A System for Community Information Sharing and its Evaluation at an International Conference

Harumi Maeda*, Masao Kajihara*, Hidekazu Adachi*, Atsushi Sawada†, Hideaki Takeda* and Toyoaki Nishida*

* Graduate School of Information Science,
Nara Institute of Science and Technology
8916-5 Takayama, Ikoma, Nara, 630-0101 Japan
Phone: +81-743-72-5265, Fax: +81-743-72-5269
E-mail: {harumi-m, masao-k, hideka-a, takeda, nishida}@is.aist-nara.ac.jp

† Data Processing Center, Kyoto University
Yoshida–Honmachi, Sakyo, Kyoto, 606–8601 Japan
Phone: +81-75-753-7418, Fax: +81-75-753-7452
E-mail: sawada@rd.kudpc.kyoto-u.ac.jp

Abstract

We discuss the requirements for information sharing in community. We propose the *weak information structures* to integrate heterogeneous information such as static information (e.g. local sites information) and dynamic information created in word-of-mouth communication. We have developed a system using the weak information structures for community information sharing called InfoCommon and evaluated it at the ICMAS'96 Mobile Assistant Project.

1 Introduction

The World Wide Web has become popular for information sharing on the Internet. As large-scale information resources on the Internet are increasing rapidly, it becomes more and more difficult to obtain information we need. Although a number of search tools are available, there are few intelligent systems which help us reorganize vast information obtained from the Internet from our point of view. We focus on the following problems in information sharing on the WWW. (1) It is difficult for users to get information they need when the menu structures of hypertexts are different from user knowledge about topics. (2) If search results are too many when using search engines, it is difficult for users to find useful information from them.

In this paper, we focus on a kind of communities in which a group of people meet together and are united by shared interests. We attempt to build a system to support community information sharing using an information representation called the *weak information structures* which are weaker than well-defined knowledge representations such as first-order logics and frames.

We discuss the requirements for community information sharing. We then propose the weak information structures to integrate heterogeneous information such as static information (e.g. local sites information) and dynamic information created in word-of-mouth communication.

We have developed an information sharing system called InfoCommon which provides people with intelligent assistance for exchanging and sharing knowledge and ideas. We have evaluated InfoCommon at the ICMAS'96 Mobile Assistant Project[1].

In what follows, first we analyze requirements for community information sharing and describe the weak information structures. We then present InfoCommon and experimental results at the ICMAS'96 Mobile Assistant Project and present discussion.

2 Issues in Community Information Sharing

2.1 Important Information

Community is a "group of people living together and/or united by shared interests, religion, nationality." In this paper, we focus on a kind of

communities in which people meet together and are united by shared interests.

By the above definition, local sites information where people meet together and information that people share interests is important. Personal information is also important to activate human-human interaction.

In addition, it is known that informal information created in word-of-mouth communication is essential to support community information sharing.

2.2 Hypothesis of Information Activity in Network Communities

As computer network technologies progress, virtual communities in which people do not live together and which are supported by computer networks have been formed. Netnews, Mailing-lists and Forums are such systems which support virtual communities. We call such communities "network communities."

We analyze how network communities are formed on mailing-lists.

Firstly, friends or companions who have the same/similar interests start a mailing-list. In the beginning, acquaintances of founders participate in. Newcomers then take part in when they happen to know the mailing-list by word-of-mouth or watching publicity.

First Messages created by newcomers are mainly questions except for self-introduction. This is because most of newcomers participate in the mailing-list to get information they need.

Newcomers try to find information by themselves in vain, and ask other members. They get chances to talk with and know others by asking questions, and they are recognized by others as well. Discussions seldom occur unless people do not know the people with whom they want to talk.

We set up a hypothesis that there are a series of processes for newcomers in information activity in network communities: "search → asking → knowing people → discussion." We think that helping these processes facilitates community information sharing.

In addition, we claim that the existence of special people who answer others' questions and encourage others to send messages is important to activate network communities.

2.3 Requirements Analysis for Community Information Sharing

From considerations described in the previous section, we analyze the requirements to build a successful system for community information sharing.

