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From human interface to human interaction: activating community with real-world technology

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ABSTRACT

This paper describes issues related to 'real-world' users using the interface of a community support system. The system, which is designed to enable users to join a community and build that community through interaction with each other, relies on users understanding and utilizing its interface. This paper provides a qualitative description of the interrelationship between users' actions, a real-world setting and a user community. It suggests that it may be possible to infer users community membership from their behavior and argues for further research in this area.

1. INTRODUCTION

This paper reports on analysis of the implementation of our system designed to support members of a conference or other similar space, by providing them with information appropriate to the connections that they have with other members. The system, the Event Space Information Support System (hereafter called ESISS) was tested at one national and one international conference, both held in Japan (JSAI 2005 and UbiComp 2005, respectively). This type of system builds on the several different paradigms of interactive computing, including ubiquitous computing [24] and pervasive computing, with their emphasis on context awareness (e.g. [2]), and recent work on Social Network Analysis [5, 13]. The system tested at the two conferences is innovative in its method of gathering community information, and the use of an IC card-based interface with which to access and modify the information.

At the heart of the system lies a Social Networking System (SNS). This extracts information about conference participants' connections to each other via web mining. A visual network diagram is created, which users can then interact with using their IC cards. Systems with similar purposes have been created recently. These include Semantic map [20], which displays networks among participants and exhibits and keywords in a gallery space. In this system participants register interesting exhibits with a PDA. The system makes relationships among participants that registered those same exhibits. Hamasaki and Takeda [7] have displayed networks among persons via their Web bookmarks, and Referral Web [10] extract social networks from the Web automatically. Where ESISS differs, is in its emphasis on the 'real-world' face-to-face interaction that occurs within the conference space. This paper takes this real world interaction as its focus, utilizing social methods of analysis to begin to understand how interaction around and with the interface is socially ordered, and how this information may be used in the future development of similar interfaces. The system is described in the next section.

2. SYSTEM Design

ESISS is comprised of several onsite subsystems and web subsystems. The onsite subsystems are means to access and modify the web subsystems. Consequently there are several means to access the SNS.

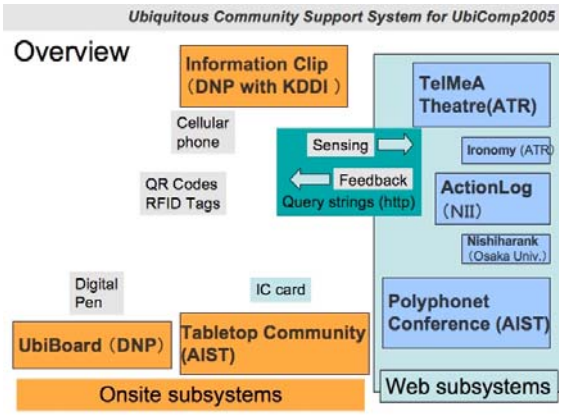

Figure 1. Overview of the ESISS System at Ubicomp 2005

The two systems most relevant to this paper, Polyphonet Conference and Tabletop Community, are described in this section.

2.1 Polyphonet Conference

Polyphonet is a social network browser and a conference scheduling system. Polyphonet obtains attendees' relationships and research topics from web sites. A user can find what research topic a researcher is doing or whom she is working with. In the scheduling part, a user can register interesting presentations (papers, demos and posters) and get recommended presentations and other researchers.

Figure 2 shows a screen shot of Mypage as a personal portal page of the Polyphonet. A personal acquaintance list is located in the middle of the left side. The right side has a list of authors and other users that have a strong edge in the network. The person's own social network is shown at the lower left.

Figure 2: Mypage

The Polyphonet has three methods to extract social networks among participants. The first of these is based on a web mining technique (described fully in [12]). Users register to the event, and the social network is subsequently built from web mining and then represented on Mypage, where the user can view it. The second and third methods are based on user interaction on the web system and at the event. On the web system, users are able to add other conference participants to their social network by clicking a 'know-link' button. In this way they can modify the web-mined social network to include those participants that may have been missed. The link is marked as a 'know link'. The third method uses a physical interface in the form of RFID cards, with which users can log into the system. Using these cards, users can add other members to their network simply by logging in at the same time with them at information kiosks. This tangible interface adds a physical, real world dimension to the SNS.

