DISCOVERY OF MEETING-PARTICLE LINKS AND THEIR APPLICATION TO MEETING RECOLLECTION SUPPORT

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Keywords: Context discovery, Meeting particle link, Periodic meeting, Meeting recollection support.

Abstract: To facilitate more efficient regularly-held meetings, it is important to consider the past discussions and recall them in the current discussion. We previously developed a meeting recording system that creates discussion content from casual meetings on the basis of digital whiteboards. In this paper, we describe a discussion tool that enables the content of past discussions to be structured, retrieved, and reused in future meetings. We developed an application system to visualize the context relating different meetings by discovering links between meeting particles that are fragments of meeting content (e.g., text, image, and sketch. This visualization enables participants to recollect past discussions in the current discussion.

1 INTRODUCTION

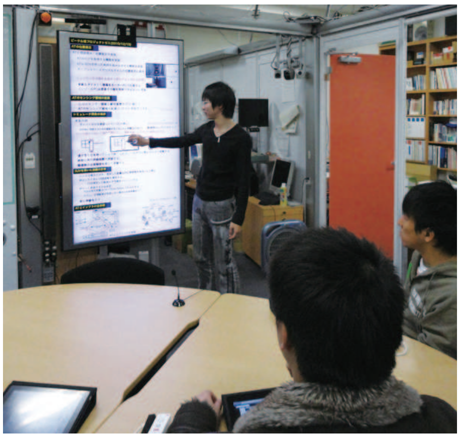

Figure 1: Meeting with TimeMachineBoard (Using a pen-device to point at context).

Organizations like companies and universities hold many meetings, large and small. People participate in meetings to solve problems they face or to get good ideas from other participants. They carry out their work on the basis of what was discussed in such meetings.

Small periodical meetings whose members have a common goal or purpose, such as team or project meetings, are especially important. Making these meetings better will lead to better company performance and research.

Meetings, as a tool for organizations to get things done, have certain problems. One problem is when a meeting goes on for several hours; it is difficult to create the minute, and as a result, the content may easily be forgotten. This situation is made worse when the relationships between previous meetings and the current meeting are not clear; we can easily lose focus of the topics, and this can lead to a repetition of the same arguments. Many readers are no doubt familiar with meetings where someone brings up the same topic that had seemingly been settled at a previous meeting. Even if we had all the minutes of the past meetings, such a problem entails lost time. To solve it, we must consider the relationships between meetings.

We have been researching the contexts of periodically held meetings. We call such meetings "casual meetings" and are developing technologies to support them. We have already developed a casual meeting support system called TimeMachineBoard (Ishitoya et al., 2009). This system enables participants to show their drawings, images, texts on a large display and record the discussion. The recorded discussion is composed by these elements and their arrangement histories, video, and audio. Figure 1 shows the appearance of our system being used in a meeting.

Our system aims to enable participants to retrieve past discussions that would be relevant to the current discussion. Participants can then base their discus-

Kentaro I., Shigeki O. and Katashi N..
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DOI: 10.5220/0003659904480451
In *Proceedings of the International Conference on Knowledge Discovery and Information Retrieval* (KDIR-2011), pages 448-451
ISBN: 978-989-8425-79-9

sion on the past content as need be, and they can view recorded content and be aware of the relationships between the past and present meetings.

We developed a tool to enable users to bring all content of past meetings into the current one, search the content for certain topics, and bring them into the current discussion. The tool extracts contextual information from the operation by discovering links between fragments of past meetings, e.g., texts, images, and sketches, that we call meeting particles. We also developed an interface for visualizing this contextual information. This interface enables participants to check the content of past meetings during a discussion and make their meetings more productive.

2 RELATED WORKS

Research on small informal meetings has often concentrated on how people use electronic whiteboards, such as Liveboard (Moran and van Melle, 2000; Oguni and Nakagawa, 1996; Streitz et al., 1994). These studiesf electronic whiteboards were projectors or large back-lit displays. Their user interfaces were digital pens and boards from which they derived semantics from the strokes and texts written on the board.

Research has also been done on recording whiteboard content. DYNOMITE (Wilcox et al., 1997) records content and related sound and information. ReBoard (Golovchinsky et al., 2009) monitors the whiteboard with a camera and if it detects that the whiteboard content has been modified, it creates a snapshot image of the whiteboard. The authors of that study built a snapshot browser to share and search white board content.

