

KIKS 2009 Team Description

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Abstract. This paper is used to qualify as participation to the RoboCup 2009 small-size league (SSL) about team “KIKS”. Our robot is designed under the Rules 2009 in order to participate in the SSL competition held in Graz, Austria. The overview is described for robots’ hardware and software of our team.

Keywords: RoboCup, Small-size league, Image processing, Motion control, Artificial Intelligence.

1 Introduction

Main purpose of our participation to the RoboCup world competition is confirmation and evaluation of the result of the PBL (Project Based Learning) experiments. Our team has participated for five years since 2004, continuously. We have no win in Suzhou 2008, but in 2007, it was resulted in one of the BEST8 teams. In RoboCupJapanOpen2009 held in 3rd-5th May 2009 Osaka, we had a first winner in SSL-Humanoid League, and got second place in SSL.

We have educated the creative minds of students using the robot contest held in our department of electrical and electronic engineering. The creative minds have been evaluated quantitatively using the examination of the creativity or the personality test continuously.

The main topics of our developed system in 2009 are following term,

- System construction for the participation to the SSL-Humanoid
- Improvement of the image and AI processing system in SSL and SSL-Humanoid
- Enhancement of the performance of dribbling and kicking devices of the robot in SSL.

2 System construction for SSL-Humanoid

A part of the member of Japanese committee of SSL proposed the new SSL, that is, SSL-Humanoid based on the global vision system which is demonstrated in Suzhou 2008. We have a plan to participate to that competition of RoboCup Japan Open held in May 2009. Now, we are working on the construction of the system based on the conventional SSL.

2.1 The robot of SSL-Humanoid

In the game of SSL-Humanoid, it is played using humanoid robots. We use the three robots named MANOI AT01 (KYOSHO Co. Ltd, Japan) shown in **Fig. 1**. The robot has the specification of height of 340mm, weight of 1.5Kg and joint of 17-axis. This robot is excellent for the cost performance. The synthetic resin blanket and metal gear are gave rise to the quick response and durability. The main control board is the RCB-3 provided by KONDO Co. Ltd, Japan. Similarly, KRT-1 (KONDO Co. Ltd.) is used as the communication device. The frequency is able to use as 25MHz of AD band (20band), but its transmission speed (baud rate) is 2400. Since it has little low speed, we may change the device.

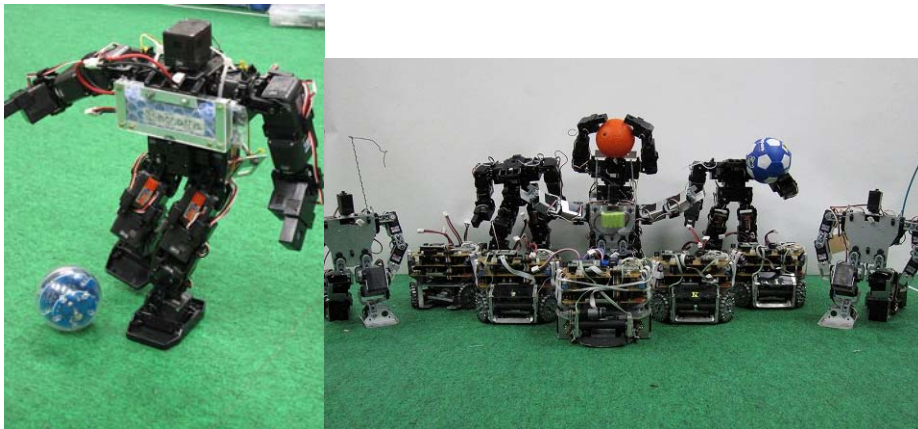


Fig. 1. The robots for the SSL-Humanoid and SSL

It is very easy to make the motion by using attached software as shown in **Fig. 2**. After the setting of servo-motor is made for each joint, it is registered as a series of motion. We made improvements mainly feet of MANOI AT01 for stable two leg's walking. The bottoms of robot's feet are changed widely to limit size (max. 130mm) as shown in **Fig. 3**. This improvement is very effective for reducing the rate of falling. Moreover, we moved backward the roll axis of the ankle and lowered a position of the pitch (pace) axis as shown in **Fig. 4**. As the results, a center of gravity of robot could be lowered, and stable walk was achieved. Additionally, the battery is in the center of

the head part, because its position has little influence even if weight of the battery changes in near future.

