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Presence Expression using Eye Robot for Computer Go and System

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Abstract— **Friendly user interface is desired for robots and computer systems which support human in all areas of daily life, e.g., information service, educational system, support service for elderly, etc.. Presence expressions by eye robot is proposed, where the eye robot expressions help human to more deeply understand robot, and then effectively provide their service in its situation e.g., a personal learning program and an entertainment program. The proposed presence expression is applied a personal education system that involves the eye robot, learning contents on a laptop PC with a web camera, a wii remote (Nintendo Co.,Ltd.) for measuring attention span of a subject based on 3D accelerometer information. To estimate effects of presence expression by the eye robot, subjective questioner is performed in the personal education system. Three type of leaning programs are conducted by the system for 10 subjects with subjective questionnaires evaluated with the 3-poin scale. The results show that the proposed expressions by the eye robot help the subject to feel like one is watching and to have an uncanny impression. As a result, the system has enabled the subjects to take the program with feeling of tension. This research plans to apply computer go system, another personal educational and entertainment system, where the system realizes casual communication in the games.**

Keywords-component; communitation robotics, computer Go, presence expression, casual communication

I. INTRODUCTION

Computer systems with computational intelligence technique is helping supporting human in all areas of daily life, e.g., information service, games, educational system, support service for elderly, etc.. In these systems, e.g. e-learning system and computer game, intelligent agents are working to assess their situations and to decide actions according to personal actions and data [1] [2]. One thing these systems have in common is one-to-one interactive situations between system and human when these systems present information to human. For assisting inputs of these types of system, evolutionary robot vision approach has been proposed for face detection [3]. For assisting outputs of one-to-one interactive systems, friendly user interface is requested communication robots, interactive interfaces that can communicate with human in a natural way.

Presence expressions by eye robot is proposed, where the eye robot expressions help human to more deeply understand robot, and then effectively provide their service in its situation e.g., a individual learning program and an entertainment program. The proposed presence expression is applied a personal education system that involves the eye robot, learning contents on a laptop PC with a web camera, a wii remote (Nintendo Co.,Ltd.) for measuring attention span of a subject based on 3D accelerometer information. To estimate effects of presence expression by the eye robot, subjective questioner is performed in the personal education system. Three type of leaning programs are conducted by the system for 10 subjects with subjective questionnaires evaluated with the 3-poin scale.

II. COMUNICATION ROBOTIC SYSTEM

Friendly user interface is strongly desired for computer system that support human in all areas of daily life, e.g., information service, educational system, support service for elderly, etc.. Communication robots have been developed as interfaces that can communicate with human in a natural way. Human comprehend others including nonhuman, e.g., robots by constructing virtual model in their own mind through their interaction, where presence is important. Communication robots are media that mainly show their presence according to their own appearance. The android robot, Geminoid HI-1 that appears and behaves like a living person have represented specified personal presence by teleoperating [4]. Telenoid-R1 is designed to appear and to behave as a minimalistic human, where the Telenoid-R1 has expressed unspecified personal presence in the distance [5]. As a real application for group education system, the android SAYA is applied for a remote class system at an elementary school, where SAYA conduct the class with her effective presence by using her voice and eye contact [6].

As a casual communication interface, an eye robot have been proposed, where the eye robot interacts with human by friendly eye expressions. The eye robot is developed based on the mechanisms of the human eye [7]. Eye motions consist of eyelid motion and ocular motion. This motion set is one of the components of casual communication. The structure of the

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eyelids part and the ocular part is shown in Fig. 1. The eye robot has 2 degrees of freedom (D.O.F) for the eyelids part and 3 D.O.F for the ocular part. The eye robot covers a wider range with each motion of the eye than is possible with human eyeballs. Therefore the eye robot can sufficiently simulate a human being's eye motions. The picture of the eye robot is shown in Fig.2, where the eye robot expresses representative motions. The size of the eye robot is 130 mm in width, 80 mm in height, and 75 mm in depth. This size is inspired by the size of a five-year-old child's head.

The eye motion of eye robot is defined as the combination of eyelid motion and ocular motion. Eyelid motion and ocular motion are independent in the pleasure-arousal plane. All motions of the eyelids and eyeballs have the tendency to change according to each axis of the pleasure-arousal plane. The motions are assigned to the 25 different partitions of the pleasure-arousal plane based on psychological knowledge and results from the questionnaire survey. The eye robot realizes casual communication between human and system by expressing mentality and intention according to human action based on affinity pleasure-arousal space.

