Sharif CESR Small Size Robocup 2002 Team

Mohammad Taghi Manzuri[1]
Pooya Karimian[1], Mehran Motamed[1], Roozbeh Mottaghi[1], Payam
Sabzmeydani[1], and Reza Taghipour Paein Koulaei[2]

[1] Department of Computer Engineering,
Sharif University of Technology, Tehran, Iran
manzuri@sharif.edu
[2] School of Mechanical Engineering / Naval Architecture
Sharif University of Technology, Tehran, Iran,

http://ce.sharif.edu/robocup/small

Abstract. This paper describes the Sharif CESR Robocup Team, which
is going to participate in Robocup 2002 small size league in Fukuoka,
Japan.

1   Introduction

Last year, the Sharif CESR team participated in the Robocup small size league
in Seattle, USA. although it was the first appearance of our team in such com-
petitions, we could introduce some new aspects, such as air-kicking, and using
the combined CPLD-DSP architectures for Digital control, as well as, for the on
board decision-making and telecommunication [Manzuri, M.T., et al.].

Based on our experiences in the last year, we reviewed our system, basically,
and made some important modifications in it. This paper explains the overall
architecture of our robotic soccer system. Fig. 1 gives an overlook of such system.

The paper begins with the explanation of the mechanical modules of our
robots, and introduces the new mechanical elements. Next, we consider the soft-
ware components of the system, and give some details over our research-aims
in this field. Finally, we explain the control and hardware components of our
system, and compare them with those of the last year.

2   Mechanics

The main activities in the mechanical branch can be divided into two parts.
First, we are working on electro-mechanical, as well as, electro-pneumatic kick-
ers. Moreover, we are going to produce two teams of omni-directional robots,
capable of performing homonymous movements, so that we can arrange for a
pre-contest match to evaluate the possible flaws in our robotic soccer system.
Last year experiences in Seattle contest revealed some difficulties in our electro-
pneumatic kicker module. One of them was that the power of the actuator was

not under the control, so that we could not switch between pass and long goal kicking procedures, arbitrarily. Moreover, due to some reasons we were not able to maintain a constant power for our kicking system. Based on the abovementioned statements, we improved our previous robots, using more powerful and reliable kicker modules. besides, we are working on our new electro-mechanical kicker, which will be installed on our new omni-directional robots. The new kicker includes a spring-mass part, powered by a DC electro-motor. The DC motor charges the kicker by pressing the spring, while pulling the mass. By this way we can get a proportional power kicker module. About the electro-pneumatic module, everything is as like as the old one, except that we have added an extra linked air-supply. Furthermore, we are going to implement a new chip-kick by working on an improved profile, which would match the rules of F180 league [Robocup Rules, 2001].
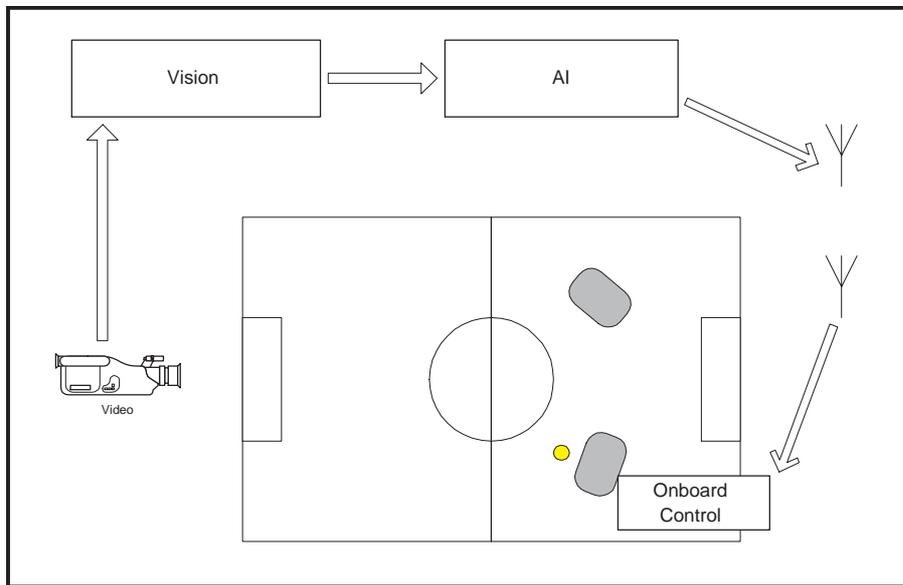

Fig. 1. An overlook from a robotic soccer system with global vision.