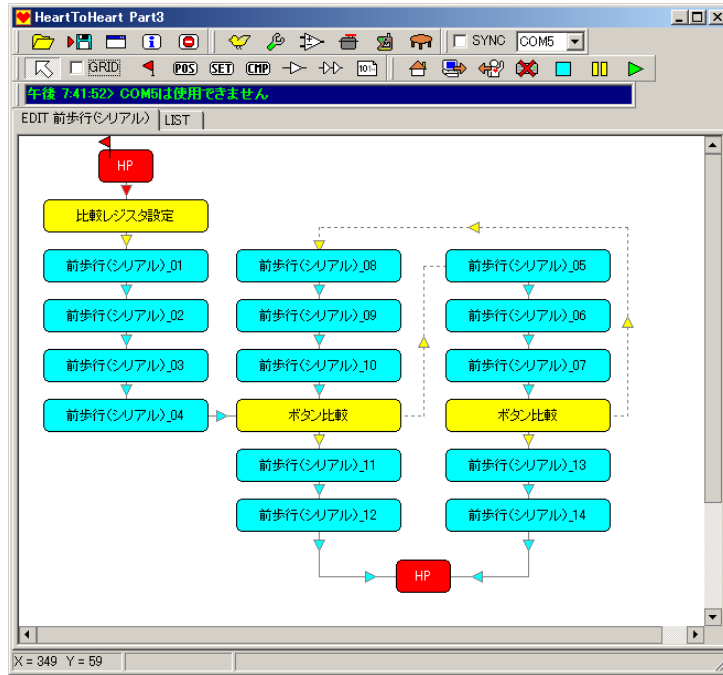


Fig. 2. The image of motion control program



Fig. 3. The bottoms of robot's feet

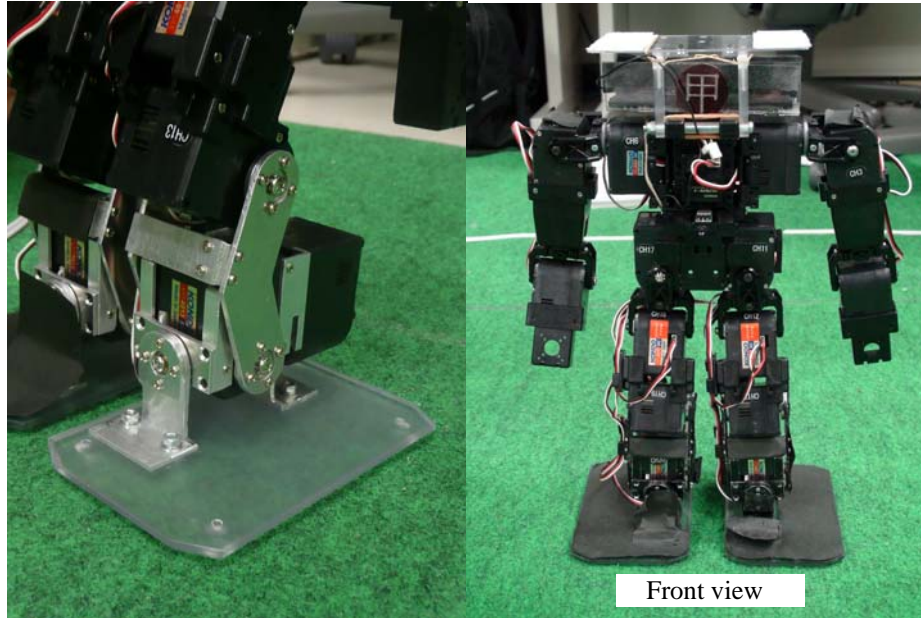


Fig. 4. The change of the position of the roll axis and pitch axis

2.2 AI processing system for SSL-Humanoid

We, KIKS performed the reconstruction of AI server entirely. First, the operability of GUI was improved. In our previous version, it could not set the parameter which is need the change of the strategy, in play of the game. So, we have to take a long time-out period in that case. Moreover, in SSL-Humanoid, because of the most of information is only position of each robot, it is difficult to know the game situation. That is, it may be caused the difference of the action between the actual motion of the robot and the motion command called when the event happened. To solve above problem, we reconstructed the new GUI shown in **Fig. 5**. As the results, it was able to display the detail information of each robot such as the direction, the position and the action etc., and change the strategy quickly.

