Agenda based Multiple Work Support for Video Conferencing Participation and Deskwork

Itaru Takata, Kousuke Tsumura, Hisashi Anzai, Hironori Egi, Ken-ichi Okada
Faculty of Science and Technology, Keio University
3-14-1, Hiyoshi, Yokohama, Japan
{takata, tsumura, anzai, egichan, okada}@mos.ics.keio.ac.jp

Abstract

In this research, we proposed an approach that aims for multiple work support of deskwork such as documentation and attending remote conferences simultaneously using conference agendas. The workers are presented with the agenda in advance, and they set the priority of each topic to specify which task the main work is. Therefore, when the topic changes, the suitable work environment is provided for the worker automatically according to the priority of the next topic. By doing so, we intended to improve the efficiency of the deskwork and the level of understanding the content of the conference. Furthermore, from the results of the evaluation experiments, it was confirmed that the level of understanding about the content of conference increased without decreasing the efficiency of the deskwork because the subjects did not have to pay attention to the current topic all of the time.

1. Introduction

Work styles called "multiple work" is attracting attention[1]. Figure 1 shows the conceptual diagrams of existing work style, ubiquitous work style and multiple work style respectively. In existing work style, the workers were able to carry out their works only in places where work environment such as network environment is completed. On the other hand, work style in ubiquitous society enables workers to carry out their works at any environment. However, ubiquitous work style also caused the situation that the workers always carry some tasks. To deal with this situation, the work style called multiple work style was thought up. In multiple work style, the workers carry out their diverse works at the same time. Multiple work style are aimed to improve the efficiency of their works and to create time to spare.

The requirements of multiple work support are to grasp the condition of the multiple works easily and switch between the works smoothly. Several approaches on multiple work support have been carried out, and are as follows: aiming on the time manegement of the workers[2, 3], laying out information other than the main work around the worker[4, 5, 6]. However, when paying attention to the actual works of office workers, many workers use most of their time attending to conferences and deskwork such as preparing and organizing data and information. Consequently, office workers carry multiple works on an indivisual basis, and are forced to pause or switch between works in order to carry out face-to-face communication[7].

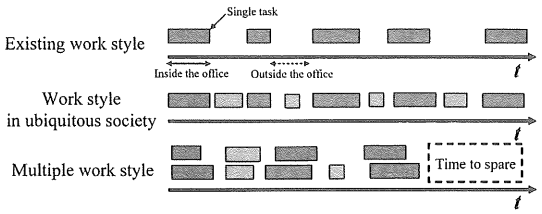

Figure 1. the conceptual diagrams of work styles

However, many of the IT devices are designed to support each different task such as documentation and E-mailing indivisually and do not deal nor consider with the relation when these tasks are combined[8]. Keeping this in my mind we look at the research on multiple work support.

The main objective of multiple work support is to support the carrying out of different works simultaneously. In our research we especially focus on the relationship between two different tasks. Figure 2 shows the categorization of tasks in office work. In Figure 2 we define real time communication with others which do not easily allow controlling or interference as "interaction work". We also define work such as E-mailing and documentation which are carried out on a non-real time basis and at an individual timing as "non-interaction work". Even though the diversification of office work continues, it can be categorized as shown in Figure 2. When controlling office work, considering works including interaction becomes significant. Therefore in this research we aim to support multiple works including documentation deskwork and remote attendance of videoconferences(simply confer-

Main work	Secondary work: Interaction work	Secondary work: Non-interaction work
Interaction work	Ex.) Attending two conference simultaneously	Ex.) Carrying on a mail while attending a conference
Non-interaction work	Ex.) Listening someone's talking in the background while carrying on documentation	Ex.) Carrying on a mail while looking special permission

Figure 2. Categorization of multiple work

ence). As the work environment, the two tasks are displayed around the worker and the worker carries out the tasks simultaneously. In this case, by providing the suitable work environment according to the topics of the conference, the efficiency of the deskwork and comprehension level of the conference is improved. What we mean by suitable work environment is that the display manner of the conference video is changed automatically according to the worker's interest in the certain topic of the conference.

In Section 2 the problems in multiple work is mentioned. In Section 3 we explain our proposal of an new multiple work support. Section 4 shows the implementation of our system and the results of the evaluation experiments are given in Section 5. Closing remarks are given in Section 6.

