WinKIT-01 : Team Description

Kosei Demura, Noriharu Kubo, Koichi Fujita[1],
Masanori Toya, Kengo Yamane, and Ken-ichi Abe[2]

[1] Matto Laboratories for Human Information Systems
Kanazawa Institute of Technology
3-1 Yatsukaho, Matto, Ishikawa 924-0838, JAPAN
[2] Factory for Dreams and Ideas
Kanazawa Institute of Technology
7-1 Ohgigaoka, Nonoichi, Ishikawa 921-8501, JAPAN

Abstract. This paper describes our research interests and technical information of our team for RoboCup-2001. 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. In addition, we have developed omnidirectional mobile systems.

1 Introduction

The aim of our activities for RoboCup is to develop the total robot system. Thus, we have been developing both hardware and software since 1998.

Our robots in RoboCup-99 were able to move at speeds of up to 2 m/s, RoboCup-2000 robots increased their top speed of 4 m/s. The speed is top-class in the F2000 league. In addition, omnidirectional mobile system have been developed. In RoboCup-99, our first omnidirectional mobile system lacked reliability. The reliable prototype in Fig. 2 has completed as a result of the continuous improvement.

Our vision system has also improved. In RoboCup-2000, localization is very difficult for all robots. Thus, omnidirectional sensors are equipped on the top of the robots, and the information of the sensors is shared by wireless communication for the robust 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.

The reliability of hardware and sensors improved , we begin to research robot learning in dynamic environments.

Fig. 1. The WinKIT Robot .

2 Architecture

2.1 Hardware Architecture

Overview

Fig.1 shows our soccer robot system that is designed to have a capability of a pass-based tactics. To realize the tactics, it has a kicking device and an omnidirectional vision sensor for the position estimation. Two robots were built in 2000, and two more robots have been developed for RoboCup-2001 that fit into new regulation. New robots are basically the same as that of the 2000 type robots, and main difference between those robots is their size. 2001 type robots will be bigger.

Those robots are equipped with industrial PCs, interface boards, infrared position sensors, rotary encoders, omnidirectional vision sensors, wireless Ethers, BT848-based PCI video capture cards, and pneumatic kicking devices.

Processing System

The processing system of our robots is an industrial computer to make the robot system reliable. 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

We use omnidirectional vision sensors from ACCOWLE. They have hyperboloidal mirrors that can generate an image taken from a single view point. And the infrared position sensors are used for the collision avoidance.

Specifications

Dimension: Length 40cm x Width 45cm x Height 40cm

Weight: 22kg

Motion: Speed: 4 m/s Acceleration: 2 m/s^2

Battery Power: 14 Ah

Drive System: 2 wheel differential drive

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

Omnidirectional Mobile System

Fig.2 shows the prototype that adopted the omnidirectional mobile system. In RoboCup-99, our omnidirectional mobile system was 4-wheel drive system. Since the system had not equipped with suspension, some of driving wheels do not ground if the surface is not flat.

New omnidirectional mobile system is 3-wheel drive system. There are 3 pairs of omniwheels as shown in Fig.2. Each pair of omniwheels is simply driven by the Maxon 70W geared motor. The advantage of it is to make the mobile system simple.

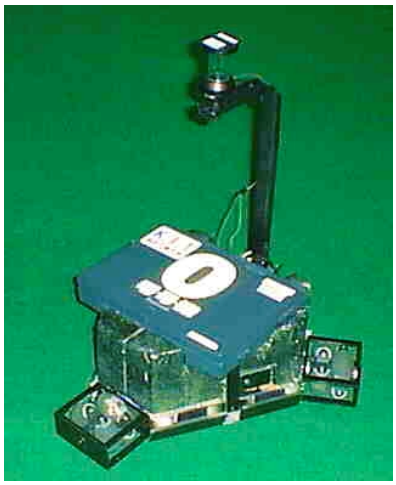

Fig. 2. Prototype of the Omnidirectional Mobile Robot

2.2 Software Architecture

Overview

The software architecture is composed of an action module, sensor modules, and a motor module. Each module runs in parallel and is implemented by POSIX thread. And we use POSIX thread synchronization primitives to avoid a race condition of synchronizing parallel processes.

ART-Linux

The max speed of our robots reaches 4m/s, they have to control two or three motors more accuracy. Thus, we start to use a ART-Linux [1] that is real-time extension of Linux, developed by Youichi Ishikawa at the Electrotechnical Laboratory (ETL) in Japan.

It is similar to RT-Linux, but it can use existing Linux device drivers and application programs and real time tasks are safer because of its execution at user privilege level. ART-Linux now correspond to Linux 2.2 kernels, and runs on RedHat Linux 7.0, 6.2, Debian GNU/Linux 2.2 r2, and so on.

Vision

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 [2]. 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.

3 Conclusions

This article presents the details of our team. RoboCup-2001 is our third challenge. The reliability of hardware improved and development of software became efficient in connection with it this year. Next year, most of our robots will equip the omnidirectional mobile system.

References

[1] ART-Linux home page: In http://www.etl.go.jp/etl/robotics/Projects/ART-Linux/

[2] N. Kubo and K. Demura: The Vision System for RoboCup, In Proceedings of ROBOMEC'00, 2P2-27-032, 2000