Presence in Communication Spaces

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Abstract:

The notion of virtual presence as it was developed in Web-based communication system measures presence as distance between surfers. Presence is then visualized on the user interface in a special window or as an overlay of the Web page. It is natural to use this presence information to manually or automatically start other communication systems such as text and voice chat, telephony, or even video conferencing. Current presence computation does however not include the availability of a person to other means of communication such as telephony, chat, or videoconferenceing.

The generalization of presence relates strength of presence to location and availabilty. This availability depends on factors such as type of work, day and time of day, calendar, type and purpose of the required communication, presence of other people, physical location, social factors, and even traffic conditions in the case of mobile users. It basically measures how much the intended communication partner (the callee) would be disturbed by the call attempt. To better denote the difference, we call this concept presence in 'Communication Spaces'.

1 Communication Spaces and Presence

Communication in the real world is either synchronous - speech based - or asynchronous using text enhanced with other media such as pictures. They require physical presence or material transport. First generation technical communication systems allow the use of real-world communication media over long distances (*tele*communication) without transport of people or material - physical presence is no longer a precondition for communication.

Our electronic communication systems together with multimedia computers provide the basis for new communication systems that have no archetype in the physical world - Hypertext and the Web are just one of many examples.

Based on the observation of classic communication, their electronic versions, and new communication services we define:

> Communication Space is a space spanned by all components (such as participants, information elements, links, nodes) and services of a communication system.

Examples of such communication spaces are TelephonySpace, WebSpace, or ChatSpace. The TelephonySpace is spanned by all the participants (subscribers), the provided service (speech communication at least in half-duplex mode), and the technical means to provide the service. Although the facsimile-service uses the same transmission infrastructure as the telephony spcae, it forms a different space - 'FaxSpace'.

The example TelephonySpace offers an important insight: even though participants do not have to be physically close to each other to communicate, they have to be in the proximity to a terminal - a telephone - to be present in this communication space. This leads us to our second definition:

> Presence is a property of an entity in a communication system enabling this entity to communicate.

As can been seen in real world communication systems, presence has two components: physical location (i.e. proximity to a person or a device) and the availability to the communication:

> Availability is a property of a person in a communication system, which is expresses it's ability and willingness to communicate.

Availability is not only a technical property. It is primarily determined by a person's emotional state, stress, and current activity that it is subjected to. Again telephony serves as a good example: incoming calls will be answered when the callee is:

- close to the phone
- not in a meeting or other intense conversation
- 'in the mood' absolute and relative to the caller
- not too busy writing a paper
- not driving with 150 miles per hour on the Autobahn.

Before we look at ways to measure and communicate presence related information, we will study a few examples, where presence already plays an *explicit* role in a communication services (as opposed to being an implicit factor as in most services).

1.1. Examples

Millions of people active in the Internet at the same time, sometimes hundreds or thousands read the same Web site concurrently. However, people browsing the Web are unaware of

fellow browsers. Browsing the Web is like shopping downtown without people on the streets. There are not even sales people in the virtual shops and department stores.

1.1.1 Instant Messaging

1.1.1.1 Dynamic Directory Services

A straight-forward approach to notify users of others online is to provide a dynamic directory service ([Firefly][Mirabilis]). DDSs allow people to create so-called buddy-lists with friends or associates. The DDS server notifies each registered user when someone on their buddy-list enters the Web. DDSs give the user a glimpse of the Web's vivid nature, but they are not flexible enough to enable accidental meetings, e.g. of people who are interested in similar topics or are just at the same place at the same time. Thus one will never meet *new* partners or friends in cyberspace.

1.1.1.2 Static Neighborhoods and Communities

Virtual meeting rooms (VMR) provide locations where people can meet in cyberspace. A VMR typically consists of a set of Web pages. Users see all others viewing the pages of the same VMR. Since the set of pages of a VMR is usually static and has fixed boundaries, the users are in a static neighborhood. Unlike DDSs, static neighborhoods allow people to meet others they have never met before.

VMRs are like real conference rooms or conference centers. People go to a certain location, and they are guaranteed to meet other persons there, providing the others entered the same VMR. All persons in the VMR are aware of each other.