2. Issues in Multiple Work

As mentioned above, the worker's environment assumed in this research is multiple work. In an environment like this, when a topic the worker doesn't need to listen to in the conference, he/she needs to concentrate his/her mind on the deskwork. On the contrary, when a topic the worker needs to listen to in the conference, he/she needs to concentrate his/her mind on the conference. However, the approach of providing suitable work environment for the worker by topics of a conference has not been carried out. Therefore, if the worker is imposed with deskwork such as documentation and attending to a conference, he/she must carry on deskwork while paying attention to the current topic. Consequently, the issue is that the efficiency of his/her deskwork and the level of understanding about the content of conference both decreases.

3. Proposal

3.1. Setting of Work Environment

Figure 3 shows the multiple work environment with monocular HMD (Head Mounted Display) and desktop display we set in this research. If two displays are set up in parallel, a worker will concentrate his/her mind on only one display. Then, the issue will occur that he/she is not aware of the change on the other display. And so, we set up two displays in a multilayered way like Figure 3. In this way, a worker can grasp the condition of the multiple work easily and switch between the works smoothly. A worker carry on the main work on the desktop and the secondary on the HMD like the worker in Figure 3.

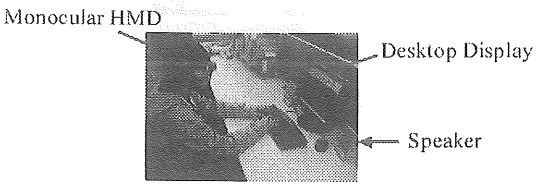

Figure 3. Multiple work environment with HMD and desktop display

3.2. Multiple Work Support with Agenda

In this research, we focus attention on the usage of the agenda of a conference. The conference consists of several topics and we call the list of topics ordered according to time as agenda. The reason why we focus attention on agenda is as follows: most conference contains a agenda, the agenda is created before a conference starts, and the topic that needs to be listened to varies accroding to the worker. Consequently, when the topic is one that the worker needs to listen to, our method allows the worker to concentrate on the conference. On the other hand, when the topic is one that the worker does not need to listen to, our method allows the worker to concentrate on the deskwork. The workers are presented with the agenda in advance, and they set priority to the topics. Priority is high when the worker needs to concentrates on the conference and low when the worker needs to concentrates on the deskwork. And so, when the topic changes, the program director pushes a button in the conference to create and provide work environment for the worker automatically according to the priority of next topic. By doing so, we intended to improve the efficiency of his deskwork and the level of understanding about the content of conference. Based on this idea, we propose the approach on multiple work support of setting work environment according to the priority added agenda. The displayed contents are switched between the desktop and the HMD as in Figure 4.

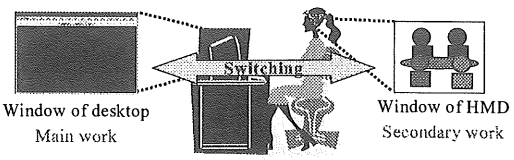

Figure 4. Changing Work Environment According to Priority

3.3. Assumed Environment

In this research we make four assumptions in the working environments. One is that workers doing documentation attends the conference remotely. Another is that the electronically written agenda is made ahead

is that the electronically written agenda is made ahead of the conference. And the topics in the agenda is listed in time order, and it is distributed as an electrical file to the remote attendees ahead of the conference. Another is that there is a program director at the place of the conference. Another is that the program director indicates to the remote attendees that the topic has changed by pushing a button.

3.4. Prioritizing Topics on Agenda

The remote attendees load the agenda file once receiving it. And the list of topics and the panel for selecting priority are displayed. The four priorities the attendees can select from are as follows:

- Completely attend conference
- Listen carefully
- Listen roughly
- Concentrate on deskwork

We will explain about the work environment provided according to these priorities in detail in the next section. Figure 5 shows one example of loading agenda and settind the priority.

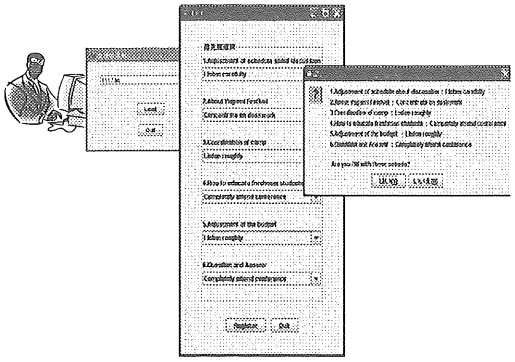

Figure 5. Loading Agenda and Setting the priorities

3.5. Providing Work Environment by Priority

By setting the priorities, the work environment and video conference video are provided for the workers according to the priority of the current topic in the conference. The work environment and conference video provided according to each priority are as follows:

1. Completely attend conference

   The work environment with complete emphasis on the conference is provided. In the concrete, the conference window is displayed on the desktop. Nothing is displayed on the HMD. In this case, the display of conference video is real-time and the shots of speaking attendant is used. And the worker can interact with people at the place of the conference.

