Collaborations and Communications in Personalized Information Spaces

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There has been an increase in creative activities being done using networked computers, due to the increase in the number of people accessing the Internet. Our target is to develop a system that facilitates novel human communications with the advantage of the Internet. We propose a concept of *computer-aided communications*, i.e. asynchronous collaboration and communications in information spaces structured through personal viewpoints of all participants. The method presented in this paper makes possible for a user accessing the WWW (World-Wide Web) to encounter other people who have similar interests. In order to provide a virtual space for the encounters, we employ a method that visualizes personal viewpoints by mapping icons of text-objects and keywords given by users into metric spaces.

1 Introduction

This paper presents a concept of *computer-aided communications*, i.e. asynchronous collaboration and communications in information spaces emerged from networked computers.

We are developing a system that encourages a novel type of communications, one that has not been seen in the real world, with the advantages of the Internet. In this paper, we propose the concept of *encounters in a networked society with the help of third persons' personalized views.* The proposed method makes possible for a user accessing the WWW to encounter other people who have similar interests. For a virtual place where they can encounter, this method appropriates a third person's home page, which has several reference links to other pages including the user's. Such encounter is definitely different from that in the real world, since they are not restricted by spatial and temporal coincidence, and made not by personal relationships, but by the *relevance of personal interests.*

In order to provide a virtual space for the encounters, we employ a method that visualizes personal viewpoints by mapping icons of text-objects and keywords given by users into metric spaces [1]. Text-objects represents electronic memos concerning with the users' ideas or knowledge. We are applying this method to visualizing personal viewpoints of contents and opinions appeared in personal pages of the WWW.

2 Toward to computer-aided communications

The volume and the range of information available on the Internet continue to expand. From the viewpoint of human communications,. the Internet has several attractive features [2]:

1. It ranges on a world-wide scale.
2. It provides a way of bi-directional communications.
3. Whoever joins in it can play the main role in communications.

The first feature enables users to expand their thought spaces and knowledge on their collaborative fields on a world-wide scale. Here, we define the *thought space* as an externalized mental space consisting of fragments of ideas or knowledge and the relationships among them in thinking activities. From the viewpoint of creative thinking, we can say that one of the major processes fostering human creative activities is divergent thinking in which broad alternatives are searched for. Another is convergent thinking in which a solution is sought for. Although these two processes must be invoked repeatedly, divergent thinking is indispensable especially at early stages of creative activities [3]. Use of the Internet can broaden one's thought spaces, and encourage divergent thinking. Thus, there have been several works on computer-aided thinking using information on the Internet. For example, [4] links a personal hypertext world-wide, and [5] and [6] have proposed card-based Internet resource accessing tools.

Human communications is basically bi-directional and interactive. However, a lot of the media such as newspapers, radio stations and television networks, provide only a one-way flow of information, i.e. broadcasting. The second and the third features of the Internet are important in this respect. Yet, the conventional usage of the Internet, such as mailing-lists and BBS (Bulletin Board Systems), is broadcasting, and distinguishes providers of information from receivers. Currently, the WWW (World-Wide Web) also only provides one-way flow of information.

When we regard the Internet as a world-wide knowledge-base, it consists of pages of contents and

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hyper-links in case of the WWW. As the contents are produced independently and the hyper-links are established sequentially, the net has characteristics of the distributiveness and the asynchronousness of knowledge, which are also the important advantages. Under this consideration, in order to make the best use of these advantages for personal and collaborative work, we should utilize the Internet not only as a medium for broadcasting but also as a space where we can convey personal information to others interactively, i.e. the interaction of provider and receiver.

Now, we point out our target in a classification of communication support systems on networked computers from three viewpoints on the types of processed information (see Figure 1).

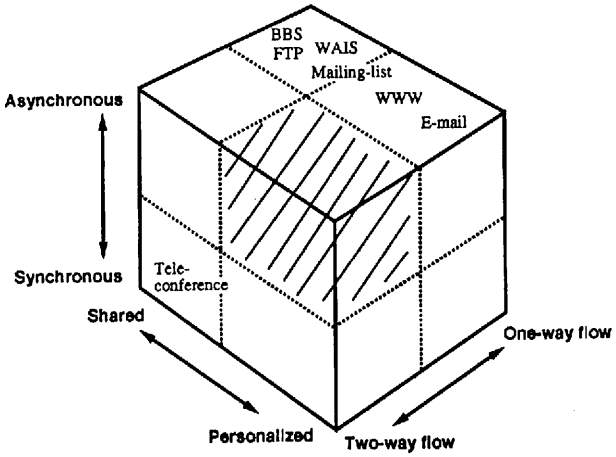

Figure 1: Classification of communication support systems on networked computers. Facilitating communications in the hatched region of this classification is our target.

synchronous meeting → asynchronous meeting Our research focuses on collaborations not limited with spatial and temporal synchronization.

shared spaces → personalized spaces Most existing systems that aid in collaborative work on networked computers focus on providing common and shared spaces to participants. Our interests shift to supporting the personalization of shared spaces for individual reflections and collaboration in personalized information spaces.

one-way flow → two-way flow Most existing systems strictly distinguish the providers and receivers of information, and deal only with one-way flow of information. We are interested in the bi-directional and interactive flow of information. That is, some actions of the receivers such as gathering information and editing are given as feedback to the providers.