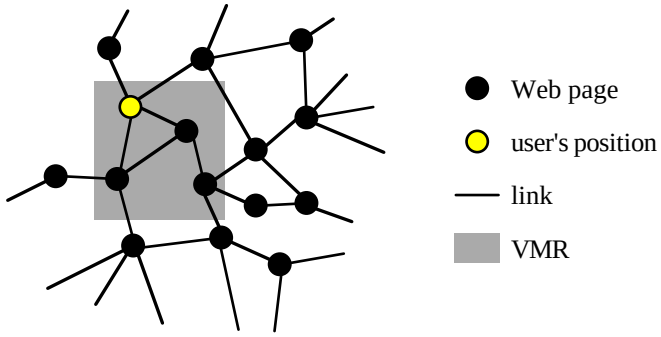

Figure 1: Example of a virtual meeting room composed of Web pages.

VMRs model closed rooms. This is useful for activities which are best conducted in closed groups or closed rooms like synchronous or asynchronous collaborative work, meetings or lectures. Such a model is ill suited for many other activities on the Web like browsing, window shopping, and individual search for information.

1.1.1.3 BuddySpace

BuddySpace [VogDz] is an interesting project trying to bring presence awareness to Internet Chat services. Among other work the project is expanding the simple availability categories of the ICQ-service to a more refined, dynamic, and possibly automatic function of the user.

1.1.2 Web Presence Awareness

The Web appears as mesh of documents, seemingly lifeless and static. This is actually wrong, there are many people around. People go on the Web to work, to find information, or to have fun. Others are just looking around without a certain destination like window shopping. There are even unmanned vehicles - robots - on the streets to pick up information. Thus there is plenty of life. But it is unfortunately hidden from users.

The real world analogy gives a strong indication that an important component - the user dimension - is missing on the Web. Adding the user dimension turns the Web into a real cyberspace thus creating awareness and virtual presence.

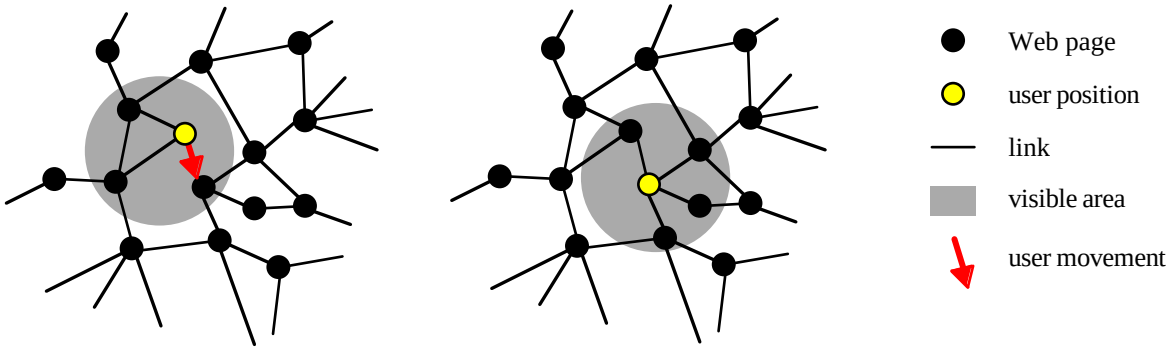

Figure 2: A Web user moving from one page to another. The neighborhood moves with the user and changes.

Dynamic neighborhoods are well suited to represent the dynamic nature of the Web, and that the model is general in the sense that it includes static neighborhoods, virtual meeting rooms, and even dynamic directory services.

2. Measuring Presence

The generalization of presence relates strength of presence to location *and* availabilty. This availability depends on factors such as type of work, day and time of day, type and purpose of the required communication, presence of other people and entities, physical location, social factors, and even traffic conditions for mobile users. A second, harder to measure factor of availability is the emotional state of the possible communication partner.

2.1 Metrics

Obviously metrics are needed to measure presence. In the real world physical distance between two locations is used. Even though the units used to denote distance and the methods to measure it have evolved, the concept itself is old. It is however limited to location.

Metrics for location in communication spaces depend on the underlying infrastructure. The telephony service for example requires physical proximity to a phone, either a fixed line terminal or a mobile phone. In the case of mobile telephony the location of a mobile phone may allow conclusions about the availability of it's carrier to communication.

The metric of choice in WebSpace is of course the link distance as it is shown in the case study below.

In the physical world humans use emotions, experience, and subtle social protocols to measure and communicate the other important component of presence, availability. In simple terms, we watch for signs like a smile or a gestures to find out if a person wants to talk to us. Establishing and keeping eye-contact is a frequently used method to communicate a 'call attempt' and it's acceptance. And it is difficult to express all this in an abstract, formal way.