2. Listen carefully

   The work environment with emphasis on the conference is provided. If the worker has more capability, he can carry on the deskwork. In the concrete, the deskwork and conference window is displayed on the HMD and the desktop respectively. In this case, the camera switching method with time shifting carried out by Kato et al[9](see Appendix) is used for the display of conference video. And the worker can not interact with people at the place of the conference.

3. Listen roughly

   The work environment with emphasis on the deskwork is provided. If the worker has more capability, he can see and listen to the conference. In the concrete, the deskwork and conference window is displayed on the desktop and the HMD respectively. In this case, the camera switching method with time shifting carried out by Sumiya et al[10](see Appendix) is used for the display of conference video. And the worker can not interact with people at the place of the conference.

4. Concentrate on deskwork

   The work environment with complete emphasis on the deskwork is provided. In the concrete, the deskwork window is displayed on the desktop. Nothing is displayed on the HMD, but audio is played. And the worker can not interact with people at the place of the conference.

In case that the conference video switches from the video using time shifting to real-time video, the time lag causes the cut of Δt seconds of the conference video. In order to cover this problem, the real-time video is displayed on the desktop and then the video using time shifting is displayed on the HMD for Δt seconds as shown in Figure 6.

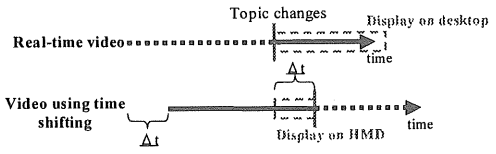

Figure 6. Swiching the Conference Video in case that "Completely attend conference"

3.6. Switching Windows Dynamically between Desktop and HMD

As mentioned in the previous section, the worker sets the priority on the topics before the conference, and then in the conference he works in the environment accroding to the priority with each topic. However, there are cases when the workers wants to change the priority during the conference. In response

to the situation like this, we enable the workers to switch windows dynamically between the desktop and the HMD. By doing so, it's possible to display the deskwork window or the conference at the desktop window on the worker's own will.

4. Implementation

Based on the proposal in Chapter 3, we implemented a prototype system for multiple work support with agenda. We will explain the details of it in this chapter.

4.1. Implementation Environment

The implementation language is J2SDK1.4 and JMF2.1.1e API. The type of HMD uesd are Data Glass 2/A and Data Glass2 by Shimadzu Cooperation. The implementation was executed on a CPU Pentium 4 2.8 GHz, 512 MB RAM machine with Windows XP Professional OS.

4.2. Structure of Prototype System

This prptptype system contains three windows, a window for loading agenda, a window for selecting priority and a window displayed on the desktop and the HMD. We will explain the details of these in this section.

4.2.1. Loading Agenda Files

The electronically written agenda file is loaded using the window in Figure 7. The details of the window in Figure 7 are as follows:

1. Text field for selecting agenda file
   The worker inputs the name of the agenda file he wants to load.
2. Load button
   When the worker clicks this button, the agenda file input in the (1) text field is loaded. If the file input does not exit, an error message is displayed.
3. Quit button
   When the worker clicks this button, the system ends.

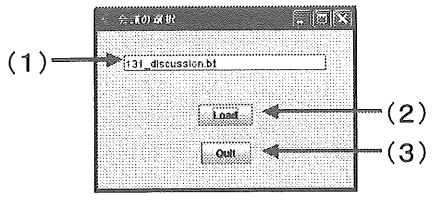

Figure 7. Loading Agenda File

4.2.2. Selecting Priority

If the worker can load the agenda file correctly, the window as shown in Figure 8 is displayed. The topics is written in order in the window and the worker can select the priority. The details of the window in Figure 8 is as follows:

1. Priority selection list
   The worker selects from four priorities mentioned in Section 3.4 for each topic.
2. Register button
   When the worker clicks this button, the priority set for each topic is registered. If there is a topic that the priority is not selected for, an error message is displayed.
3. Quit button
   When the worker clicks this button, the system ends.