(1) Contents of information are important. For example, local sites, personal, word-of-mouth information and information that people share interests should be stored.

(2) Special members assist general users to use the system.

(3) The system supports information activity in network communities: "search → asking → knowing people → discussion."

(4) Users can access heterogeneous information from the users' point of view with/without menus.

(5) Users can integrate and reorganize personal and public information.

In addition, in order to use mobile terminals, we must consider the following issues to overcome the limitations of them.

(6) The system should have easy and simple user-interface.

(7) Interaction between mobile terminals and the server should be reduced.

3 Weak Information Structures

The weak information structures connect a wide variety of information media such as natural language texts, hypertexts and images without defining the semantics rigorously. By leaving the interpretation of the semantics to tacit human background knowledge inherently shared with people, they become compact and robust. Moreover, the weak information structures are easy to generate from raw data for both of humans and computers.

In community information sharing, the weak information structures are used to integrate heterogeneous information such as static information (e.g. local sites information) and dynamic information created in word-of-mouth communication. We believe that background knowledge shared by members can be utilized to understand the meaning of the relations.

4 InfoCommon

We have developed a shared-card information sharing system called InfoCommon which allows seamless keyword-based access to a variety of information cards to support community information sharing.

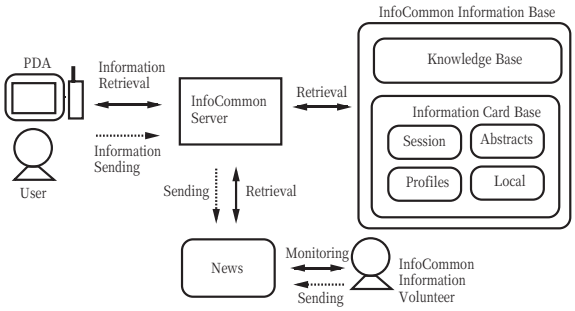

Figure 1: overview of InfoCommon

4.1 Architecture

InfoCommon is composed of (a) PDAs (Personal Digital Assistant) possessed by users, (b) InfoCommon information server which handles user requests and (c) News server which stores user messages and (d) InfoCommon information base. The InfoCommon information base consists of (d1) a knowledge base which links keywords and information cards using the weak information structures and (d2) an information card base which stores static information (Figure 1).

In addition, InfoCommon information volunteers (a) answer to user questions as the help desk to activate communications and (b) add information cards and adjust the weak information structures to improve search results.

4.2 Functions

InfoCommon supports the following functions.

Content-based Information Retrieval Given a set of keywords, InfoCommon will respond with the set of information cards connected to the keywords. The result of retrieval is stored in the user's local information base where the user can re-arrange the collection of information cards, and add/remove nodes/links as desired.

Information Sending (Posting News) InfoCommon is built on a conventional News service. Users can send messages to the News server. These messages are viewed as message cards in InfoCommon.

Personalizing Information Users can edit and reorganize gathered information and message cards and personal memoranda.

4.3 Search Algorithm

This section describes the algorithm which finds a set of cards when the server receives user input in information retrieval.

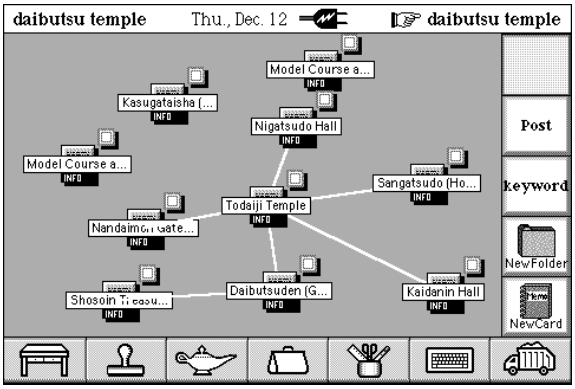

Figure 2: Screen Image of InfoCommon

- **step 1**: to remove unnecessary words/symbols from the input string and to expand keywords referring synonyms
- **step 2**: to select card candidates by full-text "AND" search
- **step 3**: to select card candidates by full-text "OR" search when card candidates are not selected by **step 2**
- **step 4**: to add card candidates by path-finding of the weak information structures and generate links
- **step 5**: to define maximum 10 [1] cards from card candidates using predefined weights

The weak information structures which are referred in **step 4** are defined by (1) predefined relations between cards, (2) predefined relations between concepts or (3) relations of cards defined by users or information volunteers.

