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Silhouettell: Awareness Support for Real-World Encounter

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Abstract. We have developed a system, called Silhouettell, that provides awareness support for real-world encounters. Silhouettell uses a large graphics screen. People's locations (who and where) are projected as shadows on the screen. The feedback from the shadows allows people to naturally know each other. Silhouettell also selects and presents topics common to two to or more people to make conversations easier to start. The current implementation uses World Wide Web (WWW) pages as the material describing the common topics. Experiments with three users are reported to show how Silhouettell works in practice. We also examined where the system would be best used by polling people from various nations.

1 Introduction

Various electronic meeting support systems have been studied and developed. There are two forms of meetings: formal meetings, such as business meetings, and informal meetings, such as chatting in a hallway or a lobby. Also, there are two ways of supporting these meetings: supporting them in the real world, and supporting them in a virtual space.

Table 1 classifies electronic meeting support systems.

Table 1. Classification of electronic meeting support systems

	Formal Meeting (business meeting)	Informal Meeting (casual meeting)
Real World	Presentation Tools (PowerPoint)	Awareness Support (Silhouettell)
Virtual Space	Conferencing Tools (MediaSpace, etc)	MUD Tools (FreeWalk)

To support formal meetings in the real world, *presentation tools* are commonly used. For meetings between separated people, *video conferencing tools* have been

developed. MediaSpace[6], MAJIC[5], InPerson[7], and CU-SeeMe[2] provide virtual spaces through computer networks. To support informal meetings, various *multi-user dungeon (MUD) tools* have widely spread. FreeWalk[3], for example, provides a virtual 3-D space to realize accidental encounters.

It is surprising, however, that almost no research has addressed informal meetings in the real world. Our approach is to provide *awareness support*, which augments the real world, to enable people to become aware of other people who have common interests.

We think that *awareness support* should provide a place for people to come together. For this purpose, we utilize a large graphics screen where people can share displayed information. WebStage[9], a Web browser, actively presents information that users are interested in or need. We introduced this idea into awareness support. We believe that a system that displays common interests to users can enrich their encounters.

This paper describes Silhouettell, a system that finds topics common to the participants and uses World Wide Web (WWW) pages to present the topics by displaying them on the large graphics screen. Section 2 describes the design concept of Silhouettell. Section 3 shows how we implemented Silhouettell. Section 4 reports experiments in real-world encounters using Silhouettell.

2 Design Concept of Silhouettell

2.1 Shadow Play

The following functions are important for awareness support.

- Displaying the presence of others:
  By representing each user as an object (shadow), the system can alert the user to the presence of others.
- Identifying the participants:
  The system displays user profiles (name, affiliation, interests, etc.), so the user can identify the other participants.
- Displaying relations between users:
  The system displays common interests between users to stimulate conversations.

To realize the above functions, Silhouettell uses a large graphics screen. Fig. 1 shows the concept of Silhouettell. Fig. 2 shows an example of it in use.

