

User Availability Detection in E2E Systems

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ABSTRACT

We anticipate and are working towards communication paradigms wherein users interact naturally from anywhere in their normal environments rather than being constrained to fixed audio or video devices. In such environments, the user's availability needs to be automatically detected such that it appropriately mediates user interaction without overburdening it. We describe a novel method for user status detection which considers a user's availability to interact in his/her natural environment rather than on any specific device. Further, we realize that a user's availability depends as much on the person requesting it as it does on his physical status. Hence we employ a combination of sensory and contextual (calendar, relationships etc.) inputs to decide *requester-specific* availability status for the user.

Keywords

Status detection, Environment to Environment communication, E2E systems.

1. INTRODUCTION

Communication is one of the basic human needs as per the Maslow's hierarchy of needs. The most *natural* form of human interaction takes place in a natural environment where the humans are free to express themselves in any desired way e.g. via speech, facial expressions, gestures, enactment, by touch, by kinetics etc. Such natural form of communication is very pertinent for applications like office collaboration, telemedicine, collaborative art performances and mediated education which require users to freely move around in their environments and undertake multiple activities involving different objects.

Current high fidelity video conference systems focus on high resolution and bandwidth, but constrain the user in terms of their physical movement (due to line of sight, field-of-view, coverage range etc.) Further, they do not mediate the communication in any meaningful way as they do not *understand* anything about the communication they are supporting. Hence, we have started the Environment-to-environment (E2E) communication project [1] wherein sentient multimodal information systems mediate user communication to actively aid and enhance it. As shown in Fig. 1, there will be no direct connection between end devices; rather the mediating information system will choose the best data capturing and presentation devices from multiple available options as per the situation requirements. Thus the overall idea is to allow users to interact naturally in their regular *environments*, without being constrained by any devices.

Over a longer period, the vision is to create a web of such connected environments, wherein user experiences are created, captured, and shared in an event-driven framework. The first two nodes of such an Event-web have been setup across two buildings

in University of California, Irvine and two more nodes are being setup at National University of Singapore and Eurecom, France.

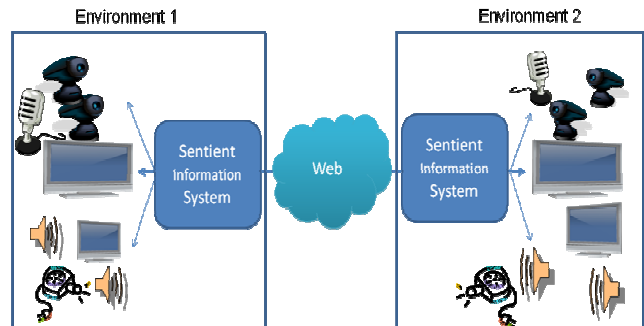


Figure 1: Overview of E2E communication systems

While the overall vision of E2E systems is beyond the scope of this paper, here we focus our attention on how one important component of such systems i.e. "user availability status" can be automatically dealt with in such a way that is intuitive, user-transparent and significantly less error-prone as compared to any current day systems. Specifically we discuss an automatic status detector which differs from current equivalents in two ways.

1. **User (*not device*) Availability:** In consistence with the E2E ideology, we do not want to consider *device-specific* availability but rather *user* availability in his natural interaction space. This means that we do not want to consider a user's availability to chat on a specific device (e.g. computer, PDA etc.) but rather his availability to interact with others in his natural interaction space e.g. office room, home etc.
2. **Requester-specific availability:** We move away from *generic availability* of a user to a *requester-specific availability* status. We believe that users are almost never "free" for everybody; nor "busy" for everybody. Instead a user's availability status is typically a function of his current actions, his schedule for the day and his relationship with the interaction-requesting person. Thus the same user would have different availability status for each requesting person.

Please note that user's availability in this context is very different from 'presence' in that environment. Thus a user may not be available to accept tele-presence calls in his office room even if he is physically present, as he may be 'busy' having a meeting, be on the phone, have a important appointment within 5 minutes or may simply not want to meet the specific requester today.

