Osaka University "OsaYans2003"

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Abstract. This is the team description of Osaka University "OsaYans" for RoboCup2003. The objective and the hardware/software architecture are briefly presented.

1 Introduction

Department of Adaptive Machine Systems, Graduate School of Engineering, Osaka University, has been conducting education of creativity for master course students. The class provides several projects, each of which consists of two or three students, a researcher from a company, and a few support staffs. As one of these projects, we are working on the project named "Development of RoboCup Small Size League Robot". Our team, Osaka University "OsaYans2003", is one of the outcome from this project. This project has started since 2000. We built up a hardware of robot in 2000. A real-time recognition system with a global vision and wireless communication were developed in 2001. And we have been developing softwares of basic behaviors since 2002. This paper presents some introductions on the engineering education effects through this project, and the system to control the robots.

2 Exercise Schedule

The elements for building up RoboCup small-size league robots involve wide engineering knowledge of the machine, electronics, the control, and the information processing. The hours of the instruction are about 100 hours a year as once a week from April to December. Because it is difficult to develop all elements in one year, we set the goal as developing world-class robots in three years. Fig.1 shows the schedule for the first year we decided through the discussion in our team.

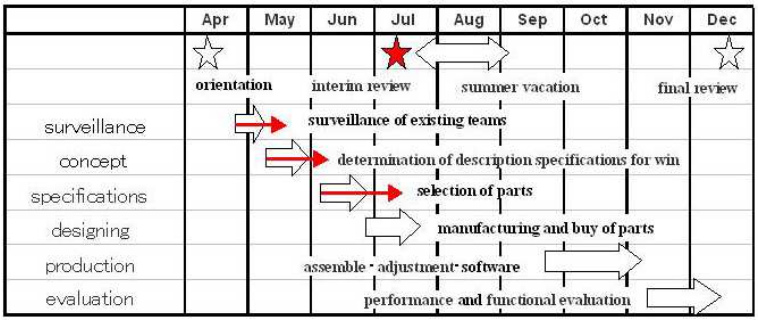

Fig. 1. Schedule of the first year

Schedule for the first year

2.1 Development Concept and Specification

Table 1. Specification of the robot

basic skills	functional design requirements	robot specifications
trap	accurate detection of a ball in front of the body ball stopper	on-board vision cushion
pass kick	accurate direction of kicked ball first kick	dual adjustment mechanism
dribbling defense	fast motion fast chasing to the ball	velocity : max $2.0m/s$ acceleration : max $5m/s^2$

We researched the robots information of the existing teams from RoboCup documents, videos, and participant's and Robocup web page. Based on these survey results, we finalized the concept of our robots as "quick reacting ball" and "sharp dribbling, pass, and shoot". Table.1 shows the brief specification of the robot.

Second year schedule The objective of the project for the second year is developing the function of the robots in order to compete in the world-class game. Because the student member of the team has completely replaced every year, we started from the understanding of the composition of the robot built up in the previous year. We analyzed past games and existing teams, and made the concept of the robot control system. Fig.3 shows three control modes based on the concept.

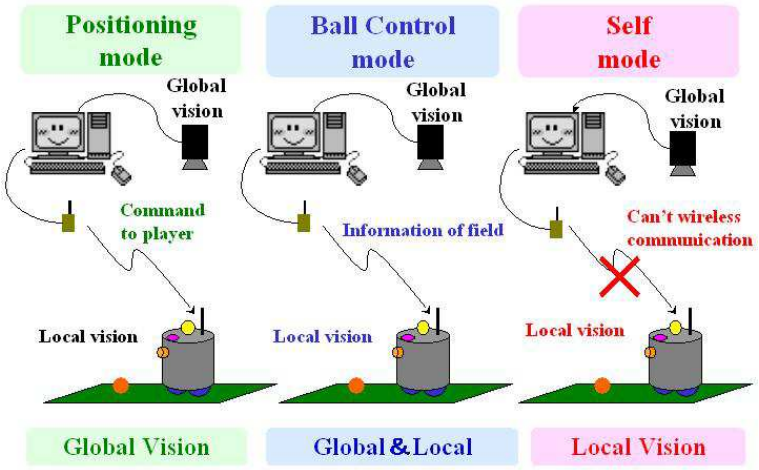

Fig. 2. control modes

Third year schedule The objective of the project for the third year is developing the team play in order to compete in the world-class game. The concept of the developing the team play is "high speed feedback and the simple strategy" Our team has an ability to participate in the game though the perfection is still low so far.