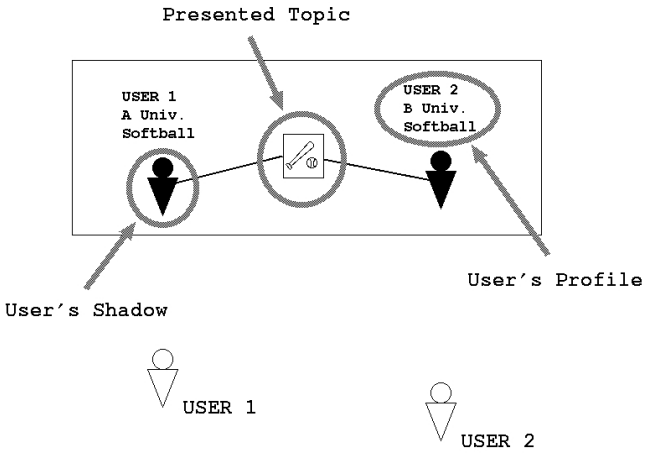

Fig. 1. Concept of Silhouettell

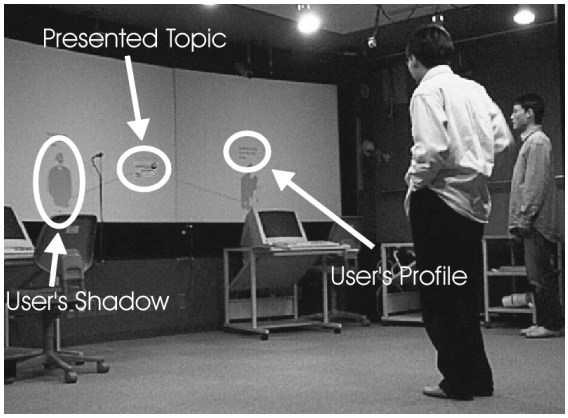

Fig. 2. Using Silhouettell in the Real World

Silhouettell displays the shadows of the other participants as objects, with their profiles above their shadow. The use of shadows is easier to understand than other ways. For example, chatting systems often use avatars or icons, such as in CommunityPlace[8]. When using avatars or icons in a real world, however, users may not be able to identify how avatars or icons correspond to them. If we use shadows, however, the correspondence becomes much clearer. Though mirroring, showing the actual appearance of the other participants, would be clearer than displaying shadows, the user may be uncomfortable at having all the other participants "looking" at him/her all the time. We think that shadows are the best way to signal existence. A comparison of the three approaches is shown in Table 2.

Table 2. Comparison of displaying users

	Avatar or Icon	Shadow	Mirroring
sense of existence	low	middle	high
level of stress	low	low	high

Moreover, Silhouettell enriches encounters and encourages conversation by presenting common topics. The connection lines between each topic and the shadows show groups interested in the same topic.

2.2 Large Graphics Screen

Social Agents[4] supports face-to-face conversation by using a CRT monitor to display the human-like face of an agent. Using a large graphics screen is more effective to support real-world encounters than a CRT monitor.

We find that large screens are better than CRT monitors in the following points.

- *Using functions in a wide sphere*
  If the system provides a small display, users have to use it in a narrow place. A large screen obviously enables users to play with the system in a wide sphere without regarding where they use.
- *Projecting users' shadows at the same size*
  To confirm the profile of a particular person, it is easy if the profile is shown above the corresponding shadow. A large graphics screen enables users to ascertain what people are there at a glance.
- *Public display*
  Even people far from the screen can see the shadows. They may be attracted and join the conversation.

Table 3 compares CRT monitors to the large graphics screen.

Table 3. Comparison between CRT Monitor and large graphics screen

	CRT Monitor	Large Graphics Screen
sphere of use	narrow	wide
shadow size	reduced	full size
number of users who can see the picture	small	large

2.3 Common Topics

It is hard for such media as TV, radio, magazines, etc., to help conversation. Though they surely include various information, they are arranged almost regardless of watchers', listeners' or readers' interests. Each user has to select contents by turning pages or changing TV channels to get information that he/she wants. Silhouettell actively promotes conversation by selecting and presenting common topics among users.

A common feature of electronic conferencing systems is that the system supports conversation by providing a virtual conference room. InPerson and CU-SeeMe, a conferencing room by displaying all participants. MediaSpace and MAJIC connect two or more locations to increase opportunities for encounter among people in distance.

Unlike electronic conferencing systems, Silhouettell increases the opportunities for conversations by presenting topics common to different groups of participants. Table 4 compares electronic conferencing systems to Silhouettell.

Table 4. Comparison of supporting ways

	Conferencing systems	Silhouettell
Provided object	virtual space	common topics
Place of encounter	increase	no change
Occurrence of conversation	no change	increase

The most efficient way of selecting appropriate topics is to find common terms (affiliation, interest, etc.). Silhouettell compares the terms in the users' profiles and presents topics related to the common terms.

For instance, imagine a conference hall with two (or more) people who do not know each other, but whose research interests are close. To encourage them to start a conversation, Silhouettell provides topics related to terms common in their profiles.

