The Concept of Matto

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Abstract. This paper describes our research interests and technical information of our team for RoboCup-99. Our robots have been developed to have advantages for playing soccer. That is, the capability of kicking a ball and high mobility. We developed pneumatic kickers and omnidirectional bases.

1. Concept

We study and analyze robots of the RoboCup-97, 98 to design our robots, and decide the design concept as follows

- Kicking device
- High mobility

Considering the kicking device, only a few teams such as the CS Freiburg team [1] and the UTTORI United team [2] equipped it. Kicking device will change the tactics of the RoboCup dramatically in the middle size league. It will be a pass-based tactics like the modern soccer.

To accomplish the tactics, there are a lot of hard problems to be solved. Mobility is a key point. The matches at RoboCup-97 and 98 show that most robots were like tortoises. Thus, we developed robots that have a fast and an omnidirectional mobile capability.

We learned from RoboCup Japan Open 99 that the complicated system is no use for the real robot soccer games. To make the robot system simple and reliable, standard PC/AT notebook computers were adopted as the processing system of our robots. Because the notebooks have been designed to deal with the nocks and shocks, moreover have excellent batteries such as the lithium ion batteries.

Fig.1 shows one of our robots. It measures 390mm × 360mm × 330mm in length, width, and height. The weight is about 8kg with a laptop PC and two 12VDC, 2.2Ah sealed lead-acid batteries.

The vision system is the most important of all sensorial systems. Commercial video capture PCMCIA cards (IBM Smart Capture Card and Ratoc System REX-9590) are used for the vision system. These capture cards can capture 320x240 images at a frame-rate of 30 per second and have device drivers for Linux. Capturing performance is based on CPU power. Therefore we used powerful CPUs such as Mobile Cerelons 300MHz and Mobile Pentium IIs 333MHz.

M. Veloso, E. Pagello, and H. Kitano (Eds.): RoboCup-99, LNAI 1856, pp. 723–726, 2000.

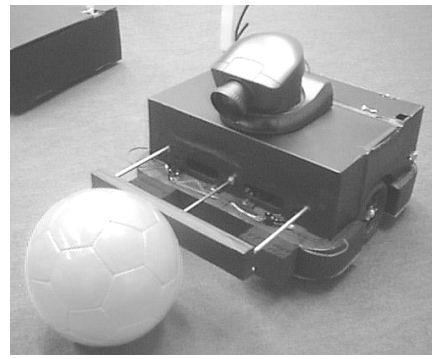


Fig. 1. One of our robot: HIKARU

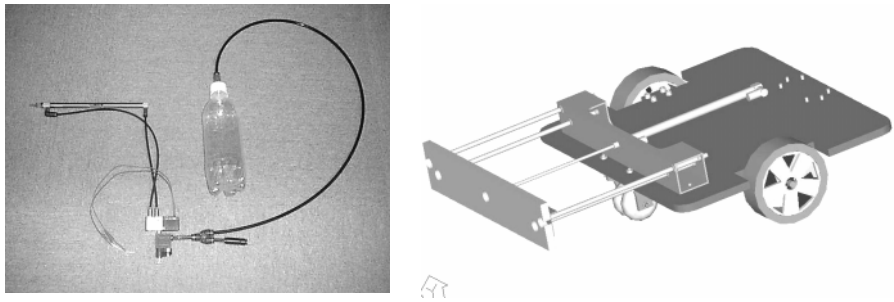
2. Architecture

We developed the actuator system and the interface system for RoboCup-99.

2.1 Actuator System

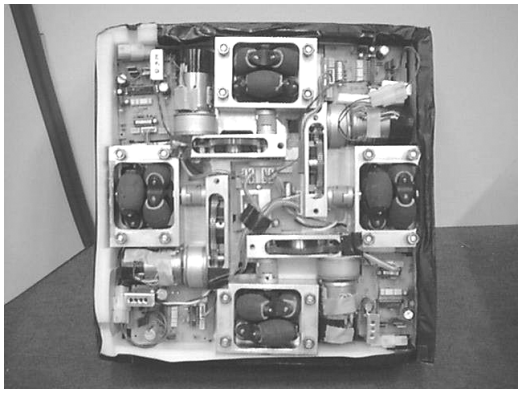
Kicking Device: The kicking device is composed of an air tank, an electric valve and an air cylinder as shown in Fig.2 (a) and installation as shown in Fig.2 (b).