4.4 User Interface

The information unit in InfoCommon is called "card." There are three kinds of cards: (a) an information card is a piece of static information stored in the information card base, (b) a message card is a piece of dynamic information created by users, which is stored in the News server, and (c) a memo card is a piece of users' personal memoranda, which is stored in PDAs.

InfoCommon provides visual interface for retrieving and sending cards. A relation between cards is denoted by a link.

Figure 2 shows an example when a user inputs "daibutsu, temple" in information retrieval. An icon of the card "Todaiji Temple" which is related to both of "daibutsu (great image of Budda)" and "temple" is shown in the middle of the screen.

[1] screen size of PDA and usability are concerned

Some card icons which are related to "Todaiji Temple" such as "Nandaimon Gate" and "Daibutsuden Hall" (these are buildings of Todaiji Temple) are linked with the card icon of "Todaiji Temple". A card icon of "Model Course around Nara Park" is shown but not linked with that of "Todaiji Temple", because the former and the latter are not related directly.

5 Social Experiment at the ICMAS'96 Mobile Assistant Project

We evaluated the usefulness of InfoCommon at the ICMAS'96 Mobile Assistant Project.

5.1 ICMAS'96 Mobile Assistant Project

ICMAS'96 is the Second International Conference on Multiagent Systems, which was held in December 9 - 13 of 1996 in Kyoto, Japan.

Nippon Telegraph and Telephone Corporation (NTT), Kyoto University, and Nara Institute of Science and Technology jointly planned the ICMAS'96 Mobile Assistant Project. It is the world first experiment in applying mobile computing systems to community support. 100 personal intelligent communicators with handy phones were loaned to conference participants to actually try out the system[1].

5.2 Overview of Experimental Results of InfoCommon

The InfoCommon information base stored static information such as abstracts of papers, session, local sites information and participants' profiles. The number of information retrievals was 351 and information sending was 32 over the 5 day period.

In what follows, we analyze how InfoCommon was used by examining the log file and questionnaires in details.

5.3 Analysis

5.3.1 Purpose

Answers to the question "For what did you used InfoCommon ?" are shown in Figure 3. 59% used the system for information retrieval and 18% for information sending including News(11%), help desk(7%) and discussion.

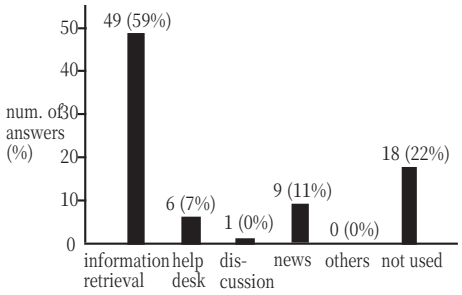

Figure 3: Purpose

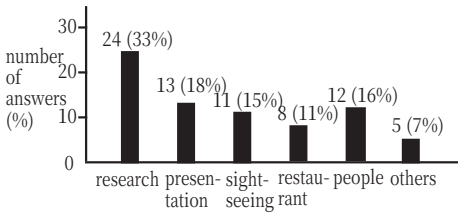

Figure 4: Topic

5.3.2 Comparison with Traditional Newsreader

In this experiment, 3 services were prepared which access to 17 Newsgroups: InfoCommon, a traditional Newsreader system and an information navigation system[2]. Users could read and post messages in each newsgroup using the Newsreader. In contrast, users could access messages regardless of newsgroups based on keywords in InfoCommon.

32 out of 48 messages (67%) were posted via InfoCommon.

