Kansei Evaluation by a Remote-Controlled Robot Designed for Viewing Art Exhibits

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The present study is part of the Special Research Project for the Construction of a *Kansei* Sensory Evaluation Model that is currently underway at the University of Tsukuba. In this study, a robot was operated by remote control at an actual art museum as part of a preliminary experiment. The results obtained therefrom were used to consider how people might view exhibits.

In a previous study, a standard lens and a wide-angle lens were used to analyze differences in sensory-based movements, while VRML was used to analyze differences in these movements between a virtual and an actual museum.

In the present study, the time delay in remote operation, which is currently unavoidable, placed some restrictions on the degree of freedom with which exhibits could be viewed, but it was apparent that sensory evaluation could be possible depending on the search behavior and viewing time. Furthermore, specific viewing behaviors using the robot were observed, suggesting that new *Kansei* sensory perceptions were derived from these behaviors.

1. Introduction

The present study involved the remote operation of a robot in an art museum using a computer and the Internet. The results were used to attempt to construct a model of human sensory behavior.

In the present preliminary experiment, the robot was equipped with a CCD camera and manipulated to view exhibits at an actual art museum. The system was designed so that images seen through the robot's "eyes" would automatically be collected as viewing log data. These data were able to identify viewing behavior.

2. Background

A previous study[1] revealed that when exhibits were viewed in an actual art museum, the difference in viewing angle between a wide-angle lens and a standard lens caused a difference in viewing behavior. In another study[2], VRML was used to show that the time axis in space was the same, and there was no difference in viewing behavior while moving.

In the present study, the viewing log data that

was obtained from the operation of an actual robot was used to identify the characteristics of viewing behavior.

3. Purpose

Art exhibits were viewed with a remote-controlled robot, and the observation log data that was automatically obtained therefrom was used to investigate methods for analyzing viewing behavior. These results were compared with those of previous studies.

4. Experiments and methodology

At an exhibition held at the Tsukuba Museum of Art, an original type of robot (Fig. 1) was used to view exhibits via remote control.

Figure 1. The original robot, KAPROS

1) There were three human subjects involved in the experiment: two were viewing by wireless LAN, while the third was viewing by an ISDN Internet connection. The system configuration is shown in Figure 2.

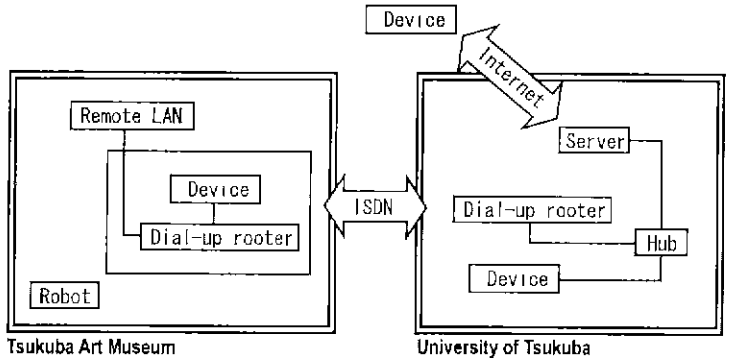

Figure 2. The system configuration

2) After the starting point for the robot was determined, the subjects were allowed to freely move the robot using remote control via a computer browser. Figure 3 gives an overhead view of the arrangement of the exhibits.

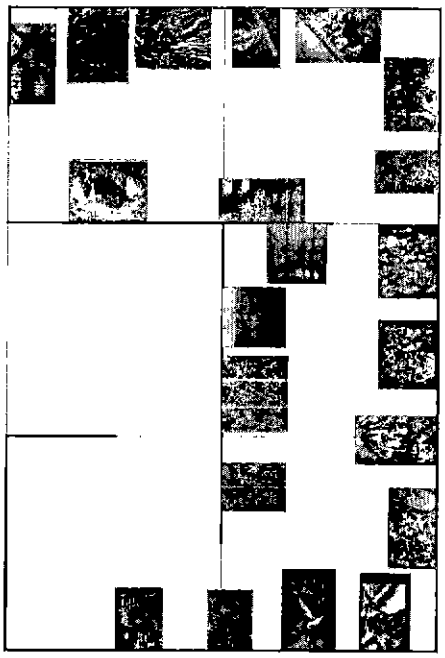

Figure 3. Overhead view of the arrangement of the exhibits

3) The images obtained from the robot's "eyes" were automatically saved as viewing log data (Fig. 4). Images were saved at the rate of once every 4 seconds for the wireless LAN, and once every 12 seconds for the ISDN connection.

