Education and Communication Research Using Robotics Based on Color Science

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ABSTRACT

Color science psychological approach for education and communication robotics system based on learning theory, human agent interaction, biological analysis and cognitive science become more important for education, driving assistance and so on. Our system was integrated with advanced topics of information, biological and robotics researches.

1. INTRODUCTION

Many challenges of robotics and human communication research, verbal and nonverbal communication is main issue [1]. In our research, we are researching education and communication with human using robotics based on color science, verbal and body representation. Main application is education of students and we are trying to improve studying motivation using color science and robotics communications.

2. RESEARCH ELEMENTS

2.1 Influence of robot expressing atmosphere using utterance mind

It has been clarified that a person unconsciously expresses the feeling "utterance mind" such as "I want to talk" when acting on speech as behavior. In this research, paying attention to the concept of "utterance mind", it is thought that a robot can read human atmosphere by implementing behavior that expresses "utterance mind" on the robot [2]. We verify whether it is possible to facilitate communication with people by implementing "utterance mind" on emotion recognition humanoid Pepper (Figure 1).

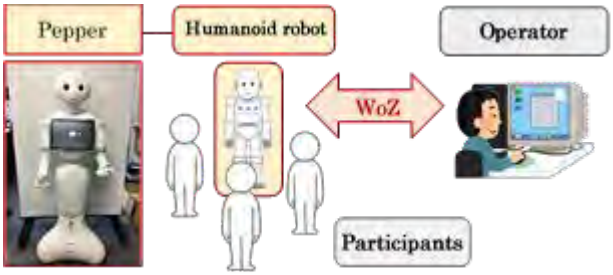

Fig. 1 Emotion recognition experiment system.

2.2 Heartbeat detection based on pulse neuron model

The design of an environment through a variety of means such as lighting and colors can stimulate perceptual and emotional responses in students and affect their behavior. Therefore, if it can be quantitatively assessed, we may obtain a novel clue as to how students' emotions vary in a learning situation. Heart rate variability is widely used as a non-invasive measure of the ANS activity. The pneumatic pressure sensor inserted into a cushion can detect the ballistocardiograph (BCG) signal (Figure 2).

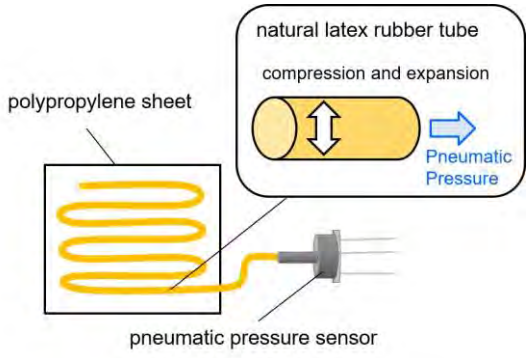

Fig. 2 Principle of the pneumatic pressure sensor.

2.3 Data mining for discovering educational rules from Log data

Through practices of the education and communication robots, large amounts of log data are generated. A text matching algorithm using the Longest Common Subsequence (LCS), a well-known algorithm of dynamic programming, is developed to provide partial matching functionality of texts, and then it is incorporated in an Apriori-based data mining algorithm to discover educational rules derived from experiments using the proposed robots for educational communication (Figure 3).

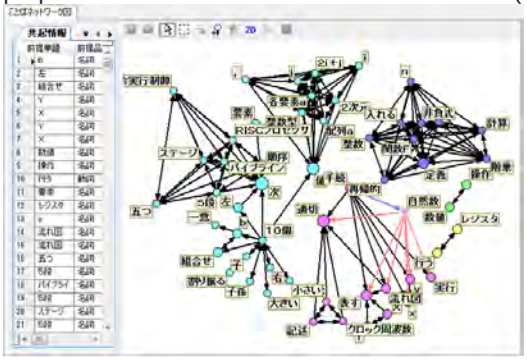

Fig. 3 Example of co-occurrence words extraction and their graphic representation.