3 Visualizing structured information spaces

CSS: Communication Support System

In this research, our approach is to visualize information spaces for collaborative work and communications on the Internet including new encounters between people accessing the Internet. This section describes the system which we developed to visualize personalized spaces as well as shared spaces.

The authors have proposed several computer tools to aid in creative concept formation by visualizing snapshots of the topological structures of a user's thought space using statistical methods. In this paper, we present one of these, *CSS* [1], which stands for *Communication Support System*. *CSS* has been used for individual reflection and shared understanding in groups working collaboratively. *CSS* works successfully on visualizing the global structure of a user's thought space. These visualizations encourage the users to their further thinking, such as finding the axes of a semantic structure in the presented space, or finding new ideas in empty regions in the presented space. *CSS* also has the potential to show users' subjective ideas and views to their colleagues.

CSS is implemented under the X Window System on a UNIX workstation, and offers a user interface with multiple windows. *CSS* manages a multivariate data table which contains text-objects as data, keywords as their attributes, and weight values as the attribute values. Designating keywords and their weight values to text-objects are done by users according to their subjectivity. The users reflect their thoughts to change the data set. Whenever the users instruct *CSS* to reconfigure the space, it calculates and shows a new configuration according to the current data. This calculation finds intrinsic vectors that quantify the relationship among text-objects and keywords.

Figure 2 is an example of using *CSS* for browsing the structure of a group discussion, where five people join to discuss "project X" which is not an articulated idea yet. The rectangular icons are text-objects, each representing a topic discussed in the meeting. The oval icons are keywords which are verbalized by the participants. The big black round icons show the participants. In this example, the coordinator declares participants as keywords too, attributing the person to the text-objects. The coordinator, in this case, one of the participants, represented and labeled text-objects, and extracted their keywords. *CSS* computes the relative distances among text-objects and keywords and visualizes their relationships spatially in accordance with the data provided. When the coordinator shows this map, most participants pay attention to an empty region in the space, which leads

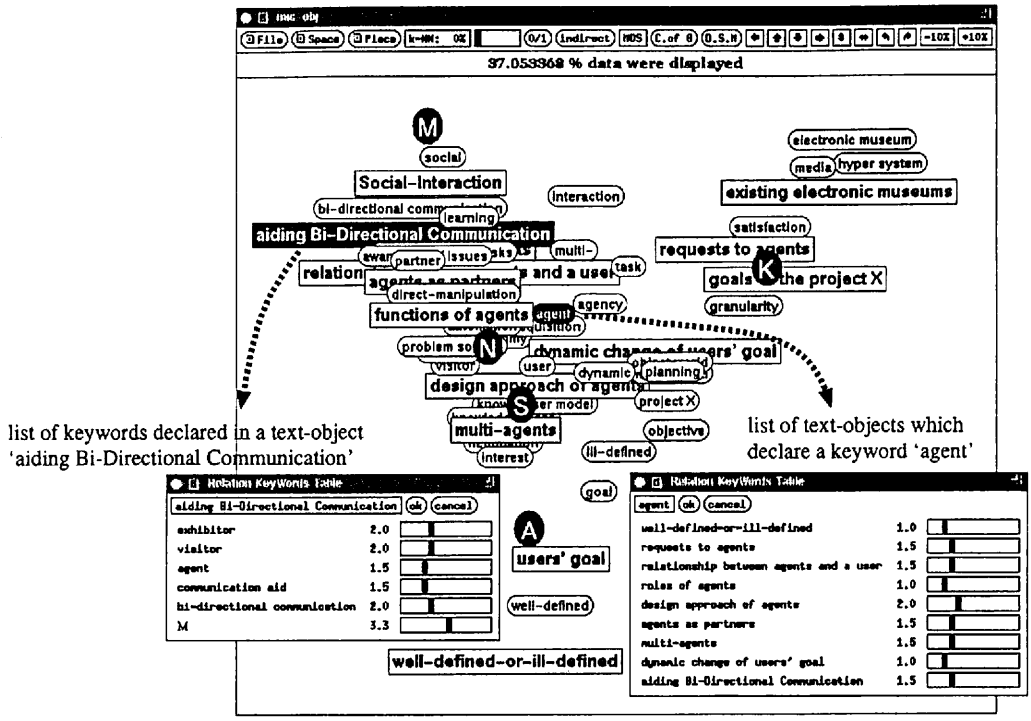

Figure 2: Example of using *CSS* for a discussion map coordinated by a participant.

them to further discussions about their future works.

