A Meeting Assistance System with a Collaborative Editor for Argument Structure Visualization

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ABSTRACT
This paper presents a meeting assistance system which produces meeting minutes from the output of a meeting. This system was designed so that participants could complete the meeting minutes cooperatively by using the following features: collaborative editing, visualization of the argument structure, voluntary vote, and dragging and dropping of speech sounds.

Author Keywords
Group Decision Support System, Synchronized system, High value-added minutes.

ACM Classification Keywords
H.5.3. Group and Organization Interfaces: Computer-supported cooperative work.

General Terms
Design.

INTRODUCTION
Improving the productivity of meetings about decision making and problem solving in small groups provides various advantages in an organization. In this style of meeting, participants state their ideas and adopt opinions as conclusions. One of the participants takes notes on these discussions and sends the minutes after the meeting to share the conclusions. This conventional meeting style, however, has some critical problems, such as the discussion often strays from the agenda, the same discussions are repeated and useless explanations exist, and important remarks not listed in the minutes are lost.

To solve these problems, we developed the meeting assistance system which has the following features: collaborative editing, visualization of the argument structure, voluntary vote, and dragging and dropping of speech sounds. In this meeting style, all participants use a PC, headset and the system consisting of three windows, "Minutes," "Work Space" and "Waveform." In a study of an archived meeting, participants used the recorded contents to search and find the important remarks for conclusions [1].

The goal of this study was to improve the meeting process itself by using the system and by producing the minutes at the end of the meeting so that participants could confirm outputs such as the conclusions and "TODO" lists.

PROBLEMS AND SOLUTIONS
In a conventional meeting style, a clerk takes notes throughout the meeting, and then the clerk organizes and distributes the minutes after the meeting. The following problems exist in this meeting style.

(a) The discussion often strays from the agenda due to the lack of a shared awareness of the agenda. In addition, recognition of the decision declines because participants receive the minutes after the meeting.

(b) It is difficult for a clerk to participate in an argument. In addition, if important remarks are not listed in the minutes by a clerk, these remarks are lost. Because all remarks are entered only by the clerk, another participant cannot individually enter his remarks into the minutes.

(c) The content to enter on the minutes is vague.

(d) Time is consumed for confirmation of the intention or for useless explanation of a remark after a decision has already been reached.

(e) Participants cannot leave implicit information such as the nuance of speech in the minutes.

Therefore, we developed the system consisting of Minutes, Work Space and Waveform windows to solve these problems (Figure 1). In Work Space, the hierarchy structure of the argument is edited by the participants. The Waveform window displays the waveform of a speech sound captured by the microphone. The Minutes window organizes and specifies the information of the Agenda, Decision and TODO in the Work Space window. In addition, the
argument structure edited in the Work Space is written down in the Minutes window in a hierarchical structure of sentences. The Minutes and Work Space windows are the output of this system. To solve the aforementioned problems, we added the following functions to this system.

To solve (a), the meeting goes on while the participants edit the Work Space window, which visually presents the argument in a hierarchy structure. Completion of the Work Space is the purpose of the meeting. The agenda is written in the root node of the hierarchy structure. Participants add an object with each remark to this hierarchy structure.

To solve (b), it is possible for all participants to edit the Work Space. If they don't understand who should be editing, they can assign one person to edit it.

To solve (c), we classify remarks into the following seven types: Idea, Agreement reason, Disagreement reason, Footnote, Question, Answer, and TODO. The system displays this information to the participants. The three states of the Idea are as follows: Decided, Pending, and Rejected. The remarks of the Idea can become the Decided for the agenda or the group that compiled them. An initial state of an Idea is a Pending. Participants can change it through the state of a Decided or a Rejected. The purpose of the meeting is to change an Idea into the Decided state.

To solve (d), participants are able to express their intention to agree or disagree with remarks such as Idea, Agreement reason, and Disagreement reason by the vote function at any time. In addition, they can always change their intention. The intention to agree or disagree is conveyed to all participants, and it is specific to each object by an icon: a blue or red square. The participants can specify the timing of votes to express their intention. In addition, any participant can vote at any time without stopping the meeting.

To solve (e), participants can leave the speech sound of a remark by selecting the relevant range in the Waveform window and dragging and dropping the meaning of the sound into the Work Space to retain the nuance of the speech. Only the actual waveform is displayed in Waveform, but participants can choose the appropriate range, because it is just after a remark that they may decide to keep the speech.

Another study presented a meeting system which uses a mind map as a similar technique to solve (a) [2]. However, our proposed approach is different from the other approach because our system has functions of collaborative editing, visualization of the argument structure, voluntary vote, and dragging and dropping of speech sounds. By including these functions, it is possible to make decisions in a meeting effectively and efficiently. Also, in one other system, participants can agree or disagree for each idea and then vote on each opinion [3]. However, our proposed system is used in a real-time meeting, such as a face-to-face meeting or teleconference, and has the distinction of being able to output various decisions and TODO lists flexibly.

**EXAMPLE MEETING**

As an example of a meeting using this system, we use the agenda to "Decide a graduation destination" (Figure 2). One person writes "Decide a graduation destination" in the root node of Work Space. Each participant contributes his or her Idea, and the Idea is derived from the root node. If there are conditions such as the season of the trip, it is derived from the root node as a Footnote. In Idea, there is typically an abstract idea such as one’s own country or a foreign country, and there is a concrete idea such as Kyoto or Las Vegas. One can change the relations of the child nodes and the parent node by cutting and pasting the object during the meeting. The Agreement reason is derived from the Idea and the Disagreement reason is derived from another Idea. It is easier to understand the next argument that should be argued, because everyone can see what has not yet been argued and what has already been rejected by the argument. Then, one can make decisions for the agenda more effectively and more efficiently by referring to the reasons and then voting.

**CONCLUSIONS**

We suggested a meeting style using a meeting assistance system with collaborative editing, visualization of the argument structure, voluntary vote, and dragging and dropping of speech sounds. Our goal was to make a decision based on the agenda of a meeting effectively and efficiently. To demonstrate use of the system, we presented an example of using the system.

**REFERENCES.**