Engineering Education Using a Long-Distance-Controlled Robot System to Enhance Students' Motivation

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Abstract **- This paper described the outline of a Long-Distance-Controlled Robot System to enhance students' motivation. In this system, the players operate the robots on one physical site via the Internet. To confirm whether the developed system was able to be used, we held exchange association between the elementary schools in Japan by the robot game named 'Ball Rolling Game' using this system. It was clarified that our system could be used for the exchange association between the elementary schools from the results of the questionnaire. In addition, we tried the international exchange between Singapore and Japan using the system.**

Index Terms - Engineering Education, Robot System, International Exchange

INTRODUCTION

Recently, Japanese students have begun to lose their curiosity about technology due to a decrease in experiences and a shortage of playtime during their childhood. As a result, the number of students who seek employment in manufacturing has decreased for children's losing interest in technology, too. Therefore, improving the understanding of the student to manufacturing has become important.

On the other hand, it is also important that students acquire international communications skills. Then, the development of the motive of the technical education where the content of international exchange was included putting teaching material was needed.

To solve those problems, the system that plays a game by operating the robot remotely has been developed in this research. Because the system relies on the use of the World Wide Web, it can be used anywhere in the world.

There are three steps in this education to enhance students' motivation.

(1) Students are exposed to technology as they operate the robot.

(2) Students create the control program for the robot, and a competition with an overseas student is held by using the program.

(3) The student makes the sensor circuit for the robot. Through these steps, they have the opportunity to interact with students of foreign countries.

In this paper, an outline of the Long-Distance-Controlled Robot system is described. Next, our proposed educational program and each step of our education are described. In addition, the international exchange between Technical College in Japan and Polytechnic of Singapore that uses it is explained

OUTLINE OF THE LONG-DISTANCE-CONTROLLED ROBOT SYSTEM

This system differs from a virtual game and has only one physical site. At the first, because the students are able to enjoy the robot operation, a simple game is thought. Figure 1 shows the game field. The robot in the field is remotely operated. Two fixed cameras (AXIS, 205 Network Camera) are focused on the playing field. The student operates the robot and plays a game that requires the placement of a colored ping-pong ball at a specific location or goal. The game requires the rolling of a ball.

Figure 2 shows the robot. The motor and the controller for the drive used goods on the market (ROBOCUBE). [1] The blocks can be freely connected through mutually attachment. Although LEGO was often used as an educational robot, [2]-[3] we did not use it. We should have the student make the sensor even by oneself in the near future. ROBOCUBE can be made complex and a functional structural robot by adding other sensor blocks in consideration of the future extendibility.

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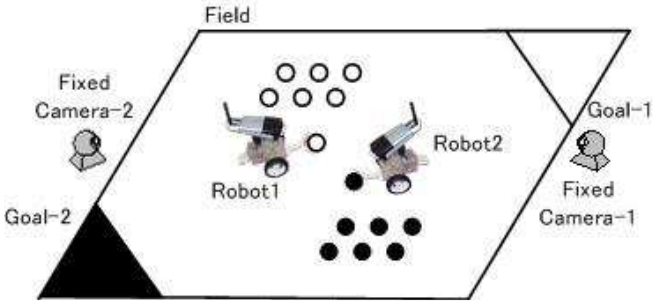

FIGURE 1
SCHEMATIC OF THE GAME FIELD.

The robot has a horn, a controller, tires, a moveable camera (PCI, cs-01B), and an antenna. The control signal to the robot is sent from a radio communication unit connected to the Linux server. The power supply is a battery. The voltage ranges from 6 to 9.

FIGURE 2
CONFIGURATION OF THE ROBOT.

Figure 3 is the outline of the development system. Students at a different school access the Linux server from the Internet and operate the robot in the field. To feel the presence of the pitch in each school, the Web camera (Panasonic, BB-HCM110) that can be remotely controlled from a browser is installed. The image of this camera is projected onto a large-scale screen in each classroom.