2.4 Human behavior recognition and control the robot actions

Recently, many robots to perform the guidance and receptionists have been utilized in a variety of places, but those that move around are very few. In this research, we aim to develop a mobile system for the Pepper robot that can be easily introduced at educational sites, such as classrooms. Teachers are called by a show of hands in some cases of lectures. The Pepper robot needs ability to recognize the show of hands and move to the hand's position by following the black line. We developed a function to recognize the students who are raising their hands in the classroom using skeleton detection from monocular camera images. We were able to recognize the show of hands from the Y axis information of their shoulders, elbows, and wrists. In addition, we were able to determine which columns they were sitting from the XY information of their neck. In order to trace a line for Pepper, we developed a function to allow Pepper to discriminate black tape affixed to surfaces in a classroom in directions using deep learning. The deep learning network was made by using transfer learning the learned VGG16 network.

Fig. 4 Moving robot by recognition of student's hand state.

2.5 Human education based on mental state

In education, not only promoting effective understanding but also teaching behavior taking into consideration the learner's mental state becomes important. In order to conduct teaching behavior at the same time as analyzing the mental state, we need robots and agents. In this research, we analyze the influence of robot's own teaching behavior on learner's mental state. Furthermore, we propose an environment including a teacher robot, a TA robot and student robot (who is a partner robot).

In the first experiment, we investigated the influence of some statements ("This is important point." and "Be quiet.", etc.) with colored eyes in robots. As a result, it was revealed that the presented color affects the learner's impression, especially impression changes depending on learner's way of thinking about learning.

In the second experiment, we investigated the impression when the robot speaks with colored eyes using script of an actual teacher. As a result, it was revealed that the presented color influences learner 's mental state also in the context of the actual lesson (Figure 5).

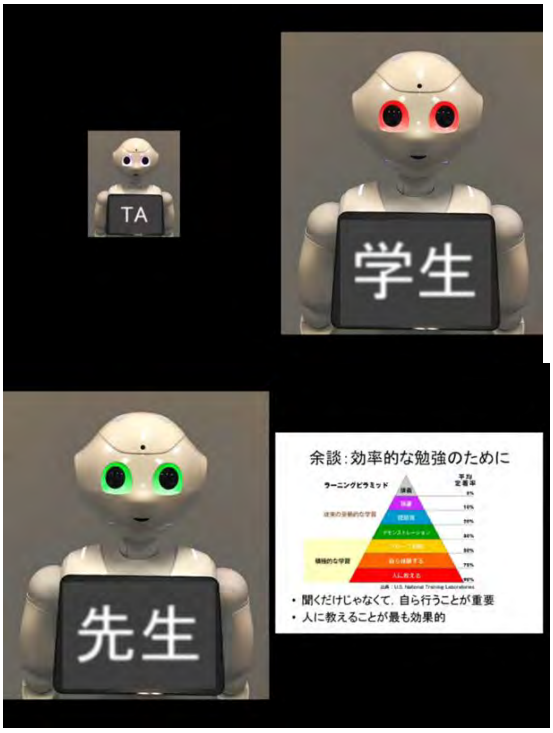

Fig. 5 Color changing experiment during education.

3. Results and conclusion

We researched and developed the main element of human education and communication assist using robotics. Color phycology effects were observed by robot education. Our base technologies are human agent interaction, biological analysis, text mining, deep learning, robot control and education with mental state method.

We will integrate these technologies and will build high levels human education assistance and communication robotics system based on color science phycology in the near future.

4. Acknowledgement

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5. REFERENCES

[1] M. Asada, "Cognitive Developmental Robotics: A Survey," IEEE Trans. Auto. Ment. Develop., 1(1), pp.12-34, (2009)

[2] T. Honya, D. Katagami, M. Yuasa, T. Obo, Y. Ogai, J. Sone, T. Tomoto, Y. Udagawa, Evaluation of robot's behavior to human based on understanding the situation using utterance mind, HUMAN COMMUNICATION GROUP SYMPOSIUM 2018 HCG2018-B-2-5, (2018)