2. The overall idea: Availability detection

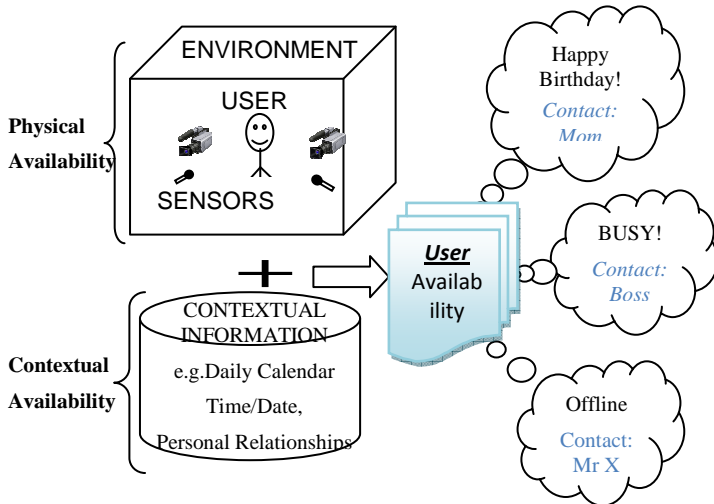


Figure 2: The user availability is a combination of his ‘physical availability’ and ‘contextual availability’

We divide the notion of user availability into two components.

The user’s physical availability is one that is decided by his physical actions in the room. Hence, if the user is in a meeting or on the phone, then the appropriate audio and video sensors would obtain this information. The contextual availability is obtained by utilizing other non-sensory information, which can be used to verify the results of physical availability, pre-empt physical availability if some important appointments are scheduled for near future and (most importantly) to determine the requester-specific status based on personal relationship between the user and the requester. Thus, as shown in Fig. 2, the overall user availability is obtained by a combination of his ‘physical availability’ and ‘contextual availability’.

3. Experimental results

For the purpose of verifying our proposed ideas we are using a typical office scenario in which the user occupies a desk-and-chair with a telephone and a PC is placed on the desk. We used two cameras and one microphone as the sensory data sources and the user ‘address book’ and ‘personal calendar’ as contextual data sources.

For our implementation we have decided to include the following availability statuses:

1. Available
2. On phone
3. Busy
4. Away
5. Special Purpose Messages (e.g. Happy Birthday Mom!)

Before deciding the final user availability status as above, the system undergoes a few stages of evaluation. Firstly, information available from audio and video sensors is used to determine the *physical* availability status of the User. Calendar events are considered next to ascertain how the schedule of the user governs his/her availability. Lastly, address book (contacts) information is used to customize the status for each person in the address book.

The idea of using an address book is to display status preferentially. The status obtained after filtering through calendar events is considered along with the priority of the person trying to establish a connection. Thus even when a User is busy, he or she may be willing to accept new call/connection from another person based upon the person’s priority (for example, if a family member is calling, or boss wants to speak with the User).

Additionally, occasion specific status messages can also be displayed (like “Merry Christmas!”, “Happy Birthday!”).

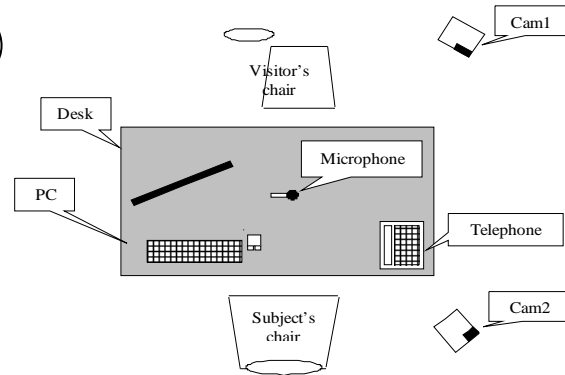


Figure 3: Top-view of experimental environment. There are two cameras, Cam1 and Cam2, which monitor the environment. Cam1 focuses on the User whereas Cam2 focuses on the Visitor to the user. Cam2 also monitors the telephone. Audio signals are received by the microphone.