3 Implementation of Silhouettell

We implemented a prototype system of Silhouettell in Human Media Equipment at Kyoto University, following the above policy.

3.1 System Configuration

Fig.3 shows the system configuration of Silhouettell. It consists of two computers, a SGI ONYX and a SGI INDY, connected via Ethernet. The ONYX is connected to a large graphics screen with 2880x680 pixel resolution through the SGI Multi Channel

Option (MCO). The INDY is connected to the output of a video camera. The screen is a rectangle some 5 meters in width and 1.5 meters in height, and images are projected on its backside. The video camera is placed at the center of the screen.

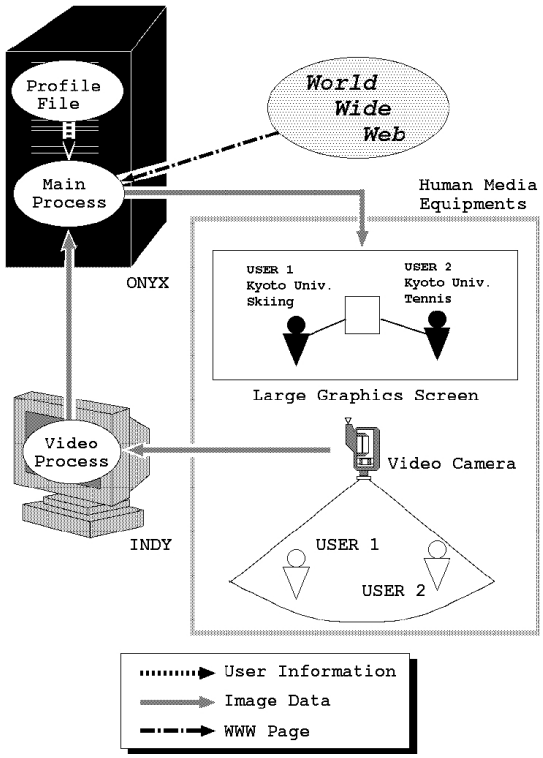

Fig. 3. System Configuration

Images from the video camera are processed by the Video Process in the INDY, and the results are sent to the Main Process in the ONYX. The Main Process generates the screen image from the profile stored in the Profile File, Web pages, and the data from the Video Process.

3.2 Presenting Common Topics

In this section, we describe the selection of common topics and their presentation.

We use WWW pages which can provide multimedia presentation for various topics. The system searches WWW pages for selected topics and displays the found pages between corresponding users as follows, which is performed.

Getting users' profile

We consider the following two ways of inputting the user’s profile.

The first one is to have each user wear a small computer[1]. Such systems can collect and present more detailed information to the user. When a user stands in front of the screen wearing a badge that includes his/her information, for example, a sensor could detect his/her profile and location.

The second approach is for the system to store all user profiles. A user enters his/her profile and information for recognition before using the system. If the user stands in front of the screen, the system recognizes him/her by some ways (for example, image processing) and searches and uses his/her profile. After that, no preparation is required.

We adopted the latter approach so as not to burden the user with equipment. The system only needs a projecting device with a large screen and a video camera, and a computer which controls the system, and no special instrument is needed. Users do not have to have any additional device. Before using it, they need to enter their profile only once. Thus, they can use Silhouettell just by standing in front of a Silhouettell screen.

Searching common topics between users

If there are common keywords among several users, system searches a WWW page that matches to them with a search engine on WWW. The page is registered and used at the next time.

Changing the size of displayed topics

The system changes the size of the topic display window to reflect the physical distance between users. When they are far from each other, the topic window is quite size. As they approach each other, the topic window increases in size. This is to encourage users to approach each other with the idea of confirming the topics listed.

3.3 Projecting Shadow

The system generates the shadow of a user by comparing the current image to the background image. This is done in the following three steps.