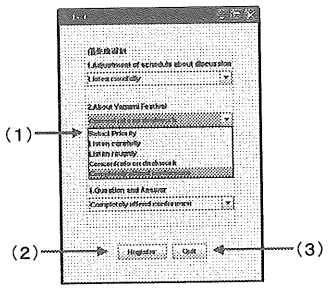

Figure 8. Selecting Priority

4.2.3. Window Displayed on Desktop and HMD

Here we explain GUI displayed on the desktop and HMD. We create the window like Figure 9 and set the display of the desktop and HMD to the left and right half of the window respectively. And the window of the desktop and the window of HMD are switch according to the priority.

In addition, we set "Change Display Button" in the lower left-hand corner of the window displayed on the desktop. This button is used for situations as mentioned in Section 3.6 to enable the workers to switch windows dynamically between the desktop and the HMD.

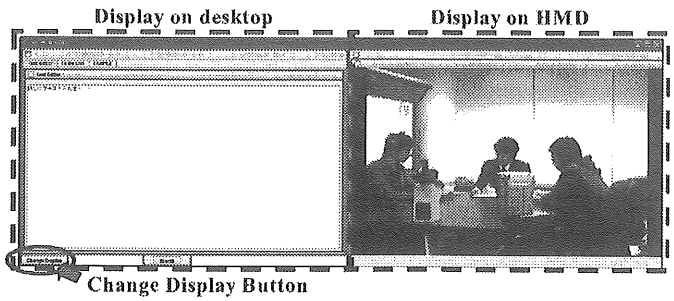

Figure 9. Window displayed on desktop and HMD

5. Evaluation

We carry out the evaluation experiment. The purpose of this experiment is to examine how switching work environment with our approach affects the worker in multiple work environment. From the results, we evaluate the usability of switching work environment. The subjects of our experiments contains 16 college students who are used to operating computers.

5.1. Content of Work

The work environment is as shown in Figure 3. The contents of multiple work are typing as deskwork and watching the conference simultaneously. Figure 10 shows the GUI of the deskwork used for evaluation. The work of typewriting is to type between three and six alphabets such as those written at the head of Figure 10. When the subject presses the Enter key, the next input alphabets are indicated. And when the conference video ends, the typing GUI closes. The conference video is four minutes long, and contains four topics. An example is how to educate freshman students in the laboratory. The subjects are told what topics a question is asked for before hand. After the subjects watches the conference video, they are asked questions considering two out of the four topics. And audio is output from the speakers set by the desktop.

The subjects carry out the works in the following order:

1. The subjects type indicated the alphabets while watching the conference video
2. The subjects answer the questions about the contents of two topics after the conference video ends

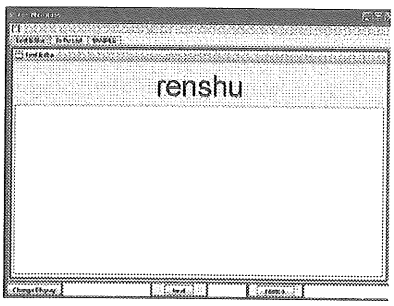

Figure 10. GUI of Deskwork for Evaluation

5.2. Evaluation Items and Experimental Environment

We set the following evalutaion criteria; accuracy rate, precision rate, and number of letters per minute. Accuracy rate is the number of question answered correctly out of the total questions and this shows the degree of the comprehension of the conference. The precision rate is the number of correctly typed letters out of the total typed letters. The number of letters per minute is the total of typed letters divided by the total time the video is played. The former criteria show the correctness and the latter show the progress of the deskwork. And for evaluating the usability of switching work environment we examined in the following two environments and compared:

1. Proposal approach

   We set the following conditions to fix the evaluation environment. Two levels of priority, high and low are set in this evaluation experiment. The priorities of each topics are decided in advance. The work environment switches automatically according to the priority of each topic. Questions are asked from topics with high priority after the conference video ends. For topics with high priority, the subjects watch the video on the desktop and carry out deskwork on the HMD. For topics with low priority, or in other words, topics which questions are not asked for, the work environment is switched around. In this way, each subject work in the same environment and carry out the same works and answer the same questions to prevent the unfairness due to the difference in the evaluation environment.

2. Fixed Work environment

   The subjects carry on the deskwork on the desktop and watch the conference video from the beginning to the end.

5.3. Results

Table 1 shows the result of the accuracy rate and Table 2 shows the precision rate and the number of letters per minute. There is not a noticeable difference between the results of proposal approach and those of the fixed work environment in the precision rate and the number of letters per minute. However, the proposal approach results higher than the fixed work environment in the accuracy rate. Consequently, it is believed that the level of understanding the content of the conference increased without decreasing the efficiency of the deskwork because the subjects did not have to pay attention to the current topic.

