The description of team “KIKS”

Yukikazu TANIGUCHI [1], Kyota MIWA[2], Makoto KAINUMA[3],

Masato WATANABE[4] and Touko SUGIURA[5]

Toyota National College of Technology
Department of Electrical and Electronic Engineering,
Eisei-cho, Toyota, Aichi, 471-8525 Japan
[1] tanippe23@yahoo.co.jp
[2] kmpostjp@ yahoo.co.jp
[3] sonic@mc.ccnw.ne.jp
[4] masa@toyota-ct.ac.jp
[5] sugi@toyota-ct.ac.jp

1 Introduction

Our purpose of the participation to the RoboCup international competition is to keep the motivation of a development of the creativeness. We are aiming the effective education of the creativeness through the project-based learning (PBL) experiment. Our team was awarded the highest prize "robocon grand-prix" in NHK robot contest held in 2004. Additionally, we are most numerous participation and numerous winners in NHK robot contest. Moreover, KIKS is resulted the 3rd prize of RoboCup Japan Open held in 2004, and got a certification for world competition. This is the result of the development of the educational creativeness by using the robot contest. Only students of 16-18 old years in our college participate to the NHK robot contest. After that, the student of 19-20 old years will take part in the RoboCup.

The education of the creativeness is mainly the method to devise and realize the idea. The S-A creative test proposed by Guildford was used to evaluate the creativity quantitatively. As the results of 100 students, the correlation between an academic ability and a creativity of student is strong. But, in this test, we think that it is not measured creative ability, correctly. We have known that there is the strong correlation between the nature and creativity of student. Thus, we aim for the development of the system to measure quantitatively the creativity with high accuracy. We also use the YG personality test which is evaluated the character. To achieve this purpose, we need to prepare the educational program to develop the creativity. After that, we try to evaluate the creativity quantitatively. In this study, we manufacture a set of the experimental system to develop the creative ability.

2 The experiment set outline for creativity education

The experimental set is manufactured on a basis of the RoboCup small machine league for the student of the Institute and/or the college of technology. The image-processing program and AI program are taking into account of the object thinking, that is, the plug-in system is adopted to improve easily the program. Thus, It is not so difficult to add the additional program. The robots which have three or six wheel are able to move all direction speedy. The mother board, communication device, communication protocol and motor control circuit used in the robots provide in advance as a basic design. The students design an original robot by combining a basic part. An experimental set is given as follows.

1. Determination of the idea through the group meeting (the KJ Method)
2. Design of the robot drawing by 3-D CAD

How to give the various data to realize the idea, and the way to do breakthrough

3. Manufacturing the robot using by CNC Fraise Board, and coding program

The usage of various machine tools and the suggestion of the method to make program

4. The robot competition and the evaluation of performance of program
5. The qualitative measurement of creativity S-A creativity test and YG personality test