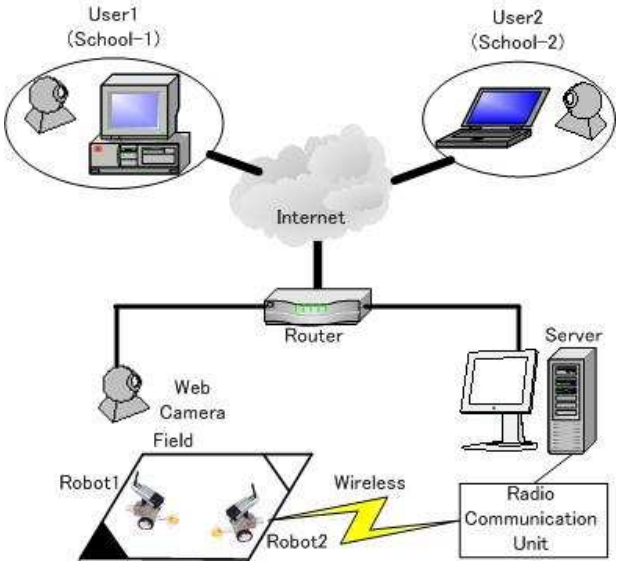

FIGURE 3
OUTLINE OF THE DEVELOPMENT SYSTEM.

The browser screen to control the robot is shown in Fig. 4. The figure is an operation screen of user 1. One moving camera image of robot 1 and two fixed camera images that project the field are displayed. The direction and the speed of the robot are controlled by CGI and JAVA, and it is possible for individuals from two schools to chat.

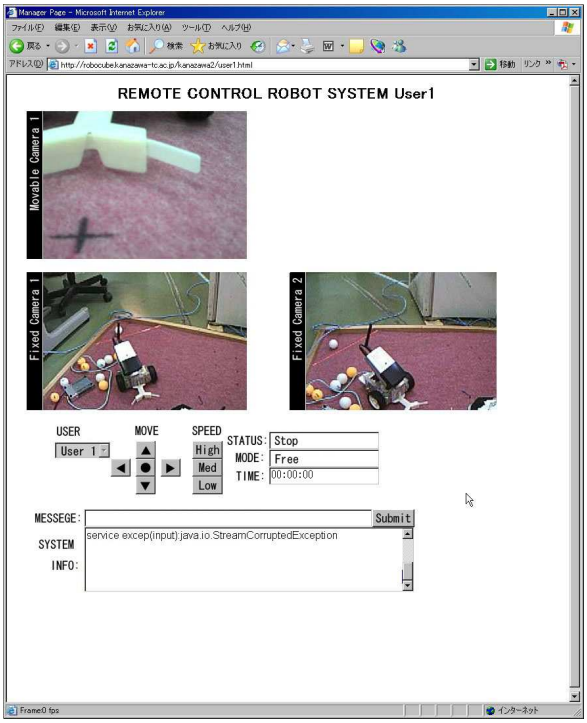

FIGURE 4
BROWSER SCREEN FOR ROBOT OPERATION. (USER1 SCREEN)

The robot is controlled from the client machine with various OS. The student can operate the robot only by clicking the speed and the direction buttons on a browser

with the mouse. Therefore, students can enjoy operating the robot because they do not need to have any technical knowledge. The instructions for the robot control by the client machine are transmitted from a wireless unit connected to the server to the main body of the robot, which controls the motor.

OUTLINE OF THE EDUCATIONAL SYSTEM

The student's international exchange might not work out only by preparing the hardware of the Long-Distance-Controlled Robot system. It is not easy to promote the project because there are a language barrier and a difference of the culture between students of foreign countries. Therefore, there is the educational staff's skillful disposition as one of the most important points to make a success of this education.

Figure 5 shows the educational staff's effective disposition. Each staff's role is shown as follows.

- (a) Manager for Promotion of Engineering Education: Role to design the entire education, and to organize the whole.
- (b) Coordinator for Mutual Communication: Role to adjust language barrier and difference of culture among the students between foreign countries to advance project smoothly.
- (c) Network Technical Adviser: Role advised to student for network of setting of Linux server and network camera etc.
- (d) Hands-on Technical Adviser: Role advised to student for making circuit and program of the robot.
- (e) Counselor: Role to receive consultation for various problems in project coordination.

Educational staffs form one team and each staff helps promotion of the project while mutually cooperating.

