Skuba 2008 Team Description

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Abstract. In this paper we describe the Skuba Small-Size League team, which are designed to meet the rules for participation in the RoboCup World Championship 2008 in Suzhou, China. The overview describes both the robot hardware and the overall software architecture of our team..

Keywords: Small-size, Robocup, Vision, Robot Control, Artificial Intelligence.

1 Introduction.

RoboCup is an international joint project to promote AI, robotics and computer vision. In the Small Size League, two teams of five robots, which are 18 cm in diameter, play soccer on a 4.7 by 6.6 m carpeted soccer field.

We have a team in the Small Size League (SSL) with four main components: the vision system, the AI system, five robots and the referee box.

The vision system process two video signals from the cameras mounted on top of the field. It computes the positions and the orientations of the ball and robots on the field then transmit the information back to the AI system.

The AI system receives the information and makes strategic decisions. The decisions are converted to commands that are sent back to the robots via a wireless link. The robots execute these commands and set actions as ordered by the AI system.

In this paper we analyze these some main topics. In the following section we give an overview of our robot hardware. In the second section we describe the vision system. And in the third section we explain our AI architecture.

2 Robots

The 2008 robots have been built using four Maxon 30 Watt brushless motors with external gear head. The angles of the wheels are located at 33,147,225 and 315 degree of each robot. The chassis is built of aluminum and has low weight. The motors have been attached to the chassis. The size of robot has a diameter of 178 mm and a height of 144mm. The dribbler cover to 20% of the ball.

The control of the hardware is done by a Spartan3 FPGA from Xilinx. This FPGA executes the low level motor control loop that can be configured independently for a variety of tasks, including quadrature decoding and Pulse Width Modulation (PWM) generation. We use the rate gyro and accelerometer from Analog Device to measure the angular velocity and acceleration of the robot.

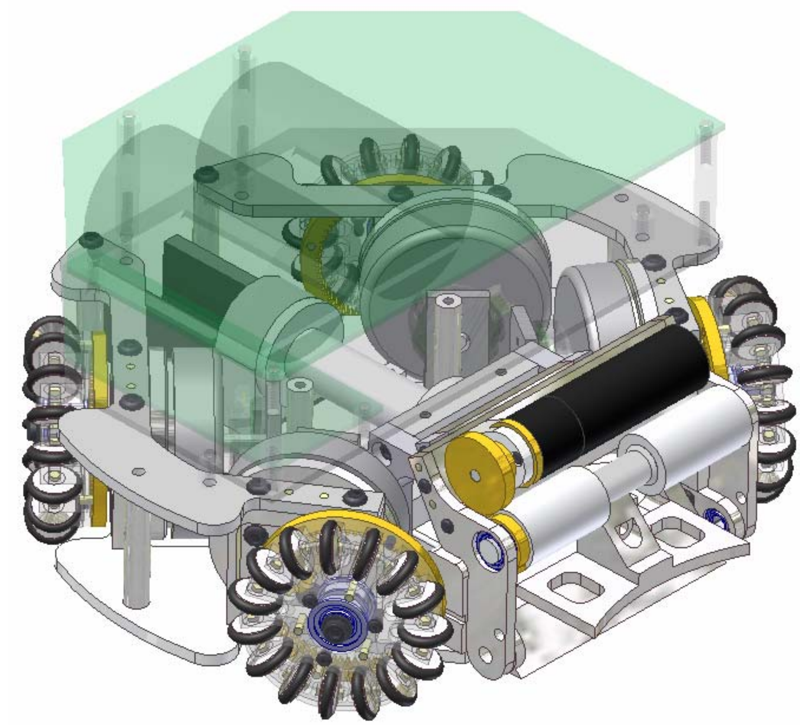

Fig.1. Skuba's 2008 Robot

3 Vision System

The main problem with the vision system was the latency that is the time it takes from when an image is first captured until object information from that image is sent to the AI computer. Testing revealed that the last vision system had a latency of 6 frames (about 120 milliseconds). Currently, we solve the latency problem by filtering and prediction of vision data. Our vision structure diagram is shown in figure 2.