2.2 Tabletop Community

In a further extension of physical RFID interface with SNS, we developed a system based on the idea of a micro-community similar to that, which is formed around tables and in situations where people are meeting in a casual manner. Consequently, the environment that the system targets is such as a corner of conference room and places for coffee breaks. In contrast to environments such as those in the middle of a large conference room, a much closer relationship in a micro-community will occur in this kind of environment and occasion.

We address the temporary-community that is also created around similar situations. The system aims to transform this type of temporary-community into a long term one in case it is needed. It is therefore possible to activate a whole community and support communication in the community's social network by enabling community members to experience the records of past activities (of the community).

The system is based on the following three elements to realize the vision we propose above.

1) An information kiosk in the form of a table. This will make community members gather with a cup of coffee and references in a casual way.

2) Monitor display for displaying items of common interest among community members. Such as schedules, private information and social networks.

3) The system must have a function of capturing the state of the micro-community as well as a function of reviewing the past of the micro-community.

To include the conditions above, the Tabletop Community has the following function aside from those of Polyphonet. First, the system can capture data such as graphical information of the people around the table and additional information such as audio/voice data and ID data. The capture occurs when the user wants. A typical instance is when the user applies a user device to the system.

Secondly, to allow community members to share experiences with other members, the system has a function of visualizing the human network inside of the micro-community with rich multimedia data.

We also use user device ID information that the Tabletop Community obtains to improve the precision of the data of the social network of the entire community that Polyphonet targets. We have developed the system shown as Fig. 1. We chose RFID cards as a user device because they are gaining popularity and are becoming widely used in Japan. An omni-directional camera and RFID card readers are on the table of the system (Figure 3). Using these camera and card readers, when the user puts an RFID card onto a reader, the system detects that individual's rough location (direction of the user from the camera) and identification of users in the picture, which is taken by an omni-directional camera every time when one users puts/draws a personal RFID card.

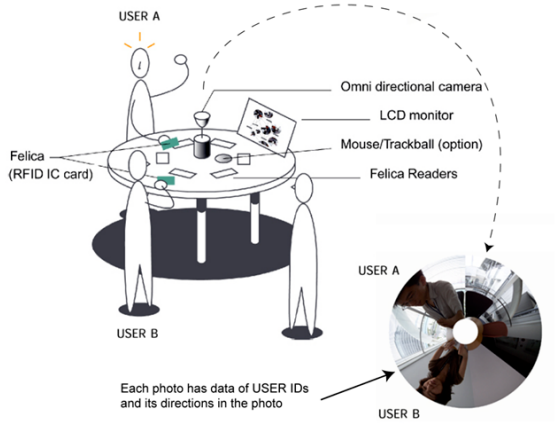

Figure 3 Tabletop community usage.

Each picture has additional information in addition to graphical data such as the name of the photo, the time and date when the photograph was taken, a unique ID number of the table (if we use more than 1 table): all the ID information of the RFID cards from card readers.

When a single participant puts an IC card on a card reader, that participant can log in directly to the Polyphonet Conference. If two or three participants put IC cards together, they can see social networks among them (Figure 4). Then the social-tie "We meet and see social networks together" is added automatically to the Polyphonet conference. These actions in the real word mean additions of know-edges to the network.

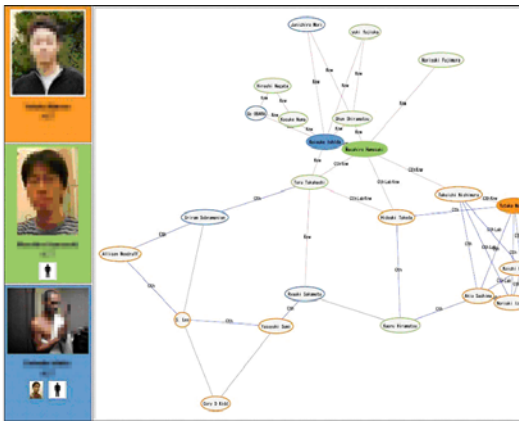

Figure 4: Social networks among three users

Here we show another monitor screen screenshot (Figure 5). It is designed for three RFID card readers on the table for three users.

