Design of Long-Distance-Controlled Robots for Engineering Education

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Abstract *— This paper described the design of engineering education using Long-Distance-Controlled Robots (LDCR). In the LDCR, the players operate the robots on one physical site via the Internet. The students' international exchange might not work out only by preparing the hardware of the LDCR. 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 education system as one of the most important points to make a success of this education.*
In this paper, an outline of the LDCR for international exchange is described. Next, our proposed education system for international exchange is described. Finally, a new LDCR system that redesigned for Distance Education is described.

Index Terms *— Engineering Education, International Exchange, Robot System, Distance Education*

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. In addition, 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 these problems, the system that plays a game by operating the robot remotely has been developed. [1] Because the system relies on the use of the World Wide Web, it can be used anywhere in the world. In this Long-Distance-Controlled Robot (LDCR) system, the players operate the robots on one physical site via the Internet. The elementary school exchange in Japan and the international exchange between Japan and Singapore have been done by the LDCR system up to now. [2]

On the other hand, over 130,000 school refusal children exist, and the necessity of the correspondence course and distance education has risen in Japan. Distance Education is important for the child who cannot go to school according to a medical reason and a geographic reason, etc. However, the endurance of child's motivation is difficult in the course through the Internet. Therefore, the LDCR system that we had developed considered that there was an ameliorable possibility the problem. We tried improving to use the LDCR system with Distance Education.

In this paper, at the first, the LDCR system that we developed for international exchange is explained. Next, a new LDCR system that redesigned for Distance Education is described.

OUTLINE OF THE LDCR SYSTEM FOR INTERNATIONAL EXCHANGE

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). The blocks can be freely connected through mutually attachment. 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. 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.

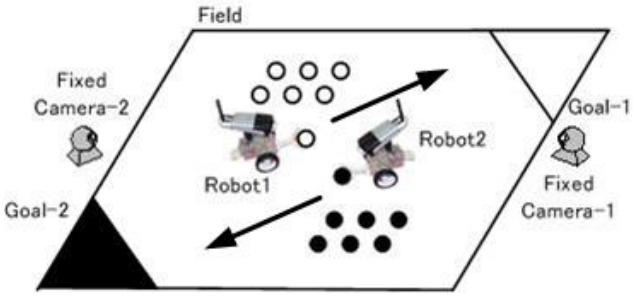

FIGURE 1
SCHEMATIC OF THE GAME FIELD.

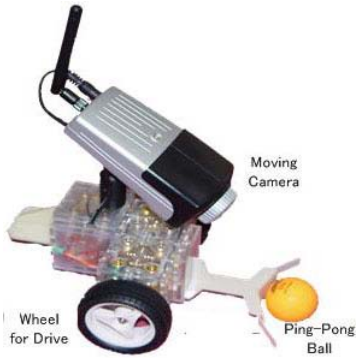

FIGURE 2
CONFIGURATION OF THE ROBOT.

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.

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.

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.

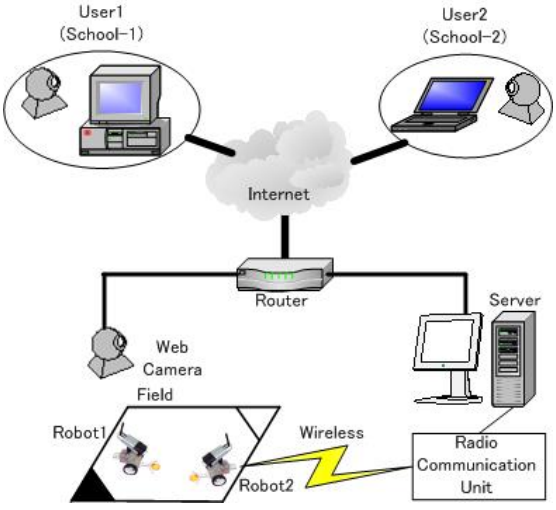

FIGURE 3
OUTLINE OF THE DEVELOPMENT LDCR SYSTEM.

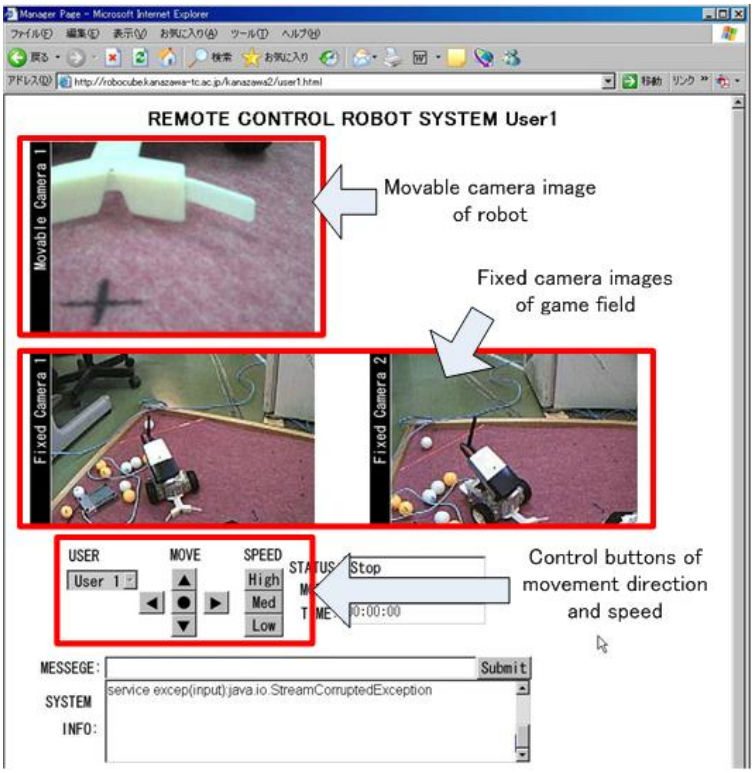

FIGURE 4
BROWSER SCREEN FOR ROBOT OPERATION. (USER1 SCREEN)

OUTLINE OF THE EDUCATIONAL SYSTEM FOR INTERNATIONAL EXCHANGE

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.