Second, the strategy corresponding to the Humanoid robot was designed. In the SSL, it needs the information of the position and velocity of the robot and ball etc. In addition, in the case of SSL-Humanoid, it will be use the motion command such as forward, backward, kick and throw-in etc. Thus, we improved the AI server system for the Humanoid robot. In strategy part, we divided into the small unit. As the results, we will be able to take the various strategies by combination of the small unit, and the development of the strategy will be easier compared with previous system. From now, we will aim to do automatic change of the strategy by robot itself.



Fig. 5. New GUI image of AI processing system

3 Image processing system for SSL and SSL-Humanoid

Now, we use the two cameras as the global vision system, but their cameras do not synchronize. The image from each camera is displayed independently. Thus, in the case of finding the ball at two images by somewhat error, the image server send the both position of the balls to AI server without checking of the validity of the balls. So, we improved the image processing program to solve the problem mentioned above. That is, we unified the information which through the recognition process for each image of the field from two cameras. It can hold the previous information of the robots and the ball, and evaluate the motion of the robots. The flow is shown in **Fig. 6**. As the results, incorrect recognition was reduced. But, the performance of the feedback process is not enough at this time. In the days ahead, the recognition rate will be improved by linear prediction model, and be achieved the high-speed processing by partial match search on the field image.

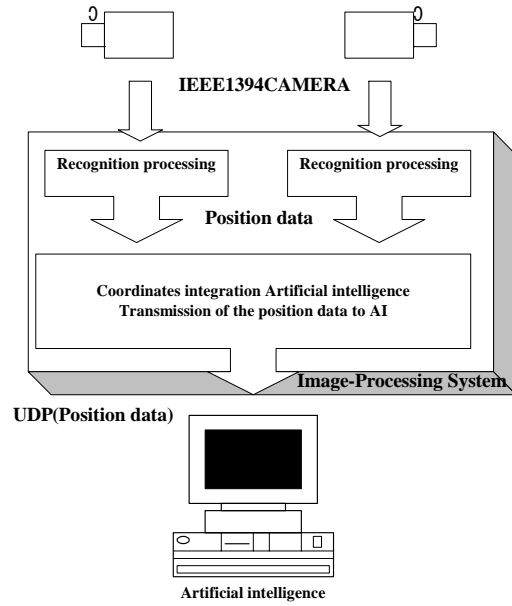


Fig. 6. Image processing system

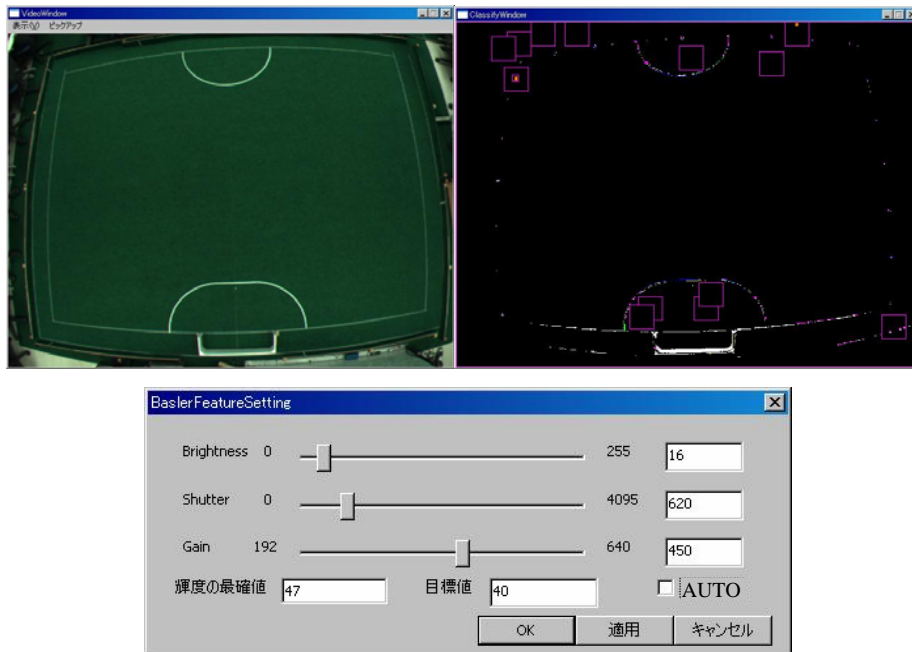


Fig. 7. GUI image of automatic illumination control program

In our previous system, when the surrounding illumination on the field was changed, it could not keep the same condition on our image server system. That is, there was in the situation that it could not be found the ball and/or the robot on the image by ambient light. So, we have made the program to automatically control the illumination on the image server shown in **Fig. 7**. It can recognize the ball and the robots even if the intensity of the ceiling light will be changed with normal various ranges.