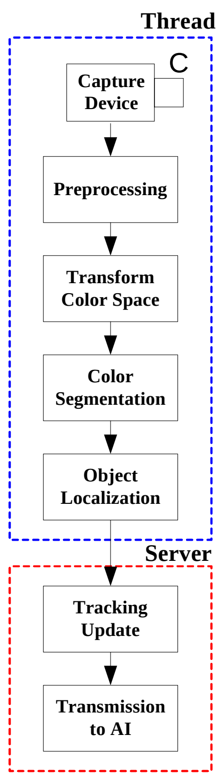

Fig.2. Vision Structure

- **Capture Device.** The Skuba vision apply the global vision and use the output signal of a top-mounted PAL camera as the input signal of a low cost capture card. We employ 3CCD camcorder which is capable of grabbing 640 x 240 images at 50 Hz (interlace)
- **Preprocessing.** The preprocessing is used to improve the quality of the image.
- **Transform Color Space.** We transform color model to the HSV space, which consists of a hue, a saturate and a value. The HSV space is more stable than RGB space in different light properties.
- **Color Segmentation.** The color segmentation assigns each image pixel into color classes. Currently, we classify and segment color by CMVision2.1 library [10].
- **Object localization.** After color segmentation, we receive all the color regions. The filtering process discards incorrect regions. Then, object localization computes the position and orientation of objects in the field from the final regions.
- **Tracking Update.** Objects which is received from localization has a lot of noise, so we need to track it. Our approach is working by The Extended Kalman-Bucy Filter.
- **Transmit to AI.** This component consists of network link used for communication between the vision system and the AI system that process on separate PC.

3.1 Camera Calibration

Camera calibration is a part in Object localization. We compute the internal and external parameters of the cameras using the Tsai [3] algorithm. These parameters are used to correct the distortion produced by the camera lenses.

4 Multilayer, Learning-based Artificial Intelligence

We use a multi-layered learning based agent architecture which has been applied to the RoboCup domain. Upper layer are used to control the activation and priority of behaviors in layers below, and only the lowest layer interacts directly with the robot.

We developed our strategy structure based on “StrategyModule” from Cornell Big Red 2002.

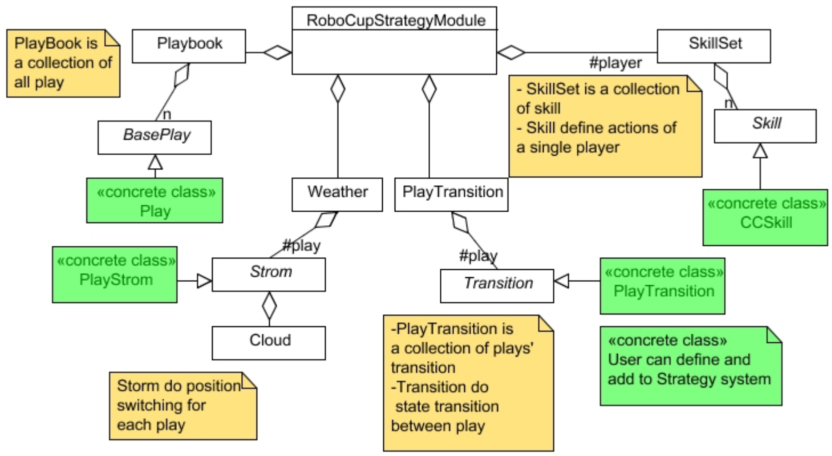

Fig.3. Strategy Structure

4.1 Play

Play illustrates a specific global state of the AI and the general goal the positions are attempting to achieve at a given time. The system will transit from one play to another by learning-based method. We score the successful play more than the failed play.

4.2 Skill

Skill is a basic action of robot, such as “MoveToBallskill” or “Kickskill”. We can use a Neural Network for train each skill independently for the best efficiency.

5 Conclusion

The new hardware and software design has improved the speed, precision, and flexibility of our robots. With some filters, we could acquire precisely coordinates of all players. The simulator can be used efficiently to help developing both hardware and software. We hope our team would be qualified so we can play and share experience with other teams around the world.

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