Team Description Eigen

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Abstract. EIGEN participates in RoboCup at World Meeting for the first time. Our team provides three robots of the same type and one goalkeeper robot. Our aim is to realize a cooperative team play among robots as well as high performance of robot relating to image processing, decision making of behaviors, and motion control. As a first step, we realized a motion control for a field-player robot by the Fuzzy control method and cooperative behaviors by a wireless LAN.

1 Hardware Architecture

1.1 System Composition

We made three robots of the same type and one goalkeeper robot as shown in Fig.1. The system composition of robot is shown in Fig.2. These robots consist of sensing system, communication system, actuator system and processing system. This architecture is designed based upon the concept of system life. Each system is described as follows.

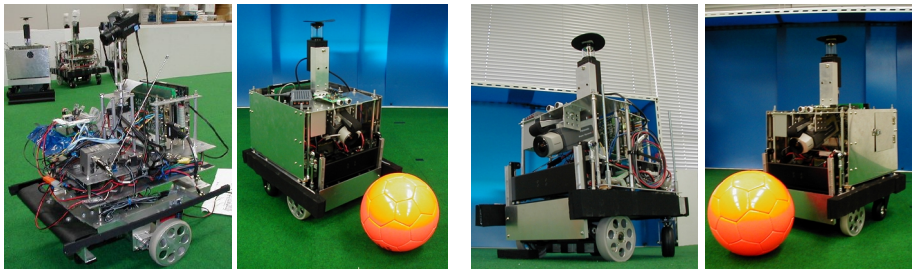

Fig. 1. EIGEN robots

1.2 Sensing System

The robots have a conventional camera system and an omni directional camera system for visual sensing system. For the conventional camera system, we

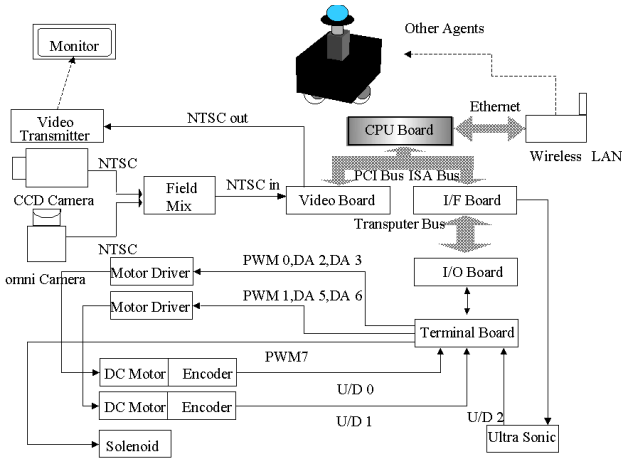

Fig. 2. Schematic diagram of the hardware architecture

chose a color CCD camera (Panasonic WV-CP464). And the omni directional camera system consists of a hyperbolic mirror and a color CCD camera (Sony FCB-IX10). All robots have two vision systems. Field-player robots process simultaneously two images from the conventional and the omni direction cameras with Video Mixing Device. In order to control each camera system, we use IP-5005BD cards (HITACHI).

Besides, the robots have an ultra sonic sensor for obstacle avoidance and two encoders for the distance measurement based on internal information.

1.3 Actuator System

Motor Control System: It is difficult to make an interface among the PC and the other devices by using commercial boards. Therefore, we developed an ISA interface board. The robots have I/O board and H-bridge Unit developed by the other laboratory of Keio University. The rotation speed of motor is controlled with PWM from these boards.

Kick System: Kick device consists of DC solenoid (ACT SD18AA-06). The robot uses the device on DC 24V.

1.4 Communication System

We utilize a wireless LAN device for communication among our robots. The wireless LAN device, NetHawk RF-100E is directly connectable to the exiting Ethernet LAN system.

1.5 Processing System

For a processing system-board, each robot possesses a half size CPU board with Pentium 2 450MHz processor and 64Mbytes RAM. Instead of HDD, Silicon Disk Drive or Disk On Chip 144MB(M-Systems) is adopted.

2 Software Architecture

2.1 Image Processing

EIGEN robots have a conventional camera and a omni directional camera which can watch both goals without turning by the omni directional camera. Hence, the robot calculates self-position by sensing position of two goals. Our procedure for Image Processing is described as follows.

1. Extract colors from camera image (orange: ball, blue: goal, yellow: goal, etc...)
2. Binarize the extracted images.
3. Labeling and Filtering by Area.
4. Calculate distance and angle from position of two goals.

Each robot calculates the distance and angle of each object by the area of object, width, height and gravity.

2.2 Path Planning

We presents a method of decision making on the basis of " System-life " concept. System Life is the concept to realize a flexible and adaptive intelligent system enabling a symbiosis with environment. The concept is proposed as a new system design concept to realize the adaptation and flexibility which are acquired by the seamless integration of the elements relating to information on the system object. This method is applied to various methods of the human-system, and is as follows concretely.

The soccer robot recognizes environmental information by real time vision system using images from two CCD cameras, and shares some information with other robots by communication system using wireless LAN. Each robot evaluates the self-condition by the information of processing module, and realizes various behaviors in real world by an activating module. These modules being integrated by integrator, the robot can perform intelligent soccer play. The information from each module is fed to the integrator, and the optimal behavior at present condition is selected as an output information.

In this method, it is expected that robots flexibly cope with dynamically changeable environment by means of designing each module separately and evaluating the situations under the information of purpose. The usefulness of the system architecture is verified by numerical calculations and an experiment using real robots.

3 Conclusion

In this paper we presented EIGEN for RoboCup 2001 contest. This description of team EIGEN paid attention to the hardware and software of robots.

From the viewpoint of hardware, it is characteristic that all EIGEN robots have both conventional and omni directional cameras. They can recognize the global map by two cameras.

For software, it is characteristic that each robot evaluates the self-condition by the information of processing module, and realizes the optimal behavior by the integrator on the base of " System Life " concept.

References

1. H.Kitano, M.Tambe, Peter Stone and et.al. "The RoboCup Synthetic Agent Challenge 97" In Proc. of The First International Workshop on RoboCup, pages 45-50, 1997.