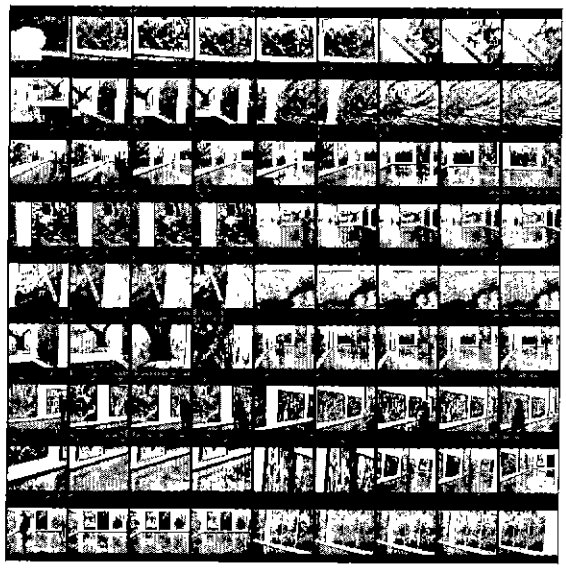

Figure 4. Some image data from the viewing log

4) Information on the robot's position, camera target, vertical and horizontal directions, and zoom status were also automatically saved as log data. In addition, the operational status of touch sensors was recorded (Fig. 5).

5. Analysis and methodology

1) Images obtained as automatic viewing log data were lined up in a time series (Fig. 3).
2) Next, after careful scrutiny pictures were separated according to whether they involved movement or art viewing, and lined up along the time axis (Fig. 6).
3) The time-series images in 1) were converted into a moving image, which was then used to make a comparison with the viewing behavior results of a previous study. This made it possible to reproduce viewing behavior later from the viewed images and the position of the robot at the times they were viewed. Since the speed of the imaging could be adjusted during the conversion