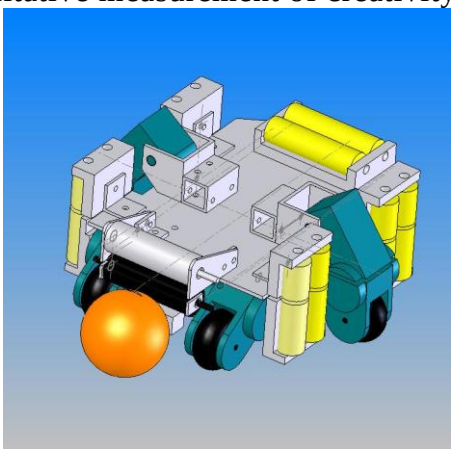

Fig.1: motor driver board

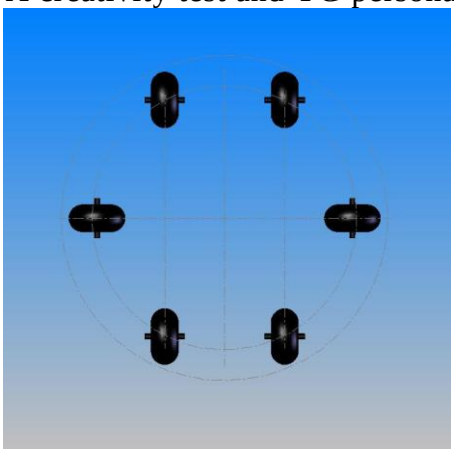

Fig.2: configuration of 6 drive-wheels

3 Manufacturing of robot with 6 drive-wheels

Up to now, we have manufactured the robots with 3 drive-wheels and 4 drive-wheels to move for all direction. In order to run for all direction, the angle of the wheels attached on the robot is 120 or 90 degree to the front-direction. So, when a robot goes straight to the front-direction, the driving-power of both-side wheel decreases 70-86% of maximum power. Moreover, a driving wheel always occur slip, that is, the system is not effective. The motor used in robots is too long compared with our machine size. So, it is very difficult to design a 3 dimensional configuration. Thus, we tried to arrange the wheel's geometry which called "Thrustor Wheel" shown in Fig.2. As the results, we confirm that it has a good performance as same as that of previous machine. These robots were designed by 3D-CAD, and manufactured by CNC fraise board.

4 Improvement of the camera system

In International Competitions held in Lisbon 2004, we were not able to recognize a ball. The problem is the size of a ball in image. Because of our one camera system, the ball size becomes very small with 4 pixels in image. Moreover, since the field size became large, the ball moving to near the goal became into the shade of a machine. Consequently, we can not recognize a ball in the vision system. In order to solve these problems, we have done the two camera system.

Fig.3 two cameras' system

In this system, the data of coordinates is asynchronously sent to AI server from two cameras. The data does not include the information of all robots and a ball, but include only an object reflected into the camera. The AI-server constructs the coordinates of all robots and a ball from the data sent by each camera. In AI server, in order to update coordinates from picture-server included with two cameras of 30fps. Thus, the operation cycle of AI server is equivalent to 60fps. In the present condition, since the execution time of our program in AI server is below 1ms, it is no problem. In this system, it is easy to extend to two or more cameras.

5. Coordinates conversion of a picture server

Since the conversion lens is used, the curvature of the central part in a lens differs from the end part. So, it is necessary to compensate for that. First, the monochromatic chess board written in a paper sized of 245mm*340mm is put on the competition field. Second, the lattice point of the monochromatic chess board displayed on CRT is clicked as shown in Fig4. The coordinates of the lattice point in the actual field are already prepared. Next, the formula to correspond to those two coordinates is approximated with the n-th function using a least-squares method. Finally, we evaluate the coordinates on the basis of the parameter obtained from n-th function. For example, the case of the approximation of the secondary function is shown as following,

$$X = Ax^2+By^2+Cxy+Dx+Ey+F$$
$$Y = Gx^2+Hy^2+Ixy+Jx+Ky+L$$

where x and y are the coordinates on an image, X and Y are the actual coordinates after converted, and A-L are shown as estimated parameter, respectively.

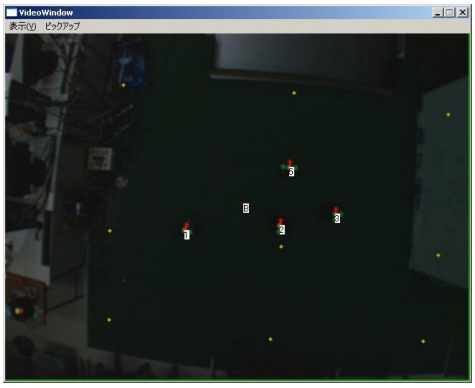

Fig4: input screen to compensate the data

The parameters of A-L are obtained from the data corresponding to the coordinates of each lattice point given by a least-squares method. The Processing of a game uses the presumed function and performs coordinates conversion.

6. Conclusion

To participate to the RoboCup International competition, it is very important for us to keep the motivation of students about the development of the creativity. In order to measure and evaluate the efficiency of education of the creativity quantitatively, it is difficult to analyze sufficiently the degree of effect for a short period. That is to say, we need the situation which is kept the high motivation for a long period. The college and/or institute in Japan which can educate continuously the creativity for the students of 16-20 ages about a long period, are scarce. In order to investigate the effectiveness from the sufficient number of students, we think that it is important to continue participating to the international competition.