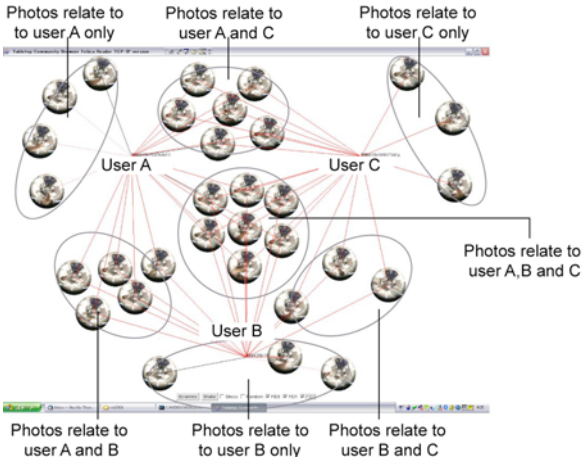

Figure 5: Photographs are shown as a network of users.

Unlike the static screenshot implies, this network of pictures reacts to a change of the network as well as users' interaction through a mouse pointer as if it were a living object. A photograph that has all three users moves to the center of the screen. A picture showing only one of three users moves towards the edges of the screen. This motion is created by calculation based on basic physical simulation. We applied two physical simulation models onto the screen. One is repulsion among each picture. The other one shows that attraction between the user node and the photograph node relates to the user using a spring model. This simple simulated physics in the visualization program automatically lays out the pictures and its network on the screen in an artistic way.

Figure.6: Tabletop Community readers, camera and monitor

2.3 Information Kiosk

At the second conference, these two systems were combined at the video-gathering site into one information kiosk. Users were expected to collect their RFID card at a reception desk, log in and browse the Polyphonet at various information kiosks, add information to their My Page using their own laptop computers and log in together to the Tabletop Community at a separate table or at the joint information kiosk, where the video camera had been placed (Figure 6).

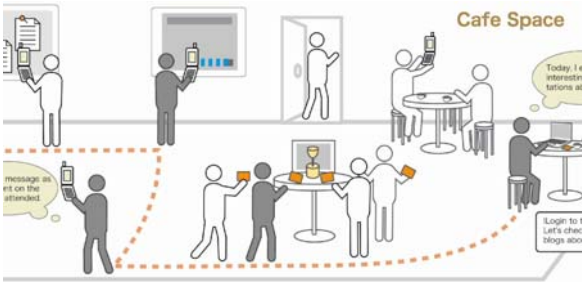

Figure 7: Expected user action at the second conference

To a large extent users followed this pattern, yet there were significant differences, as explored in section 3.

2.4 Micro-community

ESISS is a broad system that incorporates various different systems held together by the SNS, much of which is contained on the World Wide Web. The information kiosk and its interface itself however, are designed with real-world community firmly in mind. We use IC cards as a tangible method of accessing and modifying information. Users who gather around the kiosk together, and who log in to the system together are considered to have formed a 'micro-community'. This micro-community is represented on the network as a cluster of users linked together and in the real world by the act of more than one person logging in at the same time with IC cards. Both the online social network and the offline community become merged, therefore, at the point of the information kiosk. The interface of the kiosk thus becomes a highly significant part of the user experience of the whole system.

3. ANALYSIS

Various methods of assessing user interfaces have been proposed, particularly within the Interaction Design field

[15], ranging from usability studies that utilize questionnaires and focus groups, through task analysis, which aims to elucidate the cognitive and physical processes involved in accomplishing a task, to more recent long-term ethnographic studies of users in their 'natural' settings (for example [18]). This latter method, in conjunction with questionnaires and interviews, provides the best opportunity to access the 'user experience' of an interface [11]. The development of ESISS holds a unique problem in that the events where the interface of the system can be tested for usability usually only last between one day to one week. Consequently, only short-term naturalistic observation can be done. The unpredictability of user communities is another issue, as we envisage that users with differing information practices will utilize this technology at various event spaces.