3 Software Section

3.1 Vision

As specified in Robocup F180 rules, teams can decide between local or global vision. We have considered the global vision and we have used a PAL 25fps camera as the image sensor, but we are looking forward using a 60fps RGB camera. As all the objects (i.e. ball and robots) are color coded we find them by finding specific color regions.

Our previous image-processing and vision module used LUT-based color segmentation. A problem of this method, which has been increased by the expansion

of the match-field, is that the color properties differ from point to point of the field, because of the lighting conditions.

We are now working to complete a new technique for color segmentation. In this technique an offline image processing section will help the real-time vision-process, by providing it with color information, which are properties of each color (found by some time consuming but precise algorithms). These properties can contain both the ranges, in a specific color space, and the position, where these information are valid. This will help our vision program to find the colored blobs, completely and precisely, without loosing the real-time speed. This offline calibration tool can be performed once before the game start, or can be used as a parallel process which will update the color segmentation properties in the real-time process, once in a while.

After finding the color regions, a blob filter is used to filter the undesired blobs, which don't meet the objects specifications.

The next step is to fill the World-Model. World-Model is a virtual structure, which contains all of the information about the real world. World-Model is the only shared object between all parts of our program.

3.2   Decision Making

In this part, the World-Model, which is filled with the information from vision part, is transferred over the network using UDP/IP protocol to another computer which runs the decision making algorithms.

Due to the latencies in vision, network transferring, decision making, wireless modules, and robot hardware, an overall system latency has been observed, which is about 120ms (3 frames). For overcoming this problem we have a prediction module which fills the World-Model with the predicted positions of the ball and the robots. The next position of the ball is predicted by implementing a Kalman filter, which uses the direction and the speed of the ball in the previous frames, as inputs.

We have a global coach that determines the strategy of the team. After this, each robot agent is provided with some specific inputs, like the information of the World-Model, the coach decisions, and etc. Based on these inputs each agent makes some decisions, and these decisions will be converted to the necessary displacements for the robots, and then transmitted to their on-board control unit.

For decision making, we use position estimation functions which estimate and predict the events going to be happened. For example how much time needs each robot (team mate or opponent) to reach the ball. We use physical formulas for these predictions and estimations.

4   Hardware and Control Section

The hardware architecture of the Sharif CESR 2002 robots has been changed from that of 2001. The major changes have been made into the processing core

and the power supply board. These sections, together with the motor driver section, are described below.

4.1   On-board control unit

In the first generation of our robots, we used a DSP processor as the computation core and PID controller, and a CPLD for carrying out the subsidiary tasks. Because of some practical limitations, this year we decided to use the ATMEL's FPSLIC System-on-Chip (SoC) devices to implement the PID controller, telecommunication interface, and also any other data and signal processing which should be considered on-board.

The independent implementation of the three PIDs on the three wheels has some drawbacks. The most serious one is that the settling time of each one is different from the others. Because of this, the robot shows some undesirable movements, e.g. spinning at the end of a movement. There is an idea to consider the whole of a robot as a system to be controlled. This will eliminate the different settling time consideration, and therefore ensures the proper movement. Currently we are working on this issue.

4.2   Power Supply

Choosing the right power supply for robots, that should be small in size and low in weight, is a critical engineering issue. We are currently going to complete a design that minimizes the size of the batteries, while providing the same power for robots.

4.3   Motor Driver

As before, we have used the L298 dual H-bridge motor-drivers to drive the DC motors of each robot; but, this year we have five DC motors to drive, in contrast to the previous year that each robot had two DC motors, only.

4.4   Telecommunication

RPC modules are used for the remote communication between the robots the intelligent host. These modules are half-duplex and are working in 418MHz, as well as 433MHz bands.

References

[Manzuri, M.T., et al.] Sharif CESR Small Size Robocup Team. Robocup 2001: Robot Soccer World Cup V, Lecture Notes in Computer Science, Springer, (2002)

[Robocup Rules, 2001] The Robocup Federation. Robocup Regulations and Rules, http://www.robocup.org