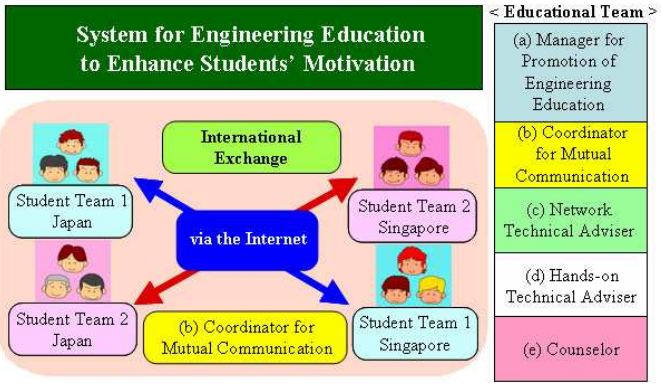

FIGURE 5
EDUCATIONAL STAFF'S SKILLFUL SISPOSITION

EXCHANGE AMONG ELEMENTARY SCHOOLS USING THE SYSTEM

The game was experimentally tried in Japan before being launched at the international level. Children of the fifth school year in the Minma Elementary School and the Yanagida Elementary School played the ball-rolling game. The distance between the two schools is approximately 100 km. The game time was two minutes, and five representatives from each school played five games. Figure 6 contains photographs from Yanagida Elementary School.

FIGURE 6
THE CLASS IN YANAGIDA.

Figure 7 shows the results of the questionnaire. Children of the object are 5 people of Minma and 38 people of Yanagida.

Q1. How would you rate your interest in the game?

Forty-eight percent of the students indicated that they enjoyed playing the game.

Q2. Were you interested in the robot?

Fifty-eight percent of the students indicated that they were interested in the robot. A large percentage of the female students indicated a lack of interest in the robot.

Q3. Would you have any interest in playing the game again?

Fifty-nine percent of the students indicated that they would like to play the game again.

The results indicated that it would be worthwhile to pursue this project in the elementary schools.

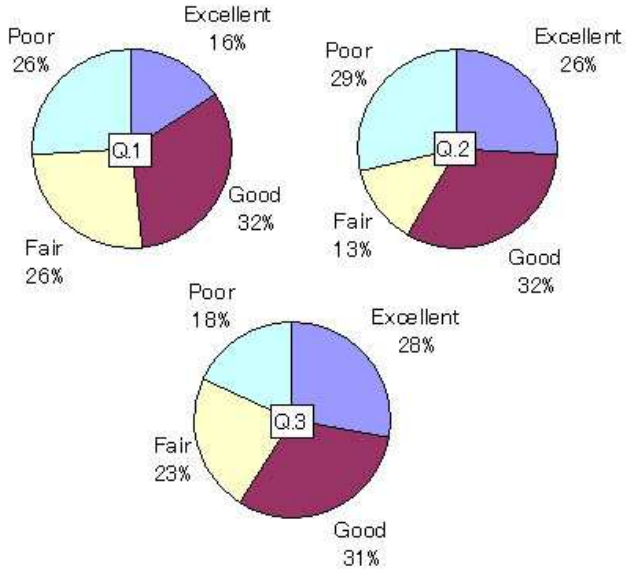

FIGURE 7
RESULTS OF THE QUESTIONNAIRE.

TRIAL OF INTERNATIONAL EXCHANGE BETWEEN JAPAN AND SINGAPORE USING THE SYSTEM

This system was used so that the international exchange between Singapore Polytechnic and Kanazawa Technical College students. Because Singapore is away from Japan at 5000km, the exchange that uses the Internet is effective. The objectives of this project were for students to improve their communication skills, develop friendships, and hone problem-solving skills while having fun. Figure 8 contains photographs of Singapore Polytechnic. Students of the two countries were able to do an international exchange effectively by using the development system.

FIGURE 8
STUDENTS IN SINGAPORE.

CONCLUSIONS

The outline of our educational system and the exchange between the elementary schools by it are described. From the results of a questionnaire, 48% of the children indicated an interest in the game, and 59% wanted to participate again. It was clarified that our system could be used for the exchange between the elementary schools from these results. In addition, students of the two countries were able to do an international exchange effectively by using the development system.

In the near future, the students will make the control program of the robot, and a competition with an overseas student will be held by using the program.

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REFERENCES

[1] System Watt Co., Ltd.: URL: http://www.watt.co.jp/english_folder/English/index.html

[2] Doswell, J., Mosley, P. "Robotics In Mixed-Reality Training Simulations: Augmenting STEM Learning", ICALT 2006 Advanced Learning Technologies, Kerkrade, The Netherlands, July 2006, pp.864-868.

[3] Karoulis, A. "Usability Evaluation of the LEGO Interface", ICALT 2006 Advanced Learning Technologies, Kerkrade, The Netherlands, July 2006, pp.1052-1054.