A parallel issue is that deciding exactly what the user tasks are, which we are attempting to provide a service for, is complicated by these differing communities. In the case of community visualization and interaction with this new technology, it is important to design the system in tandem with gaining an understanding of how community members use that technology. For this reason, we are observing user interaction with the system in real-world tests over the entire length of the conference. Suchman [18], building on sociological work of Garfinkel [4] argues that developers should treat the user as an individual (social) agent, rather than expect to be able to generalize about all users. This has motivated the detailed qualitative analysis of individuals and groups using the interface, via continuous gathering of video data. Over the course of the three-day conferences, in addition to usage log data and questionnaire data, full-day audio and video data were collected of users interacting with the system at the information kiosks (figure 8a and 8b).

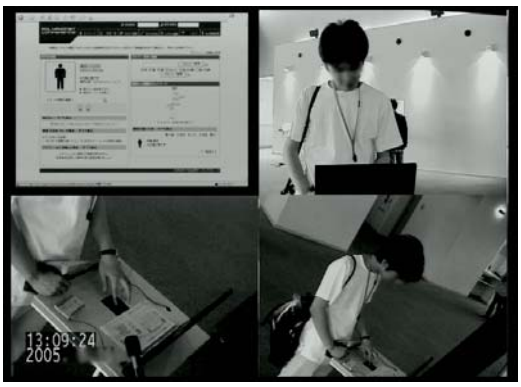

Figure 8a. Video capture from JSAI 2005

Figure 8b Video capture from Ubicomp 2005

This was combined with on-site observation and informal interviews with users. Video data enables detailed transcriptions and analysis of conversations to be done (see extract 1 in Section 3.2)[1]. The analysis in section 2 focuses mainly on the second conference, with occasional observations from the first conference that support the findings.

3.1 Access to the Interface

The first findings from the video data relate to access to the interface. The location of the actual kiosks was found to have social meaning beyond the form of the kiosk's interfaces (RFID reader, monitor) itself. The kiosks were located at several points around the conference space. This led to some confusion for users as to which was the primary access point to register to the system. It is possible that this problem was compounded by the fact that the conference featured several non-related technologies, which were also demonstrated within the same broad space. Users were therefore unsure which system to use, and where the boundaries of ESISS were. Within this 'information overload' human assistants were the first point of call to resolve issues (Extract 1).

Capture_09130927_000.mpg (10:23:50)
A: And if you've, um, used the tabletop community over there, um you would have seen-these are pictures of when you log in at the same time. When you sit down a picture is taken of you-these are pictures of people sitting around the table at the same time when they logged in, so you would have been there.
B: Oh!
A: You would have seen the link between you
((picks up RFID card from reader and picks up mobile phone from opposite stall))
(2.0)
B: Can you link it to these ones?
(0.5)
A: No. Not yet. That's a different group.

Extract 1. Defining the limits of the system

This extract illustrates the fact that the interface itself did not provide information about the boundaries of the system. The staff member, 'A', was explaining the system to user 'B', who was logged into the system with his RFID card. The fact that the system had more than one access point (i.e. several kiosks) and more than one interface device left the user with little option other than ask which other items in the room could be used to interface with the system. A system designed to provide event participants with appropriate information will need to address these difficulties, by locating information kiosks more appropriately, and marking system interfaces in a clear manner.

Access was also ordered in another way. When there was more than one user (or potential user) in the region of the kiosk, access to the interface was socially ordered. There are cases where members of a micro-community allow, or provoke, a member with high status in that community to use the system first. Though we have an obvious difficulty in assigning a clear definition of 'status' via solely observation, it is at least apparent that age may be a determining factor in who among a micro-community of academic conference participants accesses the RFID reader earliest. We may ascribe this to the prior social structure of members of that community. In some cases it

[1] For detailed explanation of Conversation Analysis transcription conventions, see [9]

is clear that one of the members is a highly regarded scholar, and that the other members are less senior. In these cases the younger scholars would allow the senior member to place their RFID cards onto the reader first. However, this is not to say that this would be the first time that any of the micro-community members had accessed the system. Often one of the younger members had experienced using the kiosk prior to that moment and served as an introducer to the senior member. This social ordering around the interface may have more to do with the desire or ability of younger community members to interact with the new technology than other status-related practices. Yet in either case, it is clear that some structuring occurs due to practices that are not directly related to the system itself, though further research is necessary to see what effects different interfaces would have on this structuring. It is also clear that this structuring of access is social, as it relates to group membership processes that occur in other environments [14]. With this in mind, it may be asserted that, should the system be able to access this contextual information, the status or social identity of users may be inferred and the interface or content adjusted appropriately.