	Accuracy rate(%)
Proposal approach	74.4
Fixed work environment	57.5

Table 1. Watching the Conference Video

	number of letters(/min)	precision rate(%)
Proposal approach	116.0	99.5
Fixed work environment	122.3	99.5

Table 2. Deskwork

6. Conclusions and Future Work

In this research, we proposed an approach that aims for multiple work support of deskwork such as documentation and attending remote conferences simultaneously using conference agendas. The workers are presented with the agenda in advance, and they set the priority of each topic to specify which task the main work is. Therefore, when the topic changes, the suitable work environment is provided for the worker automatically according to the priority of the next topic. By doing so, we intended to improve the efficiency of his/her deskwork and the level of understanding the content of the conference. Furthermore, from the results of the evaluation experiments, it was confirmed that the level of understanding about the content of conference increased without decreasing the efficiency of the deskwork because the subjects did not have to pay attention to the current topic all of the time.

We prepared four priorities in this research. However, the workers set the priority on the topics only before the conference, and they were not able to change the priority dynamically except for switching windows between the desktop and HMD. As for future work, we will improve the algorithm and GUI so that the workers can change the priority at any time.

Acknowledgements

This work described here was supported by the 21st century COE(Center of Excellence) program in Japan. And we would like to thank Shintaro Ueda for his help in shaping the work.

References

[1] Star-telegram.com and David Meyer. Multitasking makes you stupid,studies say. http://www.dfw.com, 2003.

[2] Roy Rondenstein. Owntime:a system for timespace management. Proceedings of CHI99, 1999.

[3] O'Conaill, Frohlich, and David. Timespace in the workplace. Proceedings of CHI95, 1995.

[4] Blair Maclntyre. Support for multitasking and background awareness using interactive peripheral displays. Proc. Of ACM, 2001.

[5] Andrew Dahley. Water lamp and pinwheels: ambient projection of digital information into architectural space. Proceedings of CHI98, 1998.

[6] Jacob Somervell and D.Scott McGrickard. Secondary task display attributes-optimizing visualizations for cognitive task suitability and interference avoidance. Proceedings of the symposium on Data Visualisation 2002, 2002.

[7] V. M.Gonzales and G. Mark. Constant, Constant, Multitasking Crazines. In Proceedings of CHI '04, pp.113-120, 2004.

[8] Mary Czerwinski, Eric Horvitz, and Susan Wilhite.: A Diary Study of Task Switching and Interruptions, Proceedings of CHI 2004, pp.175-182 (2004)

[9] J. Kato, T. Sumiya, A. Inoue, H. Shigeno, K. Okada: Automatic Camera Switching Method using Time Shifting, Journal of Information Processing Society of Japan (in Japanese, in press), Vol.47,No.3,March 2006.

[10] K. Tsumura, T. Sumiya, I. Takata, H. Shigeno, K. Okada: Automatic Switching Technique of Remote Conference Video Image for Multitasking Workers with Multiple Cameras IPSJ SIGNotes Groupware and Network services (in Japanese), GN-58,pp.155–160, 2006.

Appendix

Automatic Camera Switching Method using Time Shifting

Kato et al propose an automatic camera switching method using time shifting aiming on switching video images shots automatically between multiple cameras, to produce video images, which do not bore, nor discomfort the viewer due to unnatural switching [9]. In this approach, they define the purposely delaying of on-camera video and audio as "time shifting". By using time shifting, a length of Δt of multiple data of video shots and audio by multiple cameras are stored. Then the decision of switching method of video image and audio is based on the stored in Δt. Then, a set of video and audio data stored beforehand is selected from a number of sets of data, and the shot is switched and displayed. By using this approach, rendition methods used in the canned program becomes possible.

Automatic Switching Technique of Remote Conference Video Image for Multitasking Workers with Multiple Cameras

Tsumura et al propose "Automatic Switching Technique of Remote Conference Video Image for Multitasking Workers with Multiple Cameras" using time shifting aiming on support on deskwork and watching remote conference [10]. First of all, multiple data of video and audio shot by multiple cameras and glance data of each participant by sensors for a length of Δt are stored in the memory. Next, the utterance information and the nonverbal information will be acquired from the voice and the glance data in Δt. Finally, The accumulation of utterance and nonverbal information of the listener is used to control switching so that appropriate switching of the speaker is enabled. By doing so, the video image shot with little load to the viewer and a high level of understanding about the content of conference in multiple work environment is generated.