First, when the system starts, it captures the background image from the pictures taken when nobody is in the room. Noise is averaged over 100 frames. Second, at runtime, the system finds the differences between the current input image and the background image, and displays the areas as shadows if the degree of difference exceeds a predefined threshold. Since the data contain noises mixed when the image is input, the system shades off the picture to diffuse the noises. Shadows must exceed width and height thresholds. It is necessary to consider the difference in the ratio of the width to the height between the image taken by the camera and the screen. The system cuts out the area recognized as a person and pastes it after transferring the coordinates.

3.4 Identifying Users

The system identifies users by the color of their clothes in the following way.

The system averages the value of pixels corresponding to the user's chest area and identifies the participants by the stored values (they are input at the first use).

The system records the locations of all users in the current and the previous frame. The distance of user movement is calculated based on the position difference between the two frames. If it is too large, the system determines that the identification is wrong, and that the detected area corresponds to another person whose value is the second closest to the detected value. The use of both color and location significantly reduces misidentification.

4 Encounter with Silhouettell

4.1 Example of Use

Fig.4 shows an example of an encounter using Silhouettell.

1. One person shows up:
   User SAGAWA enters the media room, his shadow and profile are displayed on the screen (Fig.4(a)). The profile shows, from the top, that his name is SAGAWA Ryusuke, his affiliation is Kyoto University, and his interest is skiing.

2. Another person comes to the room:
   Next, another user (name: TANAKA Hironori, affiliation: Kyoto University, interest: Softball) enters the room. A WWW page related to the common topic, Kyoto University, is presented by Silhouettell (Fig.4(b)). Lines are drawn to link the page and the two shadows to indicate that the topic is shared by SAGAWA and TANAKA.

3. One approaches to another:
   They are motivated by the topic, and one approaches to the other. The WWW page is then magnified (Fig.4(c)). Consequently, conversation about the page occurs.

4. A third person joins:
   The third user (name: MATSUMOTO Hiroaki, affiliation: Kyoto University, interest: Softball) joins, as a result of finding two people talking to each other. The topic of Softball which is also shared by TANAKA is newly displayed, and the page about Kyoto University which is common to all of them moves to the center of the screen (Fig.4(d)).