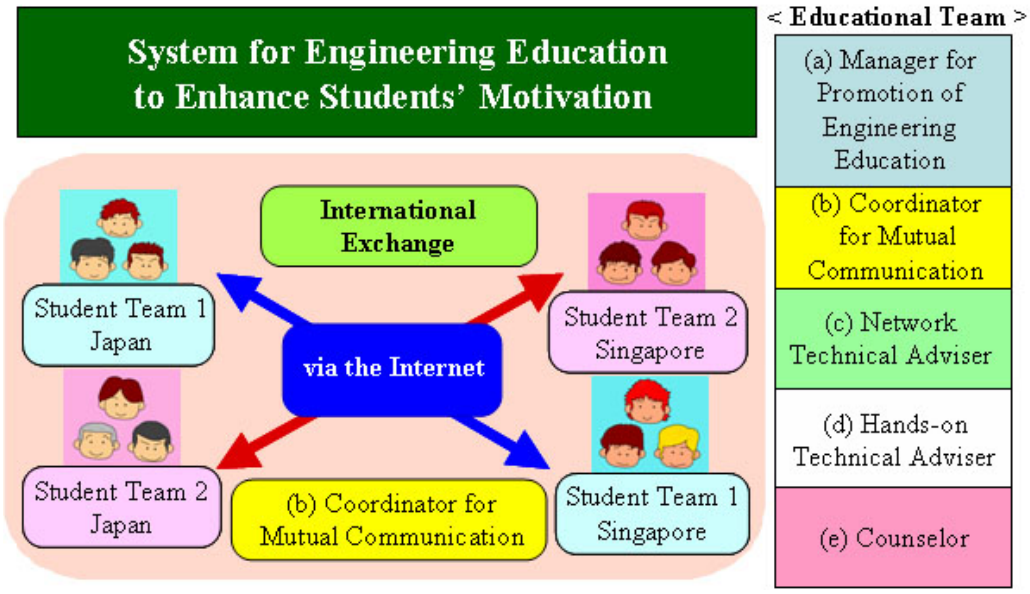

FIGURE 5
EDUCATIONAL STAFF'S SKILLFUL DISPOSITION.

- (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.

OUTLINE OF A NEW LDCR SYSTEM FOR DISTANCE EDUCATION

The condition of the robot system for Distance Education is shown as follows.

- The system must be comparatively inexpensive.
- The system must be easily securable.
- The operation of the robot must be easy.

In the LDCR system for international exchange, the motor and the controller for the drive have used the goods on the market named ROBOCUBE. [3] However, it was difficult to introduce the robot in an overseas school because ROBOCUBE that made in Japan did not obtain easily in foreign countries and was high-priced. LEGO is popular all over the world as the educational robot. If the long-distance-controlled robot can be constructed with LEGO Mindstorms NXT (LEGO NXT), schools of distance education can be activated more. In this research, the robot is changed from ROBOCUBE to LEGO NXT that has generality, and new LDCR system is constructed.

Because the user of the robot was a school child, the robot of a simple car type decided to be produced to operate it easily. Figure 6 shows the robot made for trial purposes. The robot is composed of NXT Intelligent Brick and two motors, and it has two driving tires and one supplementary tire.

FIGURE 6
CONFIGURATION OF NEW ROBOT FOR ELEMENTARY SCHOOL STUDENTS.

Figure 7 shows the composition of a new LDCR system for distance education. The child in home or the hospital operate the mouse of the client PC, and can move the robot in the school freely. The running course of the robot was contrived so that the child might enjoy it. Figure 8 shows the running course of the robot. The course is composed of some elements, and the inclination, the stairs, and the ruggedness, etc. are made in each element. Because various courses are made from changing how to put elements, children will be able to enjoy it.

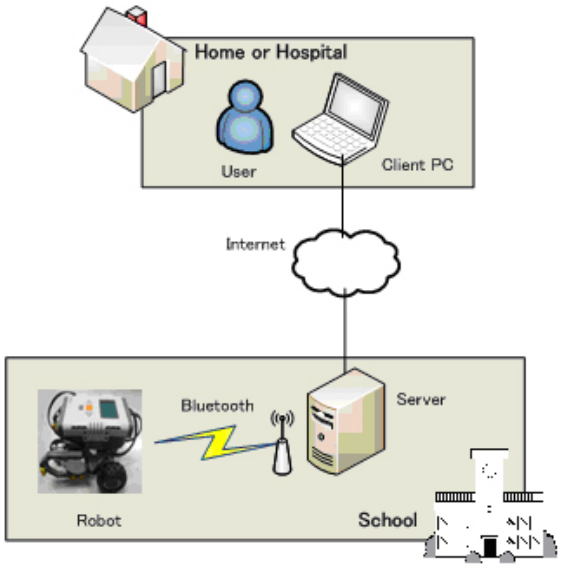

FIGURE 7
OUTLINE OF NEW LDCR SYSTEM FOR DISTANCE EDUCATION.

FIGURE 8
THE RUNNING COURSE OF THE ROBOT.

CONCLUSIONS

The outline of our LDCR systems for international exchange and for distance education were described. In the near future, children will use the new LDCR system for distance education.

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