WinKIT

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Abstract. This paper describes our research interests and technical information of our team for RoboCup-2000. Our robots have been developed to have a capability of pass-based tactics. That is, the capability of position estimations of the robots and the ball, the distinction between our team and opponent team, and passing the ball to a desired direction. To achieve the capability, robots have kicking devices and omnidirectional vision systems.

1 Introduction

The performance of robots was quite different between the F180 (small size) league and the F2000 (middle size) league in RoboCup-99. Many robots of F180 moved very quickly. Some of their average speed reached about 2 m/s. And many pass plays were observed in a real game. In contrast, many F2000 robots moved like tortoises, and some of them never moved. Few pass plays were observed only in the finals. The main reason is the difference of the vision system. F180 permits a global vision system, and F2000 does not.

Our robots for RoboCup-99 were able to move at speeds of up to 2 m/s, and their maximum acceleration speed was 4m/s^2 . They were easily stand comparison with the F180 robots.

In the RoboCup-99¹ competition, however, their average speed was less than 0.5m/s because of our vision processing capability. Thus, in the F2000 league, we study the vision system mainly. Our current research topics are as follows:

- Object Detection
- Localization

For the robust object detection, our vision system uses the shape information besides the color information of the ball, and determines the color threshold automatically using the geometric constraints. For the robust localization, an omnidirectional sensor is equipped on the top of the robot.

¹ Our team name was Matto in RoboCup-99.

Fig. 1. The WinKIT Robot

2 Architecture

2.1 Hardware Architecture

Overview

Fig.1 shows one of our new soccer robot system that is designed to have a capability of a pass-based tactics. To realize the tactics, it has a pneumatic kicking device and an omnidirectional vision sensor for the position estimation.

It is equipped with an industrial PC, infrared position sensors, an omnidirectional vision sensor, a wireless Ether, a BT848-based PCI video capture cards, a powerful kicking device, and a fast mobile system.

Processing Syste

We have learned from RoboCup-99 that the reliability of the robot system is the most important. To make the robot system reliable, our processing system is an industrial computer.

Our robot system does not have any image processing boards, the high level processor needs for the image processing. Thus, our processor is a Pentium III 650MHz with 256MB RAM.

Sensor System

The vision system is the most important of all sensorial systems. To realize a robust vision system, we use omnidirectional vision sensors from ACCOWLE. They have hyperboloidal mirrors that can generate an image taken from a single view point [1]. And the infrared position sensors are used for the collision avoidance.

Specifications:

Dimension: Length 42cm x Width 42cm x Height 60cm

Weight: 23kg

Motion: Speed: 5 m/s Acceleration: 4 m/s²

Battery Power: 14 Ah

Motor: Maxon F2260 40W 24V

Gear: Maxon Planetary Gearhead GP62, Reduction 5.2:1

Processor: Pentium III 650MHz

Hard Drive: 2.5" 3.4GB

Memory: 256 MB

Wireless LAN: WaveLAN Turbo

CCD Camera: SONY EVI-330

Omnidirectional Sensor: ACCOWLE hyperboloidal mirror, middle size

2.2 Software Architecture**Vision**

The vision system is one of the most important part in the F2000 league. Because the main difference between the F180 league and the F2000 league is that the global vision systems are not permitted in the F2000 league.

Limited in the vision system, the position estimation and the object recognition are very difficult compared to the F180 league. We make an effort to study the vision system.

In RoboCup-99, object detection was based on the object color. Visual information received from the CCD camera is converted to YUV from RGB. Because YUV is more stable than RGB when light conditions are changed. All colors (red, blue, yellow, green, white, black, light blue, purple) designated in RoboCup can be discriminated by threshold values of each color. The threshold values were manually determined.

This year, we also use the shape information of the ball to increase the accuracy of the ball direction and the ball distance. The method is based on the XY profile projection of the ball.

And, we have developed the method of determining the threshold values automatically [3]. The threshold values are calculated based on the physically-based approach. The position and the size of the ball on the captured image are determined by the actual ball size and the camera parameters. The threshold

Fig. 2. Left: Raw image, Right: The result of the image processing

Fig.3. The vision system user interface

values are determined from the position and the size of the ball on the captured image. Fig.2 shows the result of the image processing, and Fig.3 shows our vision system user interface.

3 Conclusions

This article presents the details of our team. RoboCup-2000 is our second challenge. This year, we study the vision system mainly to accomplish the pass-based tactics, and have developed the new robots that have the kicking devices and the omnidirectional vision sensors.

References

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