3.2 Interaction with the Interface

Once users had accessed the system, using the RFID card and reader, basic usability issues quickly emerged. Difficulties related to the layout of the keyboard confused many non-Japanese conference participants who, for example, could not find the '@' key and looked for assistance from members of staff. Other issues pertaining to how long to leave the RFID card on the reader arose frequently. In one video extract, a user can be seen attempting to log in to the system with consecutive spare RFID cards, which had been left by the reader for new users to register with. The feedback on the monitors did not give enough information to the user as to whether they were attempting the correct action or not.

This fact suggests that the IC Card part of the system and the network display on the monitor cannot be separated in terms of user experience. Both should be considered jointly to comprise the 'interface', as users were found to interact with both the position of the network on the monitors and the content of the network itself. In terms of monitor position, a difficulty arose due to the fact that the two subsystems (Polyphonet and Tabletop Community) both operated with their own monitors, but at Ubicomp 2005, both were accessed with one RFID interface at the kiosk where video data was collected. This led to some confusion for the users.

In interacting with the system and each other, users were able to collaboratively understand the interface. This is an essential aspect of ESISS: the system does not rely on personal interfaces such as PDAs or mobile phones. The RFID reader, linked with a semi-public monitor allows other members of the micro-community to negotiate the meaning of the system. Extract 2, below, shows one such incident, where users A and B had logged in together to see their joint network. The users were able to collaboratively understand the connections that the system had assigned to them.

```
Capture_09130927_006.mpg (16:32:23)
A: EH I don't have a direct link to [you]
B:                                 [No I [see
A:                                       [Oh yeah I ( ) No I
have actually!
B: Yeah?
A: [Sigraph?
B: [eeh
A:    Or I'm not sure if its (0.2) or is it? is it? Is it in
the[re?
B: [I hope so
                          (0.8)
A: Maybe not
                          (0.5)
B: How we're connected, is through na[me
A:                                    [name, yeah.
```

Extract 2. Negotiating the Social Network

A related point is that users were unsure of what the RFID card represented on the network. At registration, they were told to write their name on the card, thus physically linking it with them. Yet, even with this fact, users did not immediately see the connection between logging in with the card and seeing the node on the social network diagram. They used the card to gain access to their Mypage, or see a joint network, but later asked staff members what the purpose of the RFID card was. Users had to be informed that logging in together with the card simultaneously formed a link between them. This suggests that it would be effective to show the process behind the interface system to the users. In fact, the complexity of algorithm used in assigning distances between nodes on the network may be one aspect to this confusion. Nevertheless, the RFID interface did allow users to join other member's networks by physically logging in together with them. In this way interaction with the interface aided the forming of physical, real-world (i.e. not solely web-based) micro-communities (figure 9).

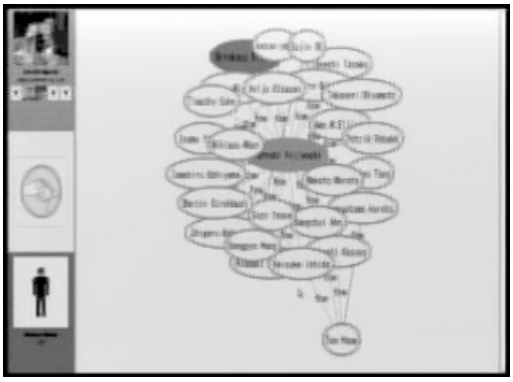

Figure 9. A strong joint-network, with priority given to physical connection

In Figure 9, we can see an example of an extreme case where one user – in the centre of the cluster – had used the RFID interface to link with many other conference participants. The algorithm assigned stronger (i.e. closer) links to physical connections than those built via the web mining prior to the conference. This assumption left some users confused as to why the distance was so far between them and other users.