The user and visitor presence in the environment were detected using a fused combination of face and blob detector modules. The detectors were written using OpenCV function. The Blob detector worked in the HSV domain with a Gaussian average of first 50 frames acting as the background.

Audio energy was used to detect the presence or absence of ‘talking’ event in the environment. Audio module decides whether the user is busy on phone or not. This is done by sensing the average energy level of the audio signal and testing it against a threshold. If the energy level is above threshold and the user is present, it is assumed that the user is busy on phone.

The combination of audio and video modules to detect users ‘physical availability status’ was undertaken as shown in table 1.

Video: User Presence	Video: Visitor Presence	Audio: Talking	User's <i>physical</i> Status
Absent	Absent	Absent	Away
Absent	Absent	Present	Away
Absent	Present	Absent	Away
Absent	Present	Present	Away
Present	Absent	Absent	Available
Present	Absent	Present	On Phone
Present	Present	Absent	Busy*
Present	Present	Present	Busy*

Table 1: Visual and Audio cues used to derive User's physical status.

Contextual information came from personal calendar and address book that the user maintains. We'll assume that these are available to the system.

Contextual data provided the following information:

Address book: For each contact, following fields were stored:

- Name of the contact
- Relationship with the subject
- Priority of this contact
- Phone number
- Birthday
- Address
- Gender

Calendar entries: Calendar entries provide contextual information that can be used to determine whether the user is busy or available. Entries in a Calendar can be of three types:

1. Meetings
2. Reminders
3. Special occasions (like festivals)

An example of the filtering of the physical status based on address book contact priority is shown in Table 2.

Contact Priority	Event Priority					No event
	Extremely high	Very high	High	Moderately high	Low	
Extremely high	-	X	X	X	X	X
Very high	-	-	X	X	X	X
High	-	-	-	X	X	X
Moderately	-	-	-	-	X	X
Low	-	-	-	-	-	X
Negative	-	-	-	-	-	-

Table 2. Event priorities and Contact priorities. ‘X’ symbol indicates that the user will be shown as *available*



Figure4: Snapshot of the system

A video recording of the obtained status detection results has been posted at <http://www.youtube.com/watch?v=BbG-S4Z1zc> and a snapshot has been shown in Fig. 4.

4. Related work

Works in ambient intelligence (e.g. [2]) have typically focused on event detection and not so much on status detection. In office collaboration field, works like [3], discuss the impacts of physical interruptions in office settings and the roles of office assistants etc. in handling them. Others take a much more technological perspective e.g. Sun’s AwareNex project [4] aims to connect its workers via multiple devices i.e. PDAs, pagers, cell phones, laptops, desktops, instant messaging, and a calendar service. It also keeps track of each user’s availability across different devices. IBM’s BlueSpace[5] project aims to achieve multi-sensory interaction amongst its workers and aims to do so by taking contextual information etc. into consideration. It is by far the closest work to ours. However, this work still has very primitive automatic statuses (i.e. ‘In’ and ‘Out’ only) and requires manual intervention for the ‘Busy’ status. We on the other hand want to detect all statuses automatically and want to employ sophisticated mechanisms for look-ahead alerts/status changes and requester-specific availability statuses.

The typical Computer-based messengers like Yahoo etc. do not infer any additional information beyond the user’s interaction with the Computer itself. Most of the status updates (except “away”) are manual and do not take into consideration users actual behavior inside his room. A patent [6], describes the use of personal calendar to update the status on chat messengers. This is significantly better than typical computer-based messengers, but still fails to consider actual *user* (and not device) status.

5. Conclusions

Using a combination of audio, visual and contextual data sources, we were able to automatically detect *user*-availability status in his/her *natural environment*. We were also able to support *requester-specific availability* based on contextual information. The results obtained from the system showed more than 90% accuracy for the various statuses under the employed working assumptions. We are currently working towards using more advanced detection and fusing techniques using multiple sensors.

6. REFERENCES

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