In electronic communication systems most of our human means to assess location and availability to communication are lost. We have to find new metrics and procedures to measure them.

2.1.1 Case Study: Measuring Web-Location [FrMeWo]

2.1.1.1 Pages and Links

The infrastructure given by the World Wide Web forms a straigthforward foundation for the virtual world to be modelled. Addresses and links of the Web are based on Universal Resource Locators (URL). Web pages, and all other types of network accessible documents, can be seens as locations in the virtual world. These virtual locations correspond to places in the real world like rooms, street corners, and stores. People are moving - browsing - between virtual locations via hypertext references.

Links between locations are currently used only as interconnections. The rel-attribute in HTML is an example of a link attribute which contains meta-information useful to separate documents, which are linked but not related. Examples are link pages which link to many unrelated documents. The opposite case is a distance of 0 combining the linked documents to a single virtual entity.

2.1.1.2 Persons and Communication

Humans, and other active entities (e.g. robots) are acting in the space spanned by URLs. One action is movement through the virtual world, as it has been described above. The second action is communication between active entities, e.g. humans or agents.

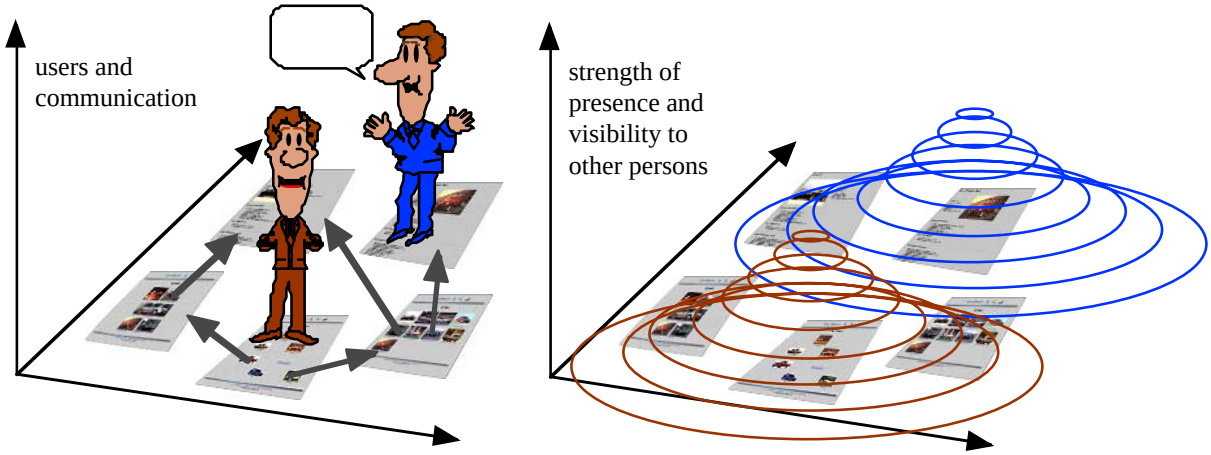

Figure 3: The left side shows a simplistic representation of 2 persons at different Web locations. On the right side are the persons' visibility-functions. People can communicate if the visibility overlaps.

Persons and communication add a new dimension to the Web. Whereas the Web serves as the environment, persons and communication exist within the space created by the Web. The presence is limited to their position and its surroundings. The strength of presence - or visibility - depends on a function of the distance from the person's position. The distance is measured in a metric imposed on the underlying hyperspace, the Web. The obvious choice as a metric are the hypertext references as described above, but others such as document content overlap have been implemented in experimental systems [D4.3].

2.2 Towards Presence in Telephony Space

Location in telephony space is often measured with active badges, triangulation, signal strength of WLAN or GSM base stations, or GPS-receivers. This location is mostly used by the technical infrastructure (e.g. the mobile network) to locate a mobile phone so that the proper routing and channel allocation can be performed.

Presence in Telephony Space (PiTS) is the focus of attention in an ongoing research project at the University of Freiberg. The objective is to collect the factors determining availability (some of them have been mentioned above), develop methods to measure or at least deduce these factors and to compute presence.