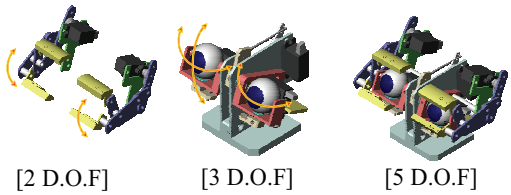

Figure 1. the structure of the robot

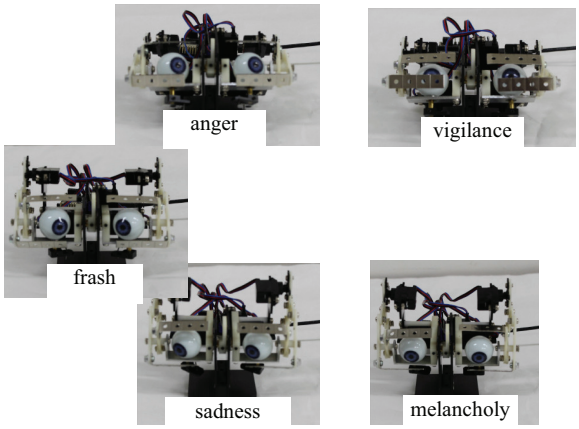

Figure 2. the representatiove motions of the eye robot

III. THE STRUCTURE OF THE ROBOTPRESENCE OF ROBOT FOR COMPUTER GO

In 2, communication robot systems are introduced, where robots assist human with expressing their presence. This type of robots can provide casual information system by combining with information system.

A. Presence expression using robotic agent for co-creation

Presence of communication robots works effectively in human-robot interaction. Presence of robots depends on their appearance, and the appropriate appearance should be selected on a case-by-case basis. In home environment, presence of robot should be restricted from the view point of size and expression manner, where space is limited and interpersonal distance is small. Presence expressions by the eye robot as a small and casual communication robot is proposed in home environment, where the presence expression encourage cooperation between human and robot system, and realize human-robot co-creation in home-use personal education system and entertainment system.

B. Individual learning system and Computer Go system

The presence expressions are applied individual learning systems and entertainment systems requiring individual learning. The presence by a robot has worked effectively in the group-learning situation [6]. In individual learning situations in home environment, robot's size and expression manner should be restricted considering the robot is on human side. In this research, the eye robot as a small and casual communication robot is used for assistant of human learner.

This individual learning system is able to be combined to entertainment systems requiring individual learning, that is computer Go system that has already developed on a CG basis [1].