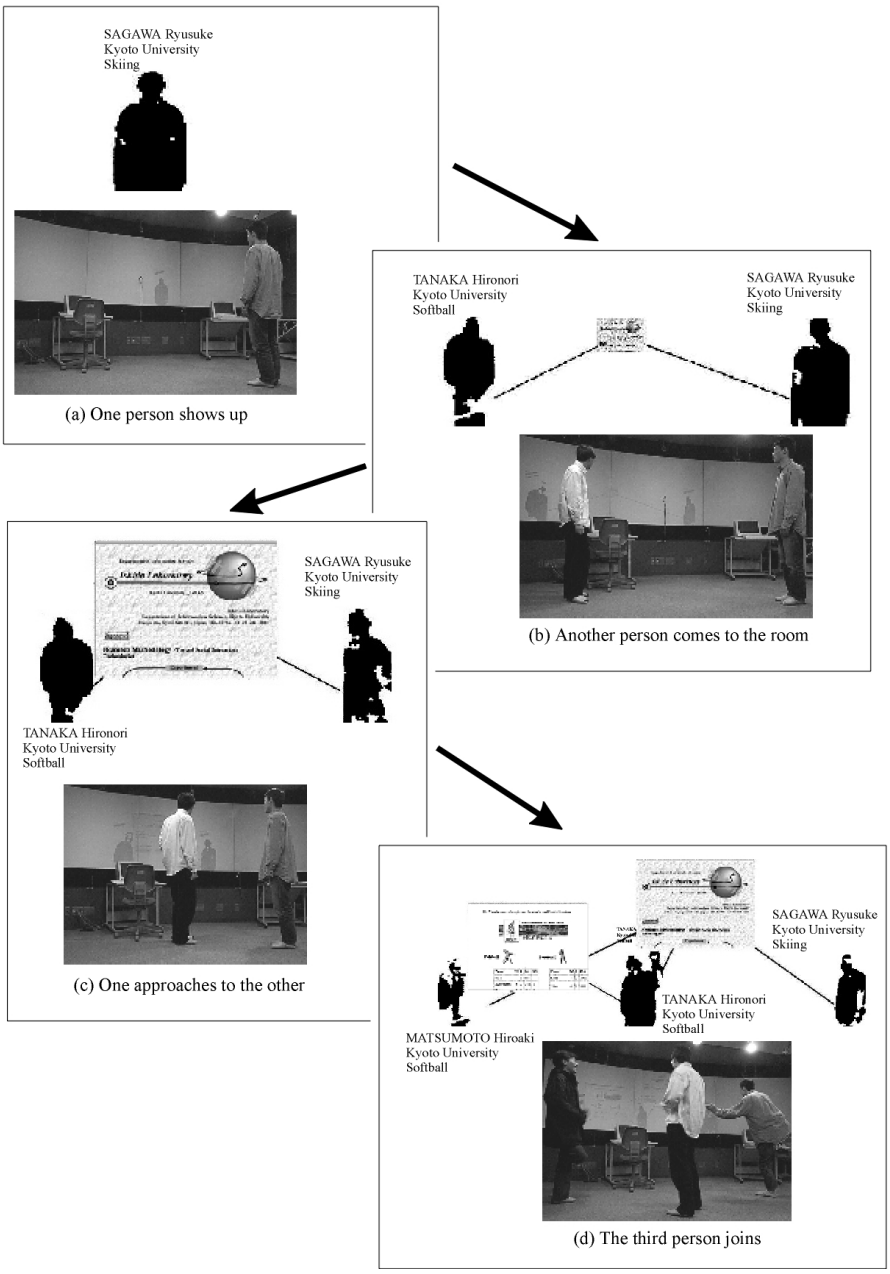

Fig. 4. Encounter with Silhouettell

4.2 Lessons Learned

Through using Silhouettell with three users, we validated our implementation policy. We had three users, who registered their personal profile in advance, spend about ten minutes in the media room with no explicit guidance. They had not been told about the system.

Before this experiment, we expected the following scenario: A user who entered the media room would notice the shadow on the screen first, and immediately understand that it represents himself/herself. The user would then find a WWW page displayed between his/her shadow and another person's shadow. At first, it is too small to be read easily. However, it is magnified when they approach each other, and the user naturally recognizes that the common interest is displayed. Conversation would then occur to discuss the contents of the displayed WWW page.

The actual behavior of users through this experiment was slightly different from our expectation as follows: They saw their own shadows and moved their hands and feet first. Second, they started playing with the shadows: they walked around and passed other users. Finally, conversation about displayed WWW pages began. During the conversation, the users seldom moved and some of them sat down.

Their behavior can be interpreted as follows.

- A user gets interested in the shadow and finds out that it is his/her own shadow because its movement is the same as that of his/hers. Secondly, the user is interested in another user's shadow and interferes by passing, crossing, and so on.
- The user stops moving after understanding the behavior of shadow, becomes attracted by a presented WWW page, and starts conversation about the topic.

Hence, we conclude as follows.

1. Showing their shadows and common interests is effective for attracting users to the system.
2. Presenting topics promotes conversations in real-world encounters.

As we expected, users recognized their own shadows and start conversations related to the WWW pages presented. However, WWW page size often remained static because the change in distance between users was not large after they started a conversation. The content of conversations was not directly concerned to the WWW page, but about the topic suggested by the page.

We also asked 5 Japanese and 25 non-Japanese in Kyoto University to answer a questionnaire. The latter were from Europe, America, Asia, and Africa, and they are mainly research fellows or (under)graduate students. Table 5 shows the nationalities and their numbers.

The following features were obtained from the results of the questionnaire.

Table 5. Rates of Nationalities

nationality	Japan	Asia, except Japan	Africa	Europe and America
number	5	11	3	11
rate (%)	16.7	36.7	10.0	36.7

- *Where would Silhouettell best be used?*
  Table 6 shows the results.

Table 6. Where would Silhouettell best be used?