3 System Description

Fig.3 shows an overview of our system. It is a centralization system. The global vision system on the central computer captures the top view of the field, applies image processing to detects a ball, teammates, and opponents, and updates the positions and the velocities information of those objects. The system evaluates the situation based on those information, selects a behavior for each robot under a team strategy prepared in advance, if sends commands to robots using wireless modem. And these robots just follow them.

4 Robot Hardware

Fig.4 shows a picture of our robot we designed and built. The vehicle has two differential wheels. The wheels are driven independently by separated DC motors, and two extra free casters ensure the static stability. The weight and the height of the robot are 2.5 kg and 140 mm excluding the antenna, respectively. The wheel size is 60 mm, and the projected area is 177.4 cm^2 . The maximum speed

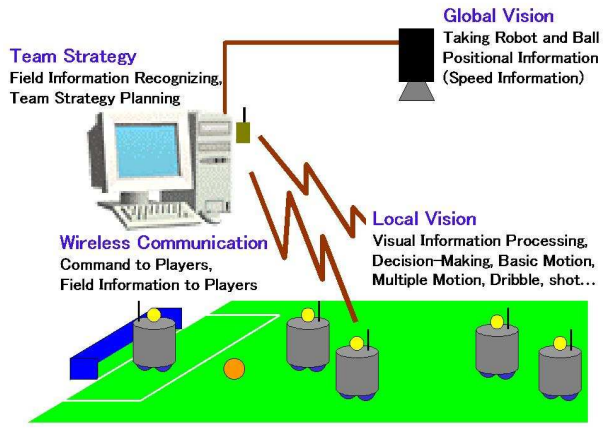

Fig. 3. An overview of our system

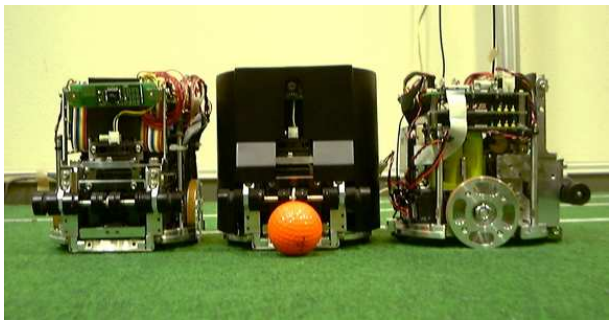

Fig. 4. A picture of our robot

and the maximum accelerated velocity are 2.0 m/s and 5.6 m/s^2, respectively. All robots excluding goalie have kicking devices. The device kicks the ball using spring energy of kick board bending. The dribble device has a roll in front of the body, rotates the ball backward, as a result, robot is able to keep the ball. The robots have Ni-Cd batteries and their acting time is about 30 minutes. The robot has a CPU board for motor control system. The CPU board running at 28.686MHz offers 5 ch plus counter, 8 ch A/D converter. A radio communication module has 38.4 kbps transmission speed.

