# The description of team “KIKS”

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## 1 Introduction

Our purpose of the participation to the RoboCup international competition is to enhance our motivation for developments of the creative mind. We think that this competition is the most advanced PBL (project-based learning) experiment. We are aiming the effective education of the creativeness through the robot contest using LEGO brocks etc. in our college. The creativity is measured and evaluated quantitatively at many points of view. As the result of education for the creativeness, we found that it was very important to keep neutral position of their knowledge. That is to say, this meaning is important to eliminate impossibilities. We summarize the specific feature of the robot as follows.

(1) For the robots, CPU was changed into SH2 from H8, the acceleration sensor was attached and the position control in accuracy was achieved.

(2) The AI system was introduced the Kalman filter and used Rapidly-exploring Random Tree (RRT) for path-planning method.

(3) A strategy program was developed on simulator software by using Open Dynamics Engine (ODE).

(4) For the image-processing system, we introduced the high-speed personal computer. The images of two cameras were processed with that one computer. As the results, processing speed and the recognition rate was improved.

## 2 Education of creativity

We have been studied about the educational method of creativity using the robot contest. The feature of our college is described as following.

(1) The process of working out for an idea is a kind of brainstorming. So, the students debate the presentation of each idea by meaning of the tournament method. As the results, the idea is evaluated by many students and improved to the refined idea.

(2) Each function of various robots can use as the image database to enhance the efficiency of idea.

(3) Our college is well known in Japan as manufacturing an original and a unique robot. And KIKS was resulted the 3rd prize of RoboCup Japan Open held in 2004 and 2006. Moreover, we got the certification for international competition of 2004 ,2005and 2006.

(4) The robot using mecanum-wheels is only one in this competition, and our machine was introduced as unique robot in ROBOCON MAGAZINE published in Japan.

## 3 Robot

KIKS consists of a keeper robot using mecanum wheel, and four standard four-wheel drive robots. Since the validity of a chip kick in a game is confirmed, we improved the robot which can do both of a normal kick and a chip shot. Figure 1 shows the KIKS' robot in 2007. Thus, the machine has two solenoids which play the role of normal kick and chip kick. In normal kick, we obtained the data of 8 [m/s] about the ball's velocity.

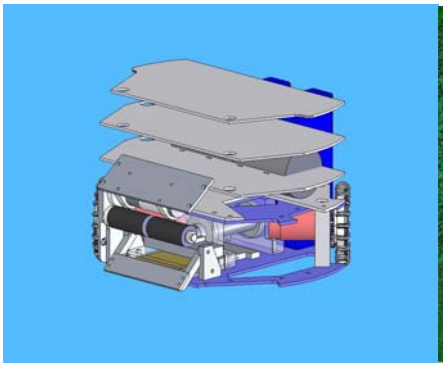

**Fig. 1. KIKS' robot in 2007**

**Fig. 2. Kick device in 2007**

The kick device used original solenoid is shown in Fig2. The dribble mechanism to trap the ball is attached in the body flexibly. All Omni wheels are hand made of aluminum. A drive motor is used Re-max24 Maxon made.

By changing a robot's main CPU into SH2 as shown in Fig.3, processing speed became 5 times of last year. Moreover, the wheel control was easy because of the acceleration sensor was added. Our original motor driver shown in Fig.4 has a CPU for each tire. So, the feedback control can be performed without the load in main CPU. As a result of improving the communication system between main CPU and a motor driver, the speed of data transmission can be achieved 30 times in comparison with last year. Furthermore, we changed the control device for kick's trigger from relay to FET, the control of various kind of kick can be easy.

Most of our machines are hand made by students. Thus, the cost performance is very high in fact.

Finally, we show you the information of the robot. The height is 14.5cm, maximum diameter is 18cm, and our robots do not cover the area of 80% of the ball

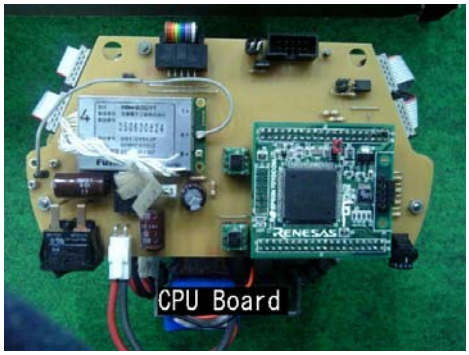


**Fig. 3.KCPU board of KIKS in 2007**

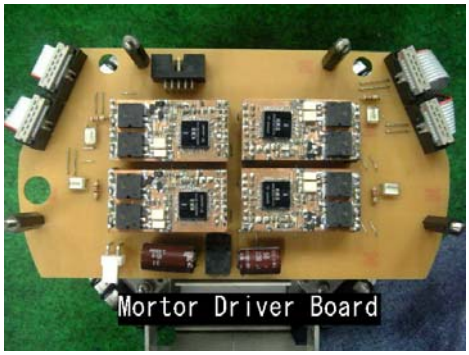


**Fig. 4. Motor Driver Board of KIKS in 2007**

## 4 Wireless communication systems

For radio frequency of communication, we use the non-interference device of FRH-SD07T of Futaba.