Other research has focused on regularly-held meetings. Branham et al. considered how to reuse whiteboard records after meetings and what values whiteboard content has. They concluded that whiteboards act an information repository (Branham et al., 2010).

3 MEETING RECORDING SYSTEM

We focused on meetings that were regularly-held by a university laboratory research project, and we specifically wanted to find ways to record, accumulate, and reuse discussion content.

Our system, shown in Figure 1, uses a large display (hereafter, board) as a whiteboard to present the content of a discussion for participants to share.

The board facilitates the present discussion by participants sharing the content in the form of handwritten characters, figures, text, and images displayed on a board (hereafter called, “display elements”). Participants can variously arrange these display elements as the meeting progresses.

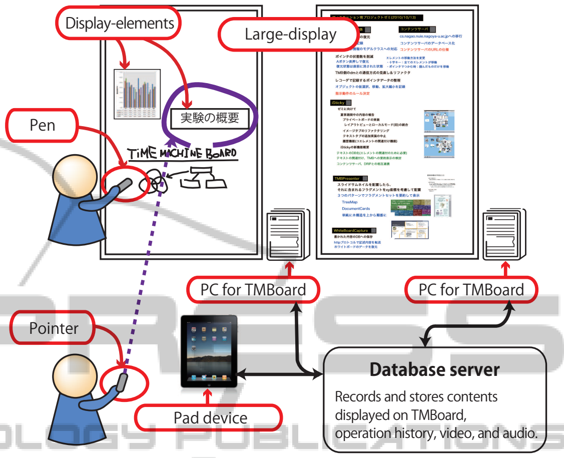

Figure 2: System overview.

Figure 2 outlines the system. To display information on the board, each participant can use a pen, a pointer, or our developed software called iSticky. Participants can write words or figures and move and scale display elements directly by using a pen. They can use a pointer to point to, scale, or move display elements while they are away from the board. iSticky is installed on the pad devices. Participants can use iSticky to display, scale, and move display elements (images, sketches, and texts) on the board. Each pen, pointer, and iSticky has a unique ID. Thus, we can find out which participants introduced or operated with which display elements.

Recorded discussion content is made up of display elements and their histories of when and who input or operated which display element on which board. At the end of the meeting, these information is sent to the database server and stored as searchable content (called discussion content). By using this system in meetings, we can easily record discussions.

TimeMachineBoard has been in operation since September 2008. Four research projects have been conducted at our laboratory (20 to 30 meetings per project per year). I have made improvements the system in response to various feedback that came from these meetings. We can browse and search 157 project meetings held from September 2009 to February 2011. The average meeting time was 2 hours 12 minutes. Information displayed on the board consisted of 244 strokes, 3627 text display elements, and

445 image display elements. Text display elements transferred in a single meeting averaged 23 display elements and 60 characters in Japanese (8 to 10 words in English) per text display element. These results indicate that TimeMachineBoard displays much more texts than a whiteboard can.

4 DISCOVERY OF MEETING PARTICLE LINKS

Figure 3: Interface for search meeting contents.

A discussion using TimeMachineBoard is different from a discussion with a whiteboard. This system is premised on discussions being recorded and later searched and read. The recorded discussion is easier to review than a record of discussion on a whiteboard such as snapshot image of the whiteboard. This is because participants often use textual display elements to conform their vocabulary to everyone else's; this makes the content easy to search.

We thought that subsequent meetings could be made more productive when each participant can effectively utilize solutions and knowledge derived from the prior meeting.

For this purpose, it is necessary to enable discussion content of past meetings to be searched, retrieved, viewed, and discussed.

To refer to past discussion content without the current discussion stagnating, the past discussion content should be able to be searched and viewed quickly. With this in mind, we developed the search interface shown in Figure 3 as a function of iSticky.

The top of the interface is a board image view that chronologically arranges the board images which express the conclusions of past discussions. The list of the discussion contents can be perused by scrolling right and left, and the board image expands when selected. The list can be narrowed down by searching using keywords, project information, participant's information, etc. Moreover, discussion content of meetings in which the users did not participate can be downloaded from a server later and added to the board image view.