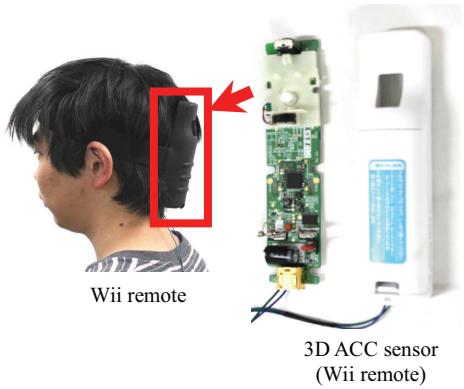

Figure 3. the 3D ACC sensor unit

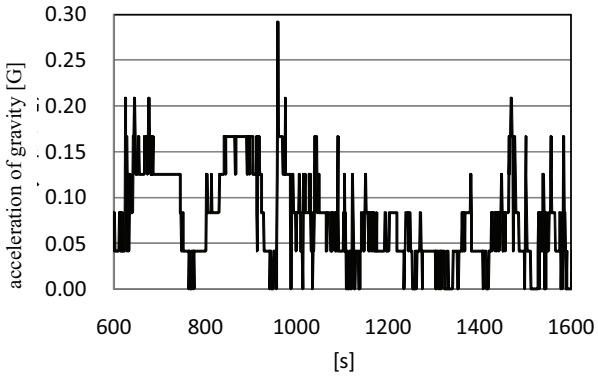

Figure 4. the sample data of ACC sensor

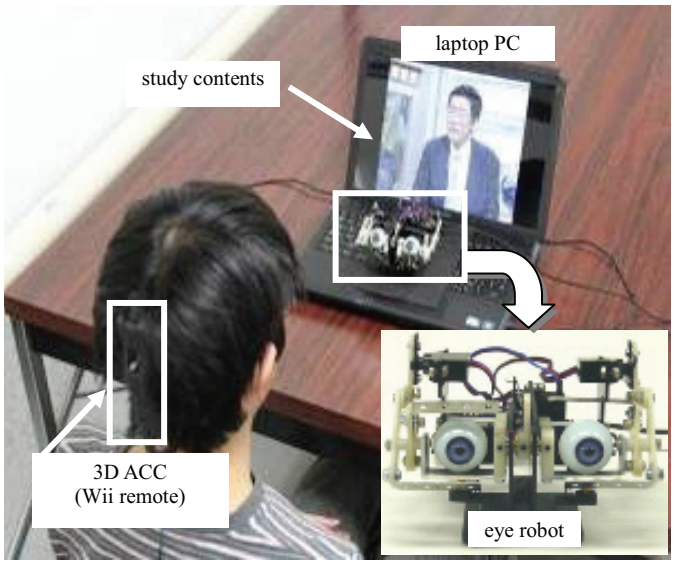

Figure 5. the expresimental situation by individual learning system

IV. INTERPERSONAL EXPERIMENTS FOR EVALUATING PRESENCE EXPRESSION

To estimate effects of presence expression by eye robot, subjective questioner is performed in personal education system. To perform effectively, memory experiments should be performed implicitly. At first psychological evaluation experiments are expressly performed in a mascot robot system environment. In the psychological evaluation experiments, memory experiments are performed implicitly.

A. Evaluation Experiments on Interactions based on Subjective Estimation

To estimate human impressions on the proposed presence expression by eye robot, interactive experiments are performed in individual learning situation by using a multimedia system. In the experiments, subjective estimations by questionnaires are conducted. In addition, attention spans are measured.

Experimental situation involves the learning contents on a laptop PC with a web camera, the eye robot, a subjective that wears wii remote (Nintendo Co.,Ltd.) for measuring his/her attention span based on 3D accelerometer information. The experiment's disposition is shown in Fig.3, and an obtained data example from accelerometer is shown in Fig.4.

To verify the influence of proposed presence expression, the following three types of action patterns are performed by the system according to the human behavior information, and compared to one another. The first pattern is that the eye robot expresses alert motion in incremental steps with voice (pattern 1: present expression with voice). The second is that the system alert with voice when a subject loses his/her consideration, but without eye robot (patter 2: voice). The third is that the system does not any alert without eye robot (pattern 3: nothing). In the experiments, these three patterns are performed in no particular order.

For the experiment, three types of the highschool-level learning contents (geography, earth science, and domestic science) are prepared, where the 30-minute learning movies are played on the PC. The procedure of the experiments is as follows;

Step1) the subject is informed about the experiment and the eye robot, and wears a wii remote on the head.

Step2) the subject start an individual learning program. The system behaves according to the attention of the subject in a predetermined one of three patterns.

Step3) after the learning program, the subject fills out a test on the learning contents. After that test, subjective questionnaires on nine items are conducted.

Step4) steps2) and 3) are repeated for the three action patterns in the same way.

The subjective questionnaires are evaluated with the 3-poin scale. The items of the subjective questionnaires are as follows;

1) Have you had the class about the learning contents?

2) Could you concentrate on the learning program?

3) Did you take the program with a feeling of tension?

4) Did you feel like one is being watched?

5) Did you feel friendly?

6) Did you feel the presence of human?

7) Did you have an uncanny impression?

8) Did you feel the learning contents interesting?

9) Was the alert done at the right time?

The subjects for the experiment are 10 engineering students.

B. Result of the Experiments

The results of the subjective estimations are shown in Fig.5. These figures show the mean values obtained for each question in the three action patterns. The subjective questionnaires are evaluated on a 3-poin scale of zero to two. Low values imply negative, and high values imply positive effect. Table I gives the average frequency of the head-nodding movement. Table II gives the average value of the attention span in the 30-minutes learning program. Table III gives the average score of the test on the learning contents, and this graph is shown in Fig. 7.

Fig. 2 shows that the pattern 1 is evaluated as the most positive on (3), (4), and (7), and the pattern 3 is the most positive on (2) and (8). Tab. I and Tab. II show the pattern 3 is the lowest, where the subject's head move less often than any others. Tab. III and Fig. 7 show that the pattern1 get most high score, but there is not so major deference.

These mean that first, the proposed expression by the eye robot shows the presence, and then the subject feel like one is watching and have an uncanny impression. As a result, the subject could take the program with feeling of tension.

On the other hand, the subjects feel no action is the fittest situation to concentrate the learning contents. And the frequency of the head movement is the lowest when the system dose nothing. But the "pattern 3: nothing" gets the lowest score in the memory test even though there is not so large deference. These result that the system has a possibility not to grasp the subject in foggy state, where the subject doesn't move his/her head, and spread his/her focus.

As all results, it have been confirmed that the proposed expression by the eye robot shows the presence in the individual learning system, and then the subject feel like the robot is watching and the subject have been able to take the program with feeling of tension.