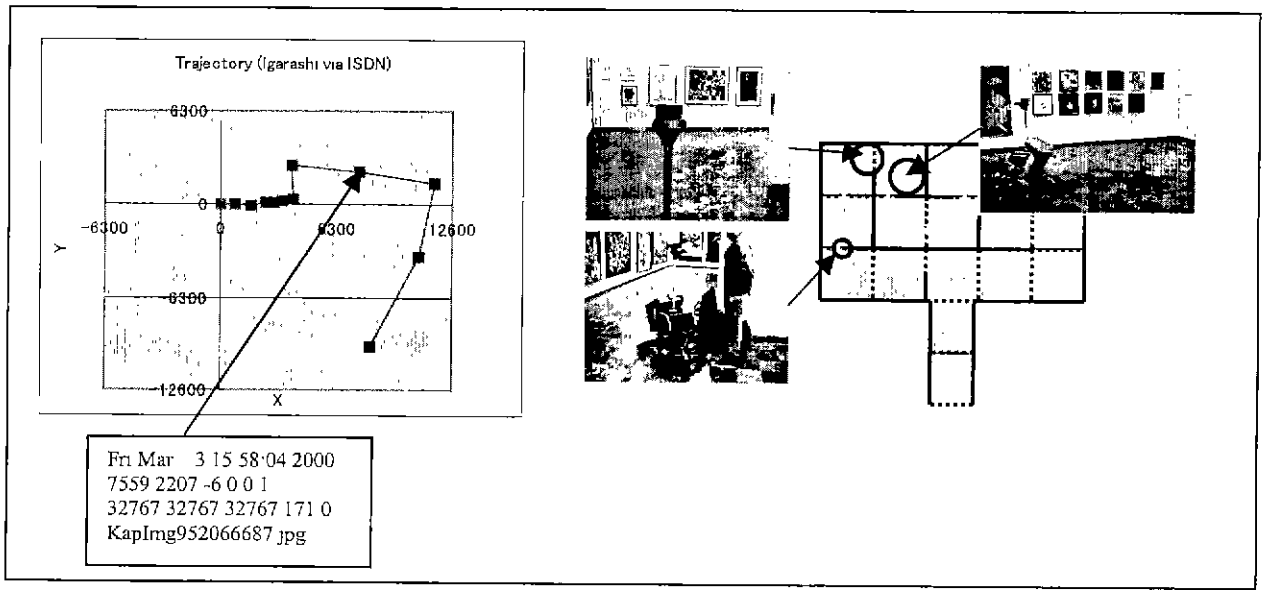

Figure 5. The robot's position, camera target, vertical and horizontal directions, zoom magnification, and touch sensor status can be understood.

process, we could determine the minimum frame speed which could still allow for stressless viewing.

In this study, there was a 4-second time interval between frames when the wireless LAN was used, and a 12-second interval when the ISDN Internet connection was used. However, these intervals have since been shortened.

Figure 6. Partial time series arrangement of different

6. Results of analysis

1) It was possible to sort images according to whether they were taken while moving or while viewing an exhibit, which in turn enabled us to obtain information on the process of art viewing.
2) We could easily get an understanding of the time required for each user to view the works and the time that they spent examining each picture. Figure 6 shows the total number of frames for one of the LAN subjects to be 300, which, multiplied by 4 (the time interval for data saving), equals 1200 seconds, or 20 minutes. From this figure, we determined that the maximum time for viewing an exhibit including the zoom function was 80 seconds.
3) As it was displayed on the plane, the locational data that was obtained as log data could be used to reproduce each subject's viewing behavior (Fig. 5). But this doesn't stop at just the viewing behavior of test subjects-- it is now possible for anyone to reproduce the viewing process through the eyes of artists and critics, giving the user an entirely new perspective on art appreciation. New ways of viewing give rise to new "kansei" (sensory) evaluations.
4) The viewing log-data images (Fig. 4) were converted into a moving image and viewing behavior was recreated by changing the speed of the playback. The playback speed of 1 frame per second was stressless, and the minimum speed for natural reproduction appeared to be 0.25 frame per second.

7. Conclusion

The present study was a preliminary experiment designed to collect data for the main experiment.

From the automatically obtained viewing log data, the images collected during movement were separated on a time axis from those collected during the viewing of exhibits. This allowed us to gain an understanding of the viewers' favorite works and the amount of time they spent looking

at them. Furthermore, the conversion of static images recorded for each time interval into moving images allowed us not only to reproduce viewing behavior, but by adjusting the speed of the frames we were also able to see that the art viewing in this study conveyed the same sense of realism as it did in a previous experiment.

Changing the speed of the playback showed us some of the limitations imposed by time interval, and it was difficult to reproduce at the slow speed of the ISDN connection, with existing technology. Research on sensory behavior that had previously been done in a virtual art museum using VRML, showed that the virtual museum was effective in ameliorating the sense of time delay. Therefore, we could see that it would be extremely effective to somehow combine the attributes of viewing in a virtual museum with viewing using an actual robot.

In the present study, there were a few problems with the feeling of time delay in the robot operation and with fine-tuning operation in the interface design, but the feeling of actually being at the museum arising from the use of the robot and the limitations imposed by viewing works through robot "eyes" make the viewers concentrating on their favorite exhibits. In addition, it was clearly possible to view objects in new ways that would not be possible if one were actually at a museum (for example, viewing pictures at different angles from below, or looking at a 3-meter-high sculpture from above).

This suggests that new types of viewing behavior can give rise to new types of sensory evaluations.

The present experiment is being conducted at the Tsukuba Museum of Art. It was featured in a live broadcast on NHK's morning television program "Ohayo Nippon".

For more information on the Special Research Project for the Construction of a *Kansei* Evaluation Model, please visit the authors' web site at ***http://www.kansei.tsukuba.ac.jp***

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