Moreover, we thought that not only searching and perusing past meeting content but also visualized parts of the content (we call them "meeting particles") on the board in subsequent meetings would make participants conscious of the context of the past meetings and prevent topics being overlooked or the same argument repeated.

Meeting particles are compositional elements of meeting content. Meeting-particles include not only display elements themselves, but a part of a display element. For example, words in an image, morphemes in a text, and speech in a recorded video. This enables relationships between meeting contents to be expressed more flexibly and in more detail.

Therefore, to input to the board a meeting-particle of past discussion content (we call this action "quotation"), we created an element list view at the bottom of the board image view that displays a list of display elements (e.g., images, texts, etc.) contained in the discussion content and selected by a user.

When a user selects the display element he/she wants to quote from the element list view, information about the selected display element is displayed in a popup window. He/she can choose to quote directly or to edit part of the content before they are input to the board. For text display elements, morphemes included in the input text are treated as meeting particles.

If a user quotes a meeting particle, it appears on the board and the quotation information is recorded. The linkage between meeting particles (information regarding the relationship between the meetings) included in the quotation information can be treated as context associating the meetings.

Quotations using this interface were performed 158 times from September 2010 to February 2011. Meetings held directly before the current ones were quoted 108 times, those directly before them 39 times, and older meetings 11 times. These results show that the most recent meetings were most often quoted. This means that useful discussions may get buried over time as more meetings are held. Thus, a mechanism is required by which a participants can better discover past discussion content.

5 MEETING CONTEXT RECOLLECTION SUPPORT

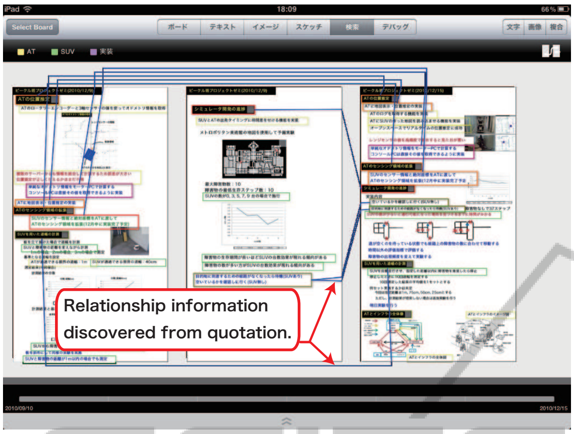

Figure 4: Interface for visualization of meeting context information (blue lines indicate context information).

The search interface described above is for perusing the content of one meeting, but it is difficult for participants to be conscious of the relationship between two or more meetings. For example, by remembering past discussions, when a participant can find out a background of an implementation which is reported in the current discussion, it would help to avoid unnecessary repetition of the same arguments and opinions.

By searching past arguments and quoting a meeting particle, information relevant to the past and present meetings can be extracted from the quotation information. To make participants conscious of the context between meetings, we developed an interface to visualize relationship information as a function of iSticky.

The interface shown in Figure 4 displays content in the form of nodes and relationship information in the form of edges connecting nodes. This visualization enables users to grasp how a series of discussions has progressed from the past into the present.

Furthermore, users can quote meeting particles visualized on the interface. In comparison with the board-image interface described earlier, this interface enables more content from past discussions to be rediscovered. Participants can quote by choosing a node, since they are more conscious of the relationships between meetings.

By using this interface during the meeting, as well as retrieving the content of past discussions, participants can become more aware of the context of past meetings. Parts of useful discussion content rediscovered by users can be displayed on the board to be shared among participants, thereby making meetings more effective.

6 CONCLUSIONS

We described a system for searching and quoting the content of past discussions in subsequent meetings and a system that supports retrieval of past discussion contents by visualizing the context relating meetings.

Many researchers have analyzed the structure of meetings, but few have concentrated on the linkages between regularly-held small-scale meetings in the knowledge-based activities of individuals and organizations. If relevant information from past meeting records can be accumulated and used appropriately in such meetings, any new discussion based on the past discussions will make individuals and organizations more productive.

Our future work includes evaluation of this system through long-term use, automatic presentation of information in accordance with the subject of a meeting, and discovery of content of important meetings by reusing information.

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