The answer to the question "Which service did you mainly use for reading News ?" is as follows; Newsreader 33 persons (64%), InfoCommon 14 persons (27%), other 4 persons (9%).

About "Which service did you mainly use for posting News ?": Newsreader 9 persons (52%), InfoCommon 7 persons (41%), other 1 person (1%).

The reasons as to why InfoCommon was used for News are described as follows: "Because keyword search was easy and useful (14 persons)", "Because I found interesting topics in InfoCommon(5 persons)" and "Because I had a question (4 persons)".

We determined that InfoCommon added new facility to the conventional Newsreader.

5.3.3 Topic

Answers to the question "For what topic did you use InfoCommon" are displayed in Figure 4: research(33%), presentation(18%), people(16%), sightseeing(15%) and restaurant(11%) and others (7%).

Table 1: Frequently Asked Keywords

	keyword	count		keyword	count
1	icstat	50	7	lunch	6
2	nara	24	9	banquet	5
3	fipa	15	9	icsuggest	5
4	keihanna	12	9	kamameshi	5
5	agent	10	9	restaurant	5
6	nishimura	8	9	shuttle	5
7	food	6			

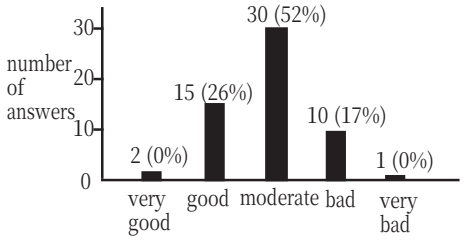

Figure 5: Search Results

5.3.4 Statistics

Table 1 shows the ranking of frequently asked keywords in information retrieval. The most frequent input word was "icstat," a special keyword to display statistics concerning frequently asked keywords and frequently discussed subjects. This result suggests that users used InfoCommon to know what other people are interested in and/or what are hot topics before information retrieval or sending. We found that such statistics are useful for sharing information among participants.

5.3.5 Search Results

Figure 5 shows answers to the question "How did you feel the search results of InfoCommon?" 81% felt that the search results were fine (very good + good + moderate) as shown in Figure 5.

5.3.6 Satisfaction

51% answered that they were satisfied with InfoCommon(Figure 6).

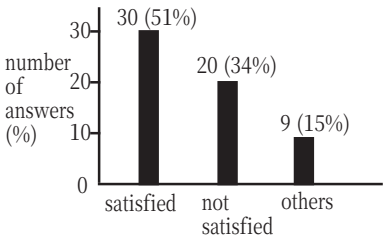

Figure 6: Satisfaction

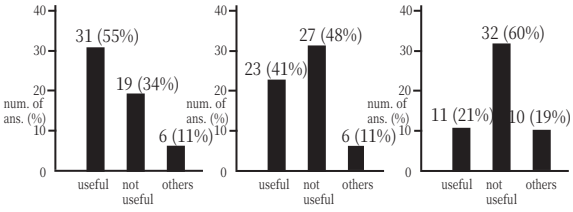

Figure 7: Usefulness

5.3.7 Usefulness

55% answered that InfoCommon was useful for getting the information they need (Figure 7(a)). On the other hand, 48% answered that it was not useful for knowing people (Figure 7(b)), 60% for discussion (Figure 7(c)). The results indicate that the system is useful for information retrieval but not for knowing people nor discussion.

6 Discussion

6.1 Contents of Information in Community Information Sharing

The result of questionnaires shows that (a) local sites information such as restaurants and sightseeing, (b) personal information and (c) information about research and presentations were searched. In addition, it is found that statistics are useful by analyzing the log file. These result support the issues raised in section 2 and suggest that people are interested in what others are interested in.

6.2 InfoCommon as an Information Retrieval Tool

We analyze that the following results support that InfoCommon is useful as an information retrieval tool for community; (a) 81% felt that search results were fine, (b) 51% were satisfied the system, and (c) 55% answered that the system was useful for information retrieval. We consider the results are supporting evidence of that people who share interests in community can have common background knowledge and they can understand the meaning of the semantics of the weak information structures.