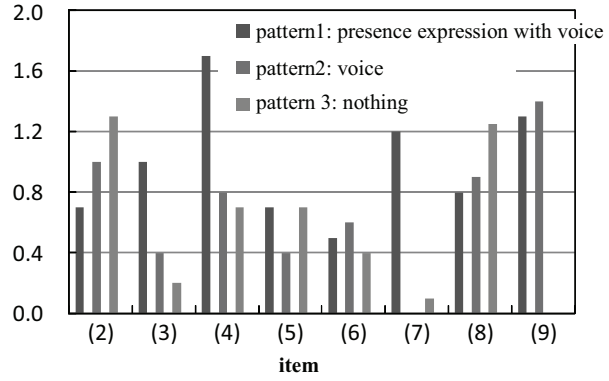

Figure 6. the score of the subjective estimation

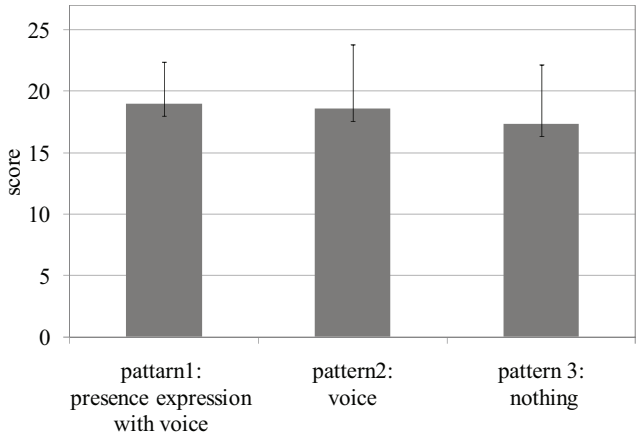

Figure 7. the score of memory test for learning contents

TABLE I. THE FREQUANCY OF THE SUBJECT'S HEAD MOBEMENT

average times		
pattern1: presence expression with voice	pattern2: voice	pattern3: nothing
8.2	6.1	5.6

TABLE II. THE ATTENTION SPAN OF THE SUBJECTS

average attention span[s]		
pattern1: presence expression with voice	pattern2: voice	pattern3: nothing
436.8	388.7	487.5

TABLE III. THE SCORE OF THE MEMORY TEST ON LEARNING CONTENTS

average score (out of 27)		
pattern1: presence expression with voice	pattern2: voice	pattern3: nothing
19.0	18.6	17.4

V. CONCLUSION

The presence expressions by eye robot is proposed, where the eye robot expressions help human to more deeply understand robot, and then effectively provide their service in its situation e.g., a personal learning program and an entertainment program. The proposed presence expression is applied a personal education system that involves the eye robot, learning contents on a laptop PC with a web camera, a wii remote (Nintendo Co.,Ltd.) for measuring attention span of a subject based on 3D accelerometer information. To estimate effects of presence expression by the eye robot, subjective questioner is performed in the personal education system. Three type of leaning programs are conducted by the system for 10 subjects with subjective questionnaires evaluated with the 3-poin scale. The results show that the proposed expressions by the eye robot help the subject to feel like one is watching and to have an uncanny impression. As a result, the system has enabled the subjects to take the program with feeling of tension.

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REFERENCES

[1] Hoock, J.-B., Chang-Shing Lee, et.al., "Intelligent Agents for the Game of Go," IEEE Computational Intelligence Magazine, Vol.5, No.4, pp.28-42, 2010.

[2] Acampora, G., Loia, V., Gaeta, M., "Exploring e-Learning Knowledge Through Ontological Memetic Agents," Computational Intelligence Magazine, IEEE , vol.5, no.2, pp.66-77, May 2010.

[3] A. Yorita and N. Kubota. "Multi-stage fuzzy evaluation in evolutionary robot vision for face detection," Evolutionary Intelligence vol 3 , pp. 67-78, 2010.

[4] Nishio S., Ishiguro, H. and Hagita, N., "Geminoid: Teleoperated Android of an Existing Person," Humanoid Robots: New Developments, de Pina Filho, A.C. eds., I-Tech Education and Publishing, Vienna, Austria, 2007.

[5] "Telenoid-R1," http://www.irc.atr.jp/Geminoid/Telenoid-overview.html

[6] T. Hashimoto, N. Kato, and H.i Kobayashi, "Field Trial of Android-type Remote Class Support System in Elementary School and Effect Evaluation," Proc. of IEEE International Conference on Robotics and Biomimetics (ROBIO 2009), pp. 1135-1140, 2009..

[7] Y. Yamazaki, K. Hirota, et.al., "Fuzzy Inference based Mentality Expression for Eye Robot in Affinity Pleasure-Arousal Space," Journal of Advanced Computational Intelligence and Intelligent Informatics (JACIII), Vol.12 No.3, pp.304-313, 2008.