MEMO EXTERNALIZER

Support environment for bridging from personal ideas to group discussions in design meetings

YUJI MATSUMOTO,¹ YUSUKE OKADA,² NAGISA KIDOSAKI,¹ RYUSUKE NAKA¹ and SHIGEYUKI YAMAGUCHI³

1. Kyoto Institute of Technology, Kyoto, Japan, {matu, ki-, naka}@kit.ac.jp
2. IBM Japan Co. Ltd., Tokyo, Japan
3. New Era Office Research Center of Kyoto Institute of Technology / Tokyo City University, Kyoto, Japan, shige.yamaguchi@gmail.com

Abstract. This paper describes our development of a face-to-face design meeting environment that considers the integration of IT and architectural space. The Memo Externalizer (ME); proposed system, focus on how to externalize personal ideas in group discussions. The ME is a very simple system using lightweight technologies; web cameras which film each participant's memos and monitors which are set up over the heads of each participant to show their memos to each other. Through analysis from a comparison experiment, we discuss the effectiveness of the ME.

Keywords. Design collaboration; face-to-face meeting; room ware; co-occurrence networks analysis; and semi-public discussion media.

1. Introduction

Our research group has been developing a computerized environment for synchronous and asynchronous design collaborations (Matsumoto, 2006; Saji, 2006a; Yamaguchi, 1999; Yamashita, 2006). Also we have been researching the workplace for knowledge-based work, including meeting spaces (Saji, 2006b; Kim, 2008). This paper describes our current study in the development of a face-to-face design meeting environment that considers the integration of IT and architectural space.
In today’s knowledge-based society, more and more creativity in the design activities is expected and the importance of design collaborations, which is one good way to create new values, is increasing.

Using a whiteboard and projector is a typical style of face-to-face meetings now. This equipment is exceedingly public media; however they are also valuable media for sharing information among group members. Meanwhile, memos, which many people take in their own way during meetings, are very private media. This is because such personal memos often include variety of ideas, awareness, understandings or points, that the authors think a personal memo has the potential to activate design discussions more and more. The point is that semi-public media is important but insufficient for face-to-face meetings, especially in the early design phase when we spread ideas.

In addition to our previous works (Yamaguchi, 1999; Yamashita, 2006), as influential past researches on this study, there is The Colab (Mark, 1987) which is one of the originators of room-ware, whiteboard based local/remote meeting room-ware (Rekimoto, 1998), and Roomware (Streitz, 2001) which is a total environment for collaboration.

2. Development of the Memo Externalizer

2.1 CONCEPTS OF THE SYSTEM

In this study we develop a new communication media named the “Memo Externalizer (ME)” which externalizes an individual’s awareness and ideas in design meetings. The following are its three concepts:

- Expands the usual behaviours and gets assistance from computers without being aware of the man-machine interaction.
- Picks up on an individual’s awareness and ideas which are buried.
- Supports the spread of ideas by being a “bridge” that connects member’s personal ideas and the group’s discussions.

This study focused on “personal memos” as something that can externalize awareness and ideas in meetings. Usually, a memo is an individual tool to record necessary information or to write down one’s awareness. Each member has different points of focus, awareness, findings etc., and thus the contents of each member’s memos are different from others.

The authors therefore propose a new system to support the picking up of information, which is buried between the shared information among the group and personal ideas.
2.2 OUTLINE OF THE ME ENVIRONMENT

The ME is a very simple system that uses lightweight technologies. We have developed a system where a web-camera captures each individual’s memo-taking and displays it on a screen, enabling the other members of the meeting to see the contents. The memos are shown on the monitors above each person’s head. Simply put, this interface is exactly like the balloon of Manga. As shown in Figure 1,2, this environment consists of 5 components: 1) Web-camera; -2) Drawing board; -3) Monitor; -4) Host PC; -5) Interface program.

Figure 1. Composition of the ME

Figure 2. ME environment (left: Whole composition, right: drawing board and web camera)
The memo that is written on the drawing board is filmed by the web-camera, and then uploaded to the host PC as video data. The video is then shown on the monitor through the interface program. The web-camera is attached to the drawing board, so that the user can use it in a comfortable position. Also, from the requests received during our preliminary experiment, the authors left a little area for completely private memos in the corner of the drawing board.