4 Enhanced mechanism of dribbling and kicking devices of omnidirectional mobile robot

In recent game, it is very important to do the high-precision pass-play among the robots. That is to say, the shock absorption material and/or mechanism of the dribble device and quick turn motion are required when the ball get . Then, we changed into the high power motor for dribble device and redesigned the variable-speed mechanism. Moreover, chip kick device was also redesigned.

Our robot for SSL is displayed in **Fig. 8**. The size of robot has a diameter of 172mm and a height of 140mm. The dribble device covers to 20% of the ball. Four robots consist of four omnidirectional wheels by using motor of Maxon RE-MAX24, and it can move at speed of 2.5m/s. The straight kick device has ability to kick the ball at speed up to 12m/s, its energy are applied from 4mF capacitor charged to 200V within 2sec. On the other hand, a keeper robot has mechanum wheel shown in **Fig. 9**, for four each motor. The mechanum wheel can move for all direction theoretically, but our robot is specialized to the motion of the right and left direction against goal. Therefore, the keeper robot is possible to move faster than other robots on that direction, and also implemented the powerful chip kick device. Redesigned chip kick device is shown in **Fig. 10**. It can give the power to a ball efficiently by making the long radius gyration of the device.

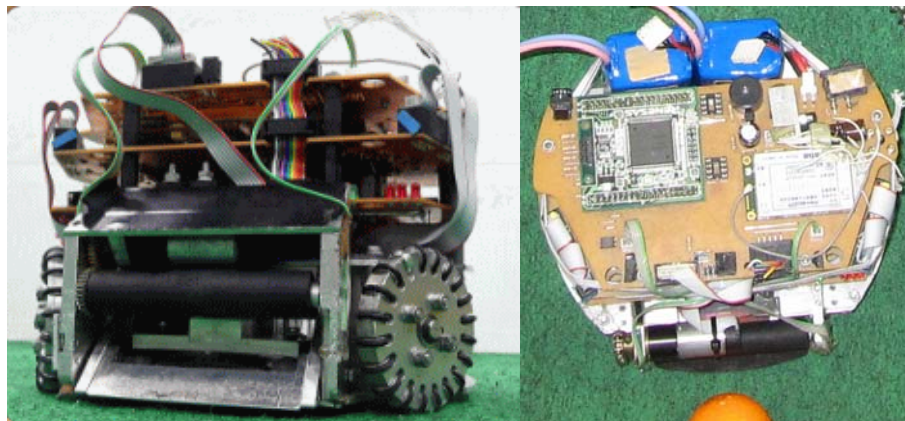