Note that this space is biased by subjectivity of the coordinator, because he/she designates text-objects and keywords based on his/her interests and viewpoints. *CSS* can be used as a personal tool that supports personalization of information spaces gathered from the external world of users. It is indispensable for each participant in creative collaboration to personalize the information (e.g. gathering, browsing, structuring, etc.) obtained in the collaboration, and offer the results to other members. Spaces presented by *CSS* may bring a confusion to participants except the coordinator. However this confusion can be seeds of new ideas coming to their mind.

Linking CSS to the WWW

We are applying the described method to visualizing personal viewpoints of contents and opinions appeared in personal pages of the WWW.

Some pages are designed as a meta page which collects many pages and classifies them in some context, which are useful for many people. Some are very huge collections for common use, and some are personal collections due to the collectors' subjectivity. The latter may be nonsense for most others, but it may offer some ideas or viewpoints to people who have similar interests.

The objective of *CSS* is to reveal personal ideas and viewpoints, and thereby encourage collaboration and communications in groups of people. Currently, *CSS* mainly uses documents given by users themselves, and this information is used for collaboration only in groups explicitly organized. However, on the current Internet, there are many electronic documents, and so asynchronous collaboration can also be expected with people who are not yet acquainted. Therefore, porting *CSS* to enable it to integrate seamlessly with the WWW is a straightforward expansion strategy.

4 Encounters with the help of third persons' views

This section describes the idea of encouraging new personal encounters from third persons' personalized views, which gives users the chance to make acquaintances according to their interests.

As places for possible encounters, we employ information spaces structured with contents of personal pages on the WWW. These personal pages have several links to other people's pages that are relative to each other in some context. The structured spaces have the potential to provide effective stimuli to people whose pages are referred to by them.

However, on the current WWW, users whose pages are referred to by other persons' pages are unable to know who make these links. If they could notice that a third person's page is referring to their page, they could get to know people who have a similar relationship from the third person's viewpoint.

These encounters would definitely be of a different type than existing communications in the real world, in the sense that they could not meet with these people unless there were personal connections.

Figure 3 illustrates the idea of new personal encounters in a third persons' views appeared in home pages on the WWW. We can expect two types of the encounters at step 4 and 5 in a following scenario.

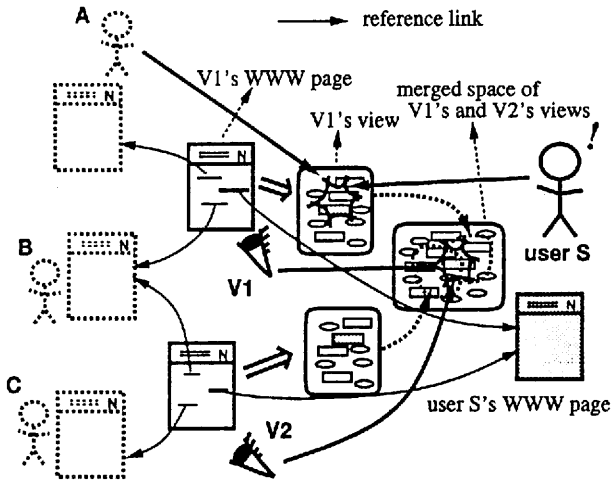

Figure 3: Emergent encounters on the WWW caused by third persons' views.

1. User S takes action to get to know people on the WWW who have similar interests.

2. The system generates a list of pages referring to user S's page by searching a database consisting of information on links. In Figure 3, V1's and V2's pages have links referring to user S's page.

3. The system provides places to facilitate encounters by visualizing each creator's view along with his/her page's contents consisting of information on links. Here, we expect that *CSS* is suitable as a virtual space for the encounters.

4. User S gets to know several people beyond the network by looking at visualized spaces. For example, user S encounters users A and B in V1's view.

5. Merging multiple spaces representing personal views with *CSS* encourages other encounters between people referring to user S's page. That is, user S's action enables encounters between people who have an interest in user S's personal page. In Figure 3, V1 and V2 encounter in V1's and V2's merged space. This encounter may enable them, who are not yet acquainted, to get to know the relevance between their viewpoints.

5 Conclusion

We have proposed a notion of *computer-aided communications* in a virtual society emerged on networked computer, e.g. the Internet. In this paper, we described a concept of a system supporting interactive and asynchronous collaboration and communications in information spaces structured with personal viewpoints. We proposed a novel type of encounter between people accessing the WWW by utilizing third persons' home pages consisting of several links to other home pages.

We presented *CSS* that supports individual reflection and collaborative concept formation by visualizing the thought spaces of users. We are connecting *CSS* to the WWW in order to facilitate world-wide asynchronous collaboration. *CSS* automatically arranges a relational map of text-objects and keywords though, it requires users to give them with weight values. In order to utilize *CSS* for facilitating collaboration and communications on the WWW, automation of these tasks is essential. Employment of existing (primitive) search engines on the WWW (e.g. Yahoo, Infoseek) seems appropriate.

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