In this environment, users just take a memo on the paper on the drawing board as usual without having to do anything special. The reason why a touch panel or a digital pen is not employed in this system is that the authors recognized the importance of unconscious support to usual behaviour through our preliminary experiment testing of digital writing devices. Also, we choose to film each person’s desktop, so that they could also share hard-copy documents which they had brought in.

3. Outline of the evaluation experiment

In order to verify the effects, we carried out a comparison experiment between the ME environment and the normal environment (using whiteboard and paper). Each experiment lasted for 45 minutes. There were 20 participants (4 teams, 5 people each). Each meeting was given design assignments which we had made, based on past entrance exams of our school, in order to standardize the difficulty level of the assignments.

- **Assignment 1**: Ideas for a new table where many people can work joyfully
- **Assignment 2**: Ideas for new playground equipment in a kindergarten

In addition, in order to reduce differences in the meeting process among the different teams, we explained the rough schedule before starting the experiment. Furthermore, the orders of the given assignments and used environments were switched during the experiment, because we wanted to minimise the influence of the order of the environments (whether the ME is used first or last) on their assignment performances.

![Figure 3. Two Environments of The Evaluation Experiment](image-url)
4. Analysis of the evaluation results

From the above-mentioned experiment, we collected 1) Video records, 2) Recordings of speech, 3) Subjective evaluations (questionnaires and interviews), and 4) Images of the memos captured every 30 seconds.

4.1 Feature Analysis of the Memos

In this analysis we categorized the participants’ usages of the memos by the captured images of the memos every 30 seconds and the video records, and then studied their characteristics. For the categorization, we used “personal/group” axis and “keyword-type/sketch-type” axis, the former shows the target and the latter the content of the descriptions (Figure 4).

As a result, 37% of the memos were used for arranging the keywords of a discussion, 33% of the memos were used for personal sketches or diagrams, 20% were for personal keywords, and 10% for diagram to organize discussion. This result shows that the participants were actually using the ME to write down personal awareness as well as the shared information of the group.

![Figure 4. Four Types of Usages of the Memo](image)

4.2 Results of the Questionnaire Survey

As shown in Figure 5, the results of the questionnaire (4 categories, 3 or 5 items each, with a scale from 1 to 7) show that the ME environment scored higher marks in most of the categories, such as communication, facilitation of discussion, and idea making, when compared to the normal environment. The ME environment had a particularly big effect on the items related to communication such as “Understanding others’ speech”.

Results that the ME environment had higher scores for “participating in the discussions” is also supported by the free comment “It enables us to com-
municate without speaking”. We can thus say that the ME was used as a media for participating in discussions via means other than speaking.

On the other hand, the normal environment scored higher marks in only two items, which were “Concentrating on the discussions” and “Sense of achievement”. As for the evaluation of the item “Concentrating on the discussion,” this can be explained by the high cognitive load on the participants in the ME, as some participants commented in the questionnaire “We were too focused on the memos”.

![Figure 5. Result of the Questionnaire Survey](image)

4.3 ANALYSIS OF SPEECH

Secondly, we analysed the effects of the ME environment by using the “speech sheet”. The speech sheet was made by transcribing the participants’ speech from the video record and IC recorder, without summarizing. In so doing, we added <speaker> <content of the speech> <silence> <accessing the memos>. Based on these five parameters, the authors analysed the following four points; from 4.3.1 to 4.3.4.

4.3.1 Amount of speech and Silence

The frequency of speech by the meeting members did not change, but the total number of letters (number of Japanese characters) in speech increased in the ME environment in three out of the four teams (Figure 6). A scene, which didn’t have any statements for longer than 5 seconds, was counted as “silence”, and we compared the number of seconds of the silences. The result was that 3 out of the 4 teams had less silence time in the ME environment (Figure 7). This is possibly because the ME externalized the discussion keywords, which improved the flow of the discussions. During the post-experiment interview, Team Y, the only team whose silence time increased, commented that they didn’t feel uncomfortable when they were silent, because they were communicating by the ME.
4.3.2 Changes in the amount of speech

The graphs in Figure 8 show the change in the number of letters used in the speech of each team. All teams showed an increased number of letters in their speech at the initial stage of sharing the discussion targets. We can therefore say the ME is effective in invigorating discussions at the “kick-off”.