These issues of misunderstanding were resolved over the course of the conferences. Users in their interactions with other members soon learnt the meanings of the system and subsequently taught other users. In this learning

process, conference participants who were acquainted with staff members of the ESISS project often introduced others to the system and taught them how to use it. Thus, the system was mediated by 'brokers' [23], who passed knowledge of how to use the interface between expert and novice user communities.

3.3 Conversation Structure

Section 3.1 illustrated how use of the ESISS system was used according to a social ordering of access. Section 3.2 showed some of the issues that users faced in their interaction with the interface, including problems of understanding its meaning. Both access and interaction with the system were socially ordered by the structure of conversation of users within the micro-communities that gathered around the kiosks. Much has been written about the way conversation is ordered, particularly its turn-taking nature[16, 21]. Extract 2 in section 3.2 is one example of a verbal conversation in which the meaning of the system was discussed. The repeated question in user A's line, "Or I'm not sure if its (0.2) or is it? is it? Is it in there?" can be seen to be calling for a confirmation response from user B. This question is a form of 'self-talk', but it's verbalization calls for a response, which subsequently leads to a joint understanding of the system. This is one way in which learning took place, and which subsequently structured the understanding of the system by other users (in this case, user B).

Within conversation around the interface, non-verbal communication also affected usage. Particularly important was the 'gaze' and gesture of users [6] as this could invite other members to use the system and direct their attention to areas of the interface (Figure 10).

Figure 10. Gesturing toward part of the interface

These conversational factors combined to order access to the interface, possibly according to social status (Section 3.1), and mediate between novice and expert users. Body positioning towards the monitors, as seen in figures 8a, 8b and 10, also had the effect of excluding some member's access to the interface. This was the case when a potential users' path to the kiosk was physically blocked by the body other members who were looking at the monitor. Additionally, when a user was logged into the system, they would often orient their body towards the monitor, which restricted their ability to torque their upper body or gaze towards potential users behind them. This restricted movement thereby prevented the user from using body torque [17] within their conversation to 'inform' potential users that they may interact with the system.

These are only a few effects of verbal and non-verbal conversation patterns; further analysis must be done to understand more fully the processes behind these effects. Nevertheless, at this stage it remains possible to see how the character of conversation and interaction around the ESISS interface structures users understanding of the system and their place within the displayed social network.

4. RELATED WORK

While much work has been done on the social aspects of technology usage, there is still opportunity to expand in this area. Suchman began much of this work, arguing for the focus of analysis to be on individual action within settings [18] and continues to contribute to knowledge of technology design [19] The development process itself is being re-shaped by researchers such as Button and Dourish, who suggested a 'technomethodological' approach to research [1]. Crabtree [3] continues in this vein developing a hybrid design discipline called *Technomethodology*.

Conversation structure, body torque and gesture are data that may be accessed through sensing technologies. For example, the work of Sumi [20], which is researching methods of capturing and interpreting interaction, could be very useful if applied to situations such as those that use information kiosk-type interfaces. Interaction data could be processed and the system tailored toward different communities. Ubiquitous technology such as this may help infer the status and identity of users. In relation to this, studies are being conducted on the cognitive modeling that people do when usingi computing technologies. Vastenburg [22] has suggested linking user profiles with situational context. Insights from the tangible interfaces of Ishii [7] may apply to RFID-based interfaces

5. CONCLUSION AND FUTURE WORK

The initial findings from the analysis of the use of the ESISS system, as described in this paper, can be applied to other interfaces where information is accessed, shared and modified on semi-public screens. The analysis has illustrated some difficulties that users had in understanding the system. In this regard, future designs could make system errors more visible to users, so that they can distinguish their own errors from them. The joint interface with two monitors created confusion, which could be remedied by either separating the systems into two distinct physical locations with different access interfaces, or more fully integrating them with only one monitor. Future work will address these issues of design, while expanding the social analysis to improve the usability and meaning of the system.

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