The many indicators for availability in TelephonySpace can be devided into 3 groups:

- occupational parameters such as work situation, sleep, travel
- contextual parameters such as presence of one or more 'third parties' in meetings etc.
- emotional parameters such as stress, unwillingness to communicate

2.2.1 Occupational Parameters

This term refers to the current activity of the callee (the person that is called). He may be either using his word processor, jog in the park, play a computer game, drive a car, or do whatever else humans are doing. The issue at hand is how to automatically detect the activity. We give a few examples how parameters can be acquired:

In the case of human interaction with computers it is fairly easy with indications such as active applications (word processor, spreadsheet, game, Internet browser, etc.) to find the focus of activity. The degree of focus can be measure with parameters such as key-rate or mouse movement frequency.

One easily acquired source of information are electronic calendars residing in PDAs, computers, or mobile phones. Occupational parameters collected from calendars are explicit and reliable. The user has a simple way of improving availability computation: she can enter activities into her calendar system.

To detect that a person is driving a car asks for the interaction between with the car's electronics. The car can even deduce the stress of the driver. A home control system can infer if a person or a family is sleeping (or at least trying to sleep) when it is dark in the room where the user is located.

In general occupational parameters can be acquired through co-operation of the many computerized devices in our life. The degree of networking between these devices is crucial to the performance of the availabilty detection in this area.

2.2.2 Contextual Parameters

'XYZ is in a meeting' is one of the most common reasons why calls in the business world fail. For one of the authors the most annoying situation for an incoming call is an exam. There are methods to deal with that (call rerouting, switching the phone off), but unfortunately the phone typically stays offline for hours after the exam. Since the author has installed a web-cam in his office, his wife and his co-workers check the video to avoid intrusion.

The systematic solution to the problem is to detect a meeting situation with technical means such as audio analysis. Voice activity detection (as used in GSM phones to save battery) and spectral analysis can detect speakers in a room or the vicinity of the phone and relate the result to typical meeting situations. As soon as there are 'third-parties' in the vicinity of the phone, calls are rejected, rerouted, or at least presented in a less intrusive fashion (vibrate instead of ring).

2.2.3 Emotional Parameters

Indicators in this group are especially hard to acquire, because metrics are not well known and ways to measure them are even more difficult to implement in an un-intrusive manner. There are however heuristics one could use together with learning algorithms:

- call history: has the person accepted calls in the past few minutes or hours
- spectral analysis of the voice (stress can be detected in human voice)
- keyboard and mouse usage patterns

Even though these parameters are fuzzy, current and future learning algorithms can compare the situation to the call acceptance history (i.e. call pickup and call duration). These indicators look especially promising if they are brought into relation with caller identity: call history and the indicators are stored in the address book.

3. Communicating Presence

As seen above the detection of presence is not an impossible task, even though the acquisition of availability parameters is often hard work. We will now discuss means to communicate presence information to enable communication or to make phone calls less intrusive.

In the completed EU-project CoBrow [FrMeWo], one of the authors and his team developed a protocol to communicate presence information, the virtual presence protocol VPP [VPP]. This project did not tackle the availability issue. A subsequent project (ShopAware) did work on the latter in a sense: it developed anonymous browsing. Anonymous browsing, which is now available in several flavours (e.g. [JAP]) hides the true identity of the surfer behind proxies.

Even though the VPP could be used to communicate other aspects of presence beyond location, a generalized model to communicate presence would be beneficial. What should be added is communication establishment negotiation. This model has to communicate location, availability, and the parameters from the originating side such as urgency and importance. One issue is the representation of soft parameters i.e. availability and urgency. The representation of the data has to be such that metrics can perform computations with them.

Togehter with the factual parameters we have to find a model to enable call negotiation without callee interaction and enforce truth in the urgency declaration (who has ever placed an un-important phone call?).

A financial model could solve the problem. We introduce a new currency - call-points:

- each caller has an account in the personal address book of the callee
- unknown callers receive a (small) credit

The economics of the model are simple:

- a caller invests points in a call
- the level of availability determines the number of points needed for a call to be presented
- part or all of the invested points are deducted from the callers account if the call is presented

    - low availability: many points are consumed

    - high availability: only a few points are consumed
- completed calls result in bonus points for the callers
- long calls may give more bonus points than short calls
- if a caller account is overdrawn, calls will only be accepted in complete availability situations.

This is just a rough sketch of the financial model envisaged. It will need refinements based on economics and game theory.

4 Summary

We have introduced the notion of presence in communication spaces consisting of location and availability. Both components have to be measured with metrics to enhance current communication systems such as Web browsing, chat, or telephony. Presence both helps to create communication and to make communication less intrusive. We have not shown a complete and ready solution. This paper should be interpreted as part of an agenda on the long way to reconciliation of our communication systems with our life.

5 References

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