In addition, except for Team Y who had more frequent silence time, the rest of three teams had an increase in the number of letters in their speech in the ME environment. We speculate that this is because the referred keywords and materials in the discussions are externalized and are still available, which gives a positive influence on the invigoration of the discussions. On the other hand, none of the teams managed to finish the assignment within the time limit in the ME environment. This may have influenced the low scores for “achievement in the discussions” in the questionnaire survey.

4.3.3 The number of citation speeches

By watching the video recording, we counted the number of “citation speeches” (the speeches which were made while the speaker was consulting written contents) that were based on the information externalized by the ME
or the whiteboard. As a result, the number of citation speeches of three out of the four teams increased (Figure 9).

4.3.4 Change in information access and the amount of the speech

Figure 10 is a graph which indicates the change in frequency of externalized information access*1 per unit time and also the amount of speech. This paper, incidentally, shows the graphs of only two teams who used both the ME and whiteboard in the experiment. We can see from the graph that-, while the ME is used throughout the time of meeting, the whiteboard is used only locally. This is because while the whiteboard is used as a media to write down the group’s shared information, the ME serves as an intermediary media between the personal and the group media before shared information is created within the team.

4.4 CO-OCCURRENCE NETWORKS ANALYSIS OF THE DISCUSSION

Finally, we made a co-occurrence network analysis of the conversations that took place, a kind of text-mining method, in order to compare the state of idea creation. Here we treat the co-occurrences in speech as connections within a discussion, and by visualizing them as networks, we can see the spread of
Co-occurrence networks are a graph where words with similar appearance patterns, in other words, words with a high rate of co-occurrence, are connected by lines. In this study, we extracted nouns from the speech in each meeting, using a morphological analysis. Any the nouns which appeared more than five times were defined as keywords. When these keywords were used together within the same speech, we treated this as a co-occurrence, and we created a co-occurrence network graph (Figure 11). Using this graph, we examine how the ME changed the citation relations in the speech and how it changed the way ideas are spread.

The nodes (nouns that appeared more than five times) and the edges (the co-occurrence relations) both mostly increase in the ME environment, and we can see that each connection between the keywords is stronger. Additionally, there is also an increase in the number of keywords which appear in association with other speech contents. This tells us that ideas can more easily be spread in the ME environment.

Regarding the co-occurrence relations as the connections between speeches, the increase in co-occurrence relations means discussions are now more easily connected. This suggests that the ME helps the process of shaping up the discussions.

Moreover, we can say that the weak-bonds which connect to the clusters of strong-bonds play a role in connecting ideas from different perspectives. That is to say, they bring new perspectives into the discussions and spread ideas. When we look at each network, though very subtle, we can see that in the ME environment there are more weak-bonds which have the “bridging function” to connect clusters of strong-bonds*2. This suggests that the information
externalized by the ME connects new opinions and ideas towards a certain direction, and spreads ideas in the discussions.

5. Conclusions

This paper proposes a new face-to-face design meeting environment; the Memo Externalizer. One of the biggest merits of this environment is that special construction work is not required and that it can be provided in any regular meeting room just by setting up monitors with poles or frames.

Results form the experiment illustrate its effectiveness and potential for facilitating meetings, activating discussions, and also spreading ideas. In conclusion, our trial in this study provides an example of the support environment for enhancing creativity of design collaborations in knowledge-based society; when very small ideas might come to have a big value.

Endnotes

1. “Access” here refers to an act where a participant of the experiment sees externalized information. The frequency of information access was counted by watching the video record (clearly looked at a monitor or WB).
2. We have used the Jaccard coefficient for the measurement of the co-occurrence, and we defined the bond as strong when the Jaccard coefficient is 0.1 or greater.

References