

Another observation is that passive cues can lead to passive adjustments of focus and nimbus, making Aether easier to apply (since one of the concerns in the spatial model is how are users setting such sets). The complex of explicit and passive cues can feed enough information to Aether to do importance ratings that are efficient enough. For example, notification requests are an increase of focus in spatial model terms. In another example, a teacher’s nimbus can be limited to the lab colleagues and students who are currently registered for on of their courses. Note that both these measures come form passive cues.

### Push and Pull

Push outlets includes e-mail, zwrite, beep, terminal, phone, java applets, special application modules, etc. Pull outlets require the user to actively ask for the information, for example: web, terminal commands, finger, sign-in board, etc. The information given to a user should probably differ in format depending on whether push or pull is used.

Push media will be used with priority in case large awareness levels are detected using Aether methods.

## Clients

The users will interact with the system with different clients. A client is a set of explicit cue input controls and outlets, and might allow configuration of cues and outlets. As mentioned in [Tollmar 96] usage of general purpose programs and protocols is suitable, since there is a big probability that most people would use such programs on a permanent basis for their work and therefore connecting from within such programs to the system could be convenient. The web-browser was the tool of choice in the @work system, but a pull medium is not the best for getting awareness information. Besides, since web browsers is a navigation tool, people will probably leave easily the system’s page, and tend to forget to get back to it.

A dedicated client for the system would then be a push medium, with a permanent, non-intrusive presence on the desktop. It would also provide a better interface than the web forms.

## Implementation

The objective is to provide a flexible system, with cues and outlets plugged in at any time (even “on the fly“). There should be an open protocol (API) for the plug-ins. Hardware protocols for different simple sensors attached should also be defined. Architecture of the system is to be discussed.

Obviously, potential for mass production and scalability of such a system are low, because bridges to already existing systems to create cue drivers will be quite system-dependent. But protocol openness and flexibility could overcome this.

## Conclusion

The idea of a flexible, integrated cue-based social awareness system proves to have a lot of potential and leads to many unexplored areas, from various domains, ranging from human-computer interaction through computing science to sensor electronics and smart devices. We are convinced that developing such a system in a flexible manner can bring a lot of experience and can eventually lead to a successful CSCW system.

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