## 5 Image-processing systems

Now, the image-processing system of KIKS divides the game fields into two regions, and two personal computers process the image from two cameras. First, about each images obtained from the camera, the labeling is performed. Next, a machine and a ball are recognized from the coloring region, shape and/or position in the image. Finally, the information of whole region has been obtained by composing two image data by AI server.

We introduced partial searching and recognition which analyze only around the ball and robots. As the result, the processing speed was improved compared with that of last year. However, in the system, to get immediately the information of boundary region is difficult because of independent processing of two PCs. So, we have the plan of One PC processing which has high-performance CPU. One PC composes the two images of two cameras, and does the partial searching and recognition instead of two old PCs. Even when the disturbance is happened such as change of light intensity, the maintenance of parameter in image processing will be easy.

## 6 Artificial Intelligence program

When our robot rotates at high speed, the inside traction of the wheel will be weak due to centrifugal force. As the result, the control will be unstable. In order to prevent this problem , it is necessary to change the speed ratio between an external wheel and an internal wheel. So, we need to know the present speed. But, if the speed data is obtained from the position data, a signal may be hidden in high frequency noise. Thus, we introduce the Kalman filter. Figure 5 shows the results. We were able to obtain the good S/N signal.

Moreover, the advanced control of the robot itself was achieved by high-performance CPU. Additionally, the communication protocol of robot was changed.

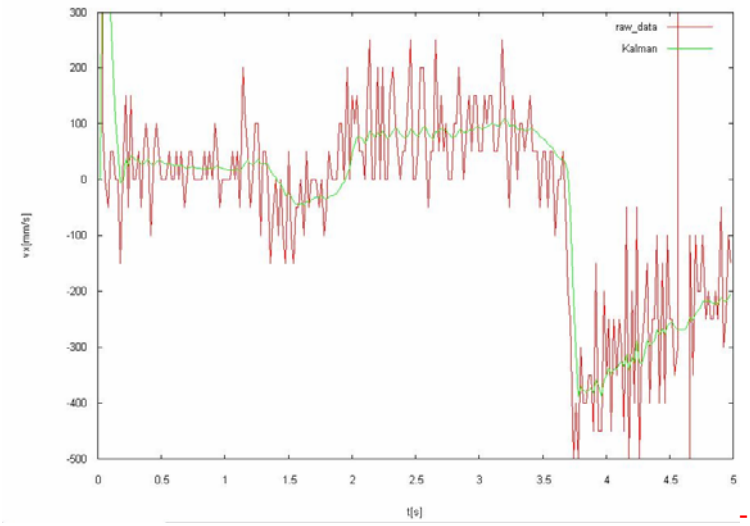


**Fig. 5 Noise decrease by using Kalman filter**

**- Change of the communication system of AI**

Up to now, the data of machine velocity was transmitted as the format of rotation numbers of each wheel. In present system, we improved into the format of the position and the angle of polar coordinate system. As the result, it was enabled to control easy for robot, and to apply simply the feedback of speed from AI server side. Additionally, the amount of transmitted data decreased and communication speed was enhanced due to the improvement.

**- Path planning**

On path planning in last year, when there was an obstacle, the path-planning method indicates the path that avoided on the right side without regard to situation. In present system, we use the Rapidly-exploring Random Tree (RRT) method as path planning. As the result, more efficient path planning was achieved.

**- Strategical simulator using ODE (Open Dynamics Engine) for RoboCup small size league**


**Fig. 6 Image of the strategical simulator**

6 **The description of team “KIKS”**

Although KIKS has been participated in International RoboCup soccer small size league since 2004, the lack of ability to get score was a very serious problem. To solve that problem, it is necessarily to rise up the quality and quantity of a strategical program. But, the developments through the experimental approach to improve using the machines are not so easy because of a maintenance of robot and preliminaries to setting of systems are needed. Thus, we introduce the ODE (Open Dynamics Engine: free kinetics calculation engine) simulator software using on PC. Figure 6 show the image of the strategical simulator. 3D graphics (Open GL) and a collision detection function are already mounting. In present, we are changing the strategical program for the better.

## 7 Conclusion

We have done most of improvement for all part. As the results, we got the high performance for the robots and AI program, compared with that of last year. At the RoboCup international competition held on Germany in last year, our team have achieved first goal since we participated in 2004. Moreover, we got two won and suffered two defeat at round robin. As the results, we advanced to the tournament stage. So, in this year we aim at and expect that our machine will achieve the better result in comparison with last year.

To participate to the RoboCup International competition, it is very important for us to keep the motivation for the development of the creative mind. The quantitative measurements and evaluation of the efficiency about education of the creativity is difficult. Especially, sufficient analysis of that effect is not able to do for a short period. That is to say, we need such situation which is highly kept the motivation for a long period. The college and/or institute in Japan where can educate continuously the creativity for the students of 16-20 years old are scarce. But, we can do that for a long period. 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.