6.3 InfoCommon as an Information Exchange Tool

The result that 32 messages out of 48 (67%) were via InfoCommon suggests the InfoCommon can be

useful as an information exchange tool. We analyzed this because of simple user-interface and availability of information volunteers. In addition, the comparison with the traditional Newsreader suggests that InfoCommon does not replace the traditional Newsreader but add new functions to it.

6.4 Hypothesis of Information Activity in Network Communities

We attempt to evaluate whether the system is useful about the hypothesis of information activity in communities: "search → asking → knowing people → discussion" that we set up in section 2. (1) We evaluate that the system supported the process "search" from the results of questionnaires. (2) The process of "search → ask" is partially supported by the system because the log file shows that some users asked questions after information retrieval. (3) Half of users answered that the system was not useful for "knowing people." However, we consider that this is because there were other systems in which users can access participants information without connecting the server[3] and users did not need to use InfoCommon for the purpose. We expect that InfoCommon is useful for knowing people and try to verify it in the future. (4) The process of "discussion" cannot be supported by InfoCommon.

We feel that the time period was too short to form the kind of community in which people create many active discussions. We need to conduct a longer-term experiment to evaluate the usefulness of the system for discussion in the future.

7 Related Work

CYC[4] and ARPA Knowledge Sharing Effort [5][6] have made a significant contribution in the sense they shed light on the importance of knowledge and information sharing and that they have presented a self-completed computational model. Their approach orients computer information sharing while ours is for human information sharing.

Gaines[7] uses semantic networks as information representation for group knowledge sharing. Our approach is based on much weaker information representation than semantic networks.

8 Conclusions

We have presented requirements for community information sharing. We then proposed the *weak information structures* to integrate heterogeneous information such as static information (e.g. local sites information) and dynamic information created in word-of-mouth communication.

We developed an information sharing system for community called InfoCommon which provides people with intelligent assistance for exchanging and sharing knowledge and ideas. We evaluated InfoCommon at the ICMAS'96 Mobile Assistant Project.

As a future research, We plan to conduct a longer-term experiment to evaluate the usefulness of the system for discussion.

References

[1] Y.Nishibe, H.Waki, I.Morihara and F.Hattori, "Analyzing Social Interactions in Massive Mobile Computing - Experiments of ICMAS'96 Mobile Assistant Project - ," In Working Notes for IJCAI-97 International Workshop on Social Interaction and Communityware, pp.19–24, 1997.

[2] R.Otsubo, K.Takahashi, Y.Nishibe and I.Morihara, "Information Service System for Decision Support- Action Navigator -," IPSJ SIG Notes Vol.97, No.54, 97-MBL-1, pp.7–12, 1997 (in Japanese).

[3] T.Gotoh, H.Yamaki, T.Komura, N.Itoh, T.Nishimura and T.Ishida, "Social Matchmaking Experiment on the International Conference ICMAS96," IPSJ SIG Notes Vol.97, No.54, 97-MBL-1, pp.19–24, 1997 (in Japanese).

[4] R.V.Guha and D.B.Lenat, "Enabling Agents to Work Together," Communications of ACM, Vol.37, No.7, pp.127–142, 1994.

[5] R.Neches, R.Fikes, T.Finin, T.Gruber, R.S.Patil, T.Senator, and W.R.Swartout, "Enabling Technology for Knowledge Sharing", AI Magazine Vol12, No.3, pp. 36–56, 1991.

[6] R.S.Patil, R.E.Fikes, P.F.Patel-Schneider, D.Mckay, T.Finin, T.R.Gruber, and R.Neches, "The DARPA Knowledge Sharing Effort: Progress report," Principles of Knowledge Representation and Reasoning: Proceedings of the Third International Conference, Charles Rich and Bernhard Nebel and William Swartout, Morgan Kaufmann, 1992.

[7] B.R.Gaines and M.L.G.Shaw, "Using Knowledge Acquisition and Representation Tools to Support Scientific Communities," AAAI-94, pp.707–714, 1994.