Omnidirectional Mobile System: The omnidirectional mobile system has been developed for two of our robots (the rest of robots are conventional mobile system). This type of system has also adopted by several teams, e.g. RMIT[3], Uttori United [2]. Those teams have developed a new system. Our system is conventional, however the reliability is very high and the max speed 2.0m/s is expected. There are 4 pairs of omniwheels as shown in Fig.3 (b) and 4 DC gearmotors as shown in Fig.3 (a). Each pair of omniwheels is simply driven by the DC motor.

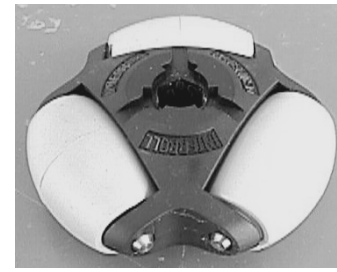


(a) Kicking Device (b) Kicking Device and Base

Fig. 2. Kicking device



(a) Omnidirectional Base



(b) Omniwheel

Fig. 3. Omniwheel

2.2 Interface System

Interface System: A small notebook computer is suitable for a processing system of the mobile robot. Because it is reliable and self-contained.

However, the interface system between the PC and other devices (sensors, motors) is few and expensive on the market. Therefore we developed the interface system composed of a hub and motor drivers.

Fig.4 shows the hardware architecture of our interface system. The interface system can be two-way communication. The character of the interface system is that each device is connected by a serial bus with the SPI (Serial Peripheral Interface) protocol [4]. It provides support for a high bandwidth (1 Mbps) network connection amongst CPUs and other devices.

Hub: The hub unit transforms a signal between PC and the device (motor drivers, sensors). Hub unit works as the FIFO buffer, too. Power of the devices is supplied from the hub unit. Therefore it is need only one cable, when we increase a new device. The communication speed between the hub unit and the device is about 10 Kbps.

Motor Driver: It is the H-bridge PWM motor driver. The control unit of the motor driver is composed of the PIC micro controller (PIC16F84)[5]. Therefore, it gives intelligent PWM control for a DC motor. The frequency and the resolution of PWM are about 1 kHz and 5Bit. The frequency of PWM is low, but it is sufficient for the middle size league and easy to clock up by replacing the micro controller. The cost of the motor driver is less than $50.

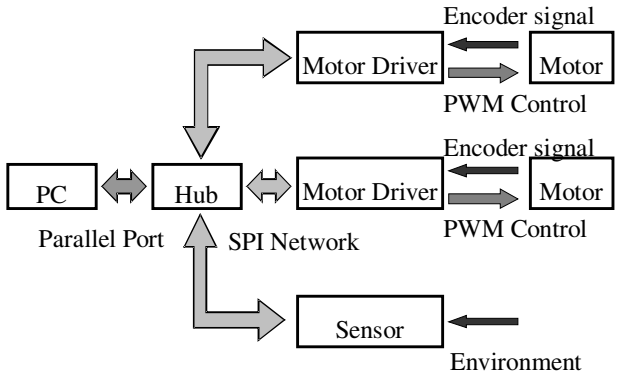


Fig. 4. Interface System

3. Conclusions

This article presents the details of our team. RoboCup-99 is our first challenge. We have been spent a lot of time to build our robots. Developing a reliable and suited robot platform for the soccer game is very important not only to win the competition, but also to make the study.

Therefore, we have developed the interface system, the kicking device and the omnidirectional base. They are indispensable to accomplish the pass-based tactics.

Acknowledgements

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[4] The serial peripheral interface (SPI): http://mot-sps.com/
[5] PIC micro controller: http://www.microchip.com/