Fig. 8. Robot for SSL

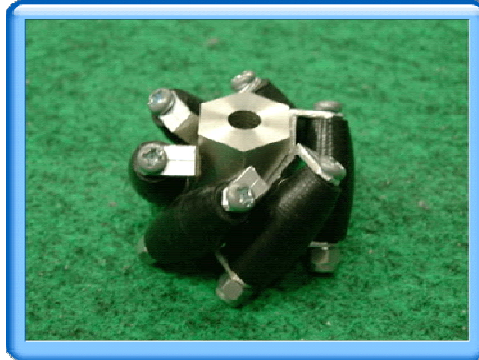
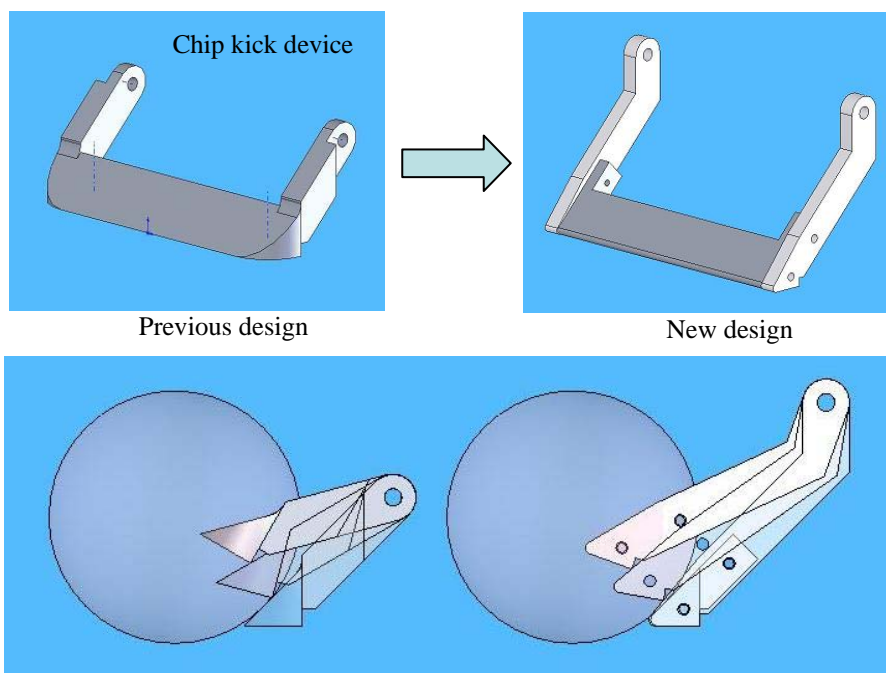


Fig. 9. Mechnum wheel

The robot receives the control commands from the AI server using the non-interference device of FRH-SD07T (2.492GHz) of Futaba. Our robot did not send back the status command.



It can apply the power to a ball efficiently by long radius gyration of the device.

Fig. 10. Redesigned chip kick device

We evaluated the performance of both solenoid and chip kick device, quantitatively. The results under the same condition are shown in **Fig. 11**. It shows that the mechanical performance of the robot is improved sufficiently.

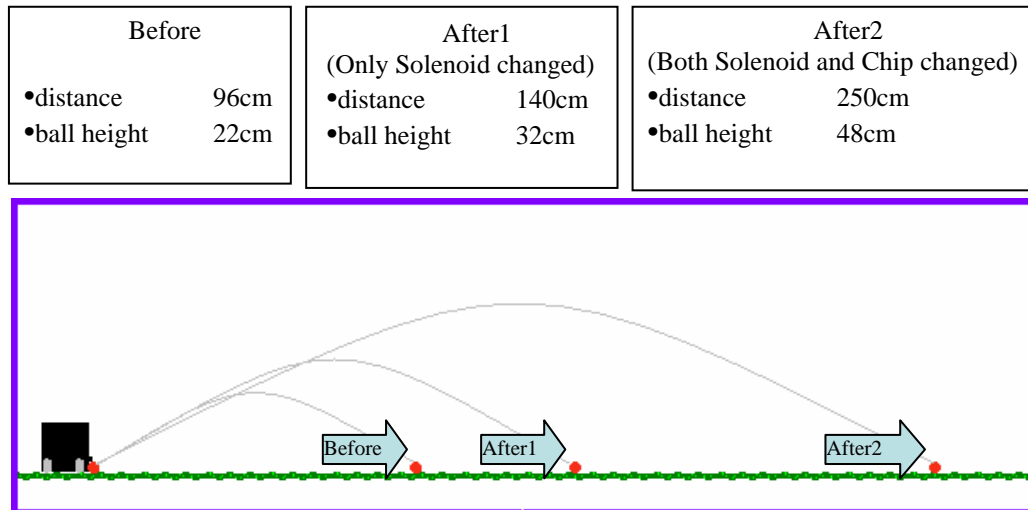


Fig. 11. Performance of chip kick under the same condition

5 Conclusions

We have constructed the system for the SSL-Humanoid and improved the robots and the control program for conventional SSL in this year. The performance of our robot is getting high over the year. Most of devices are hand made by students. Thus, the cost performance is very high in fact. According to our experience, the participation to the Robot competition is very effective method to nurture the creativity for student of less than 20 years old.

We hope that our robots will perform better in this coming competition than that of last year. We will have a plan to join such competitions continuously in the future.

References

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