Order (1 means most suited)	1	2	3	4
Public Space	2 (7.1%)	5 (17.9%)	6 (21.4%)	15 (53.6%)
Event Hall	10 (34.5%)	8 (27.6%)	7 (24.1%)	4 (13.8%)
Community Space	12 (42.9%)	8 (28.6%)	8 (28.6%)	0 (0.0%)
Private Party	6 (22.2%)	7 (25.9%)	6 (22.2%)	8 (29.6%)

Over 70% of the subjects selected community space (student union buildings and so on) as being very useful (1) or useful (2). 62% also selected event hall (the site for an international conference and so on). In contrast, over 70% thought that Silhouettell would not be useful in public spaces (i.e. a street corner). The responses for Private Party (home party and so on) varied widely.

- *Contents of profile which a user shows*
  Table 7 shows the profile contents that were considered acceptable to the subjects. Most subjects accepted the display of name, affiliation, interest, and nationality. However, few accepted the display of phone number and address.

Table 7. What data should be displayed

content	number
name	25
affiliation	21
nationality	24
address	9
phone number	7
interest	22
birthday	12

- *Cultural Differences*

According to the results of this questionnaire, we found the following cultural differences.

- Places suitable for Silhouettell use

Table 8(a) shows the answers of the subjects from Asia, where the data are the those in Table 6, while Table 8(b) shows the answers of the subjects from Europe and America.

Table 8. Where would Silhouettell best be used?

(a) Asia

evaluation	1	2	3	4
Public Space (%)	9.1	27.3	36.4	27.3
Event Hall (%)	18.2	36.4	18.2	27.3
Community Space (%)	70.0	20.0	10.0	0.0
Private Party (%)	10.0	20.0	30.0	40.0

(b) Europe and America

evaluation	1	2	3	4
Public Space (%)	10.0	20.0	10.0	60.0
Event Hall (%)	27.3	36.4	27.3	9.1
Community Space (%)	20.0	30.0	50.0	0.0
Private Party (%)	40.0	20.0	10.0	30.0

While 90% of Asians have affirmative opinions about the use in community space, only half those from Europe and America shared the same opinion. Though 70% of Asians had negative impressions about its use in private parties, European and American people had various opinions.

- Displayed Profile

Table 9 shows the same data as Table 7, but they are divided into two columns according to the region the subjects were from. The left column shows the number of positive answers for each content from Asian people, while the right column shows those from European and American people. European and American people have negative opinion for displaying their affiliation, while Asians are more liberal on this issue.

Table 9. Cultural differences in releasing data

content	number (Asia)	number (Europe and America)
name	10 (90.9%)	8 (72.7%)
affiliation	10 (90.9%)	4 (36.4%)
nationality	10 (90.9%)	8 (72.7%)
address	5 (45.5%)	2 (18.2%)
phone number	4 (36.4%)	2 (18.2%)
interest	8 (72.7%)	7 (63.6%)
birthday	3 (27.3%)	3 (27.3%)

We summarize these results from three points of view.

1. Utility of Silhouettell
   In community spaces where people who have common topics and do not know each other gather, Silhouettell can be an effective tool in helping people to start conversations.

2. Privacy
   People hesitate to release their complete details to the public.

3. Cultural Difference
   We suggest that there are some differences of sense about presenting topics and privacy between areas. The sense on what topics or attribute one can open to public depends the area he/she come from.

5 Conclusion

We proposed a system, named Silhouettell, for awareness support in real-world encounters. Silhouettell uses a large graphics screen, but does not require the user to possess any additional equipment. It attracts people by projecting their shadows and promotes conversation by presenting common topics based on users' profile. Silhouettell dispays WWW pages as a way of showing common topics. Through a preliminary experience with three users, we validated our implementation policy: the system can support awareness in real-world encounters. We also examined where the system would best be suited through the results of questionnaire collected from people from various nations.

We have developed a series of tools for community computing[10][11]. Community computing supports the early stage of collaboration, or helps various

people to organize communities. Awareness support for real-world encounter encourages people to know each other[12].

Future work includes extending Silhouettell to improve of topic selection, and more analysis of the reactions of users from different cultures.

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