5 Global Vision System

We use a standard PC parts, a commercially available PCI frame-grabber, a normal CCD camera, and DirectShow API on a Windows2000 system. We developed a simple color based object recognition system. Fig. 5 shows the markers on the

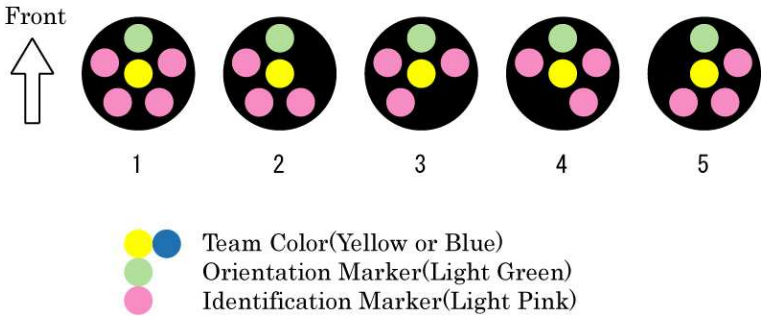

Fig. 5. Markers on the top of robots

top of our robots. The system detects the own team color at first, looks small area around it, and detects the number and the pattern of the other markers, then recognize the individual teammates.

6 Fundamental Approach to Control

6.1 Team System

The team system has a coach agent, field players, and a goalie. The coach decides behaviors of the field players and the goalie. A field player has a number of basic behaviors, while the goalie has only two behaviors. And when the coach receives a signal from a referee box, the players switch to the special behavior to keep the rules provided in the laws of the F180 League 2003.

6.2 Field Player

We design a number of behaviors for each role of the field players (defender, attacker, goalie). These behaviors consists of smaller behaviors. Fig.6 shows a behavior of chasing a ball as an example.

6.3 Goalie

Fig.7 shows goalie behavior. Basically the goalie moves to the position between the ball and own goal in parallel direction the goal line (Fig.7(a)). If the ball comes within a certain distance from the goal line, the goalie aggressively charges the ball (Fig.7(b)).

6.4 Role Assignment

Each robot have the role of the forward or the defender. These roles are static and unchanged. Defensive players are not allowed to come close to the offensive players because present strategy focuses on attacking.

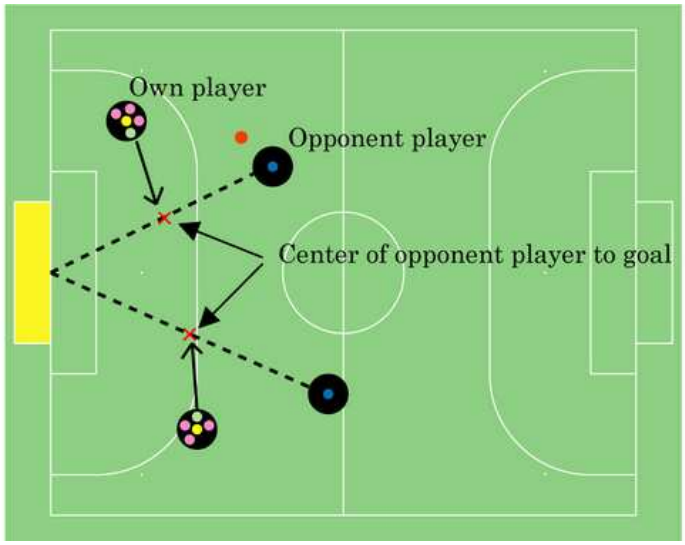

Fig. 6. a behavior of defense robot

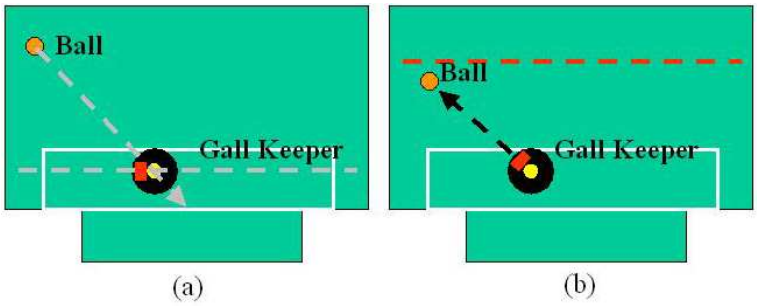

Fig. 7. goalie

Acknowledgments

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