Building Robots for RoboCup Small-Size Category MauaBots Team

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***Abstract*— This paper describes the development of the system and the robots by the MauaBots team, from "Instituto Mauá de Tecnologia - IMT" in order to participate in the RoboCup Small-Size category of LARC (Latin American Robotics Competition) in 2010.**

I. Introduction

THE main objective of the project "Development of Autonomous Robots" at Mauá Institute of Technology - IMT is the development of researches related to autonomous robotics including the publication of papers [1] – [6] and to promote researches in several areas, as for instance, mechatronics, artificial intelligence and image processing [7], [8] and [9].

Robotics competitions provides motivation, a great incentive for students and encourage the development of researches.

This year (2010) the first MauaBots team for robots soccer competition (F-180 league RoboCup SSL - Small Size League) was formed. This category shows five robots teams with up to 150 mm high and diameter up to 180 mm (including the goalkeeper) as illustrated at Figure 1, which allow the use of local vision (video camera embedded on robot's body), that can be used as a model for the development of others applications. The main idea is to design a system with the robots that is able to capture images, to process them individually, and to take decisions based on a set of informations.

Fig. 1. Robot of F-180 category.

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This year the competition requires from all the teams the use of a standard global vision system (SSL -Vision System). To attend this requirement, the work arena needs a camera positioned above the field that collects images of the area. Those images are sent to a computer with an open source software that identifies the robots position (including the opponents) and the ball. The teams have to develop a strategic logic (by means of a dedicated software) that must decides which action each robot should take (to move forward, backward, to kick, to turn around, etc.).

II. The Robots

At the beginning of competitions, the Small-Size League was able to use local or global vision system as a way to communicate with the robots and to monitor the opponents. Now, however, the global vision system is the only option. The control movements of MauaBots is defined by commands sent from a personal computer by means of a wireless system based on modules based on the ZigBee® technology (Figure 2).

Fig. 2. ZigBee® Module.

The mechanical structure of the robot is illustrated at Figure 3. The system includes motoredutors Maia G6242-201 DC, omnidiretional wheels with diameter of 51 mm, an encoder, a kicker and a dribbler.

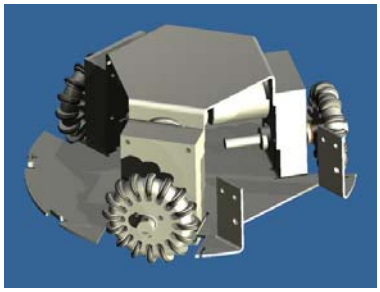

Fig. 3. Mechanical structure of the robot.

The dribbler mechanism is illustrated at Figure 4 and includes two cones, a Faulhaber 1516012S DC motor, pulleys and O-ring.

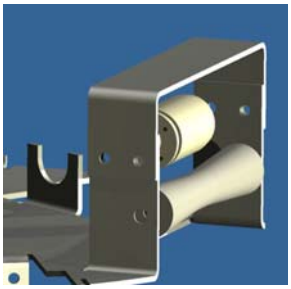

Fig. 4. Dribbler mechanism.

The kicker (Figure 5) presents a solenoid that permits to control the movement of a bar. Also, carries the kick mechanism.

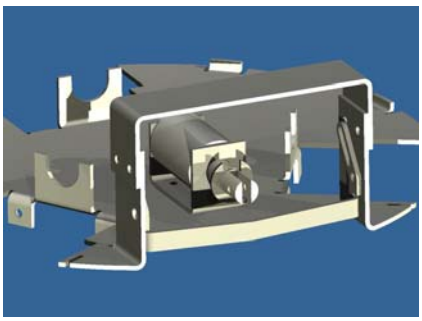

Fig. 5. Kicker mechanism.

The complete structure of the robot: the base fixes a battery pack and the electronic circuit, as illustrated at Figure 6.

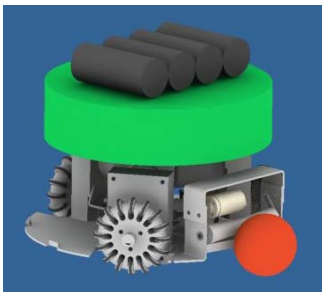

Fig. 6. Robot of "Small-Size League".

III. Electronic Circuit

The layout of the electronic circuit of the robot is presented at Figure 7. The circuit includes:

- a microcontroller ds PIC30F3010;
- a XBEE module for wireless communication (ZigBee® technology);
- an amplifier circuit based on L298 integrated circuit for motor drive;
- voltage regulators;
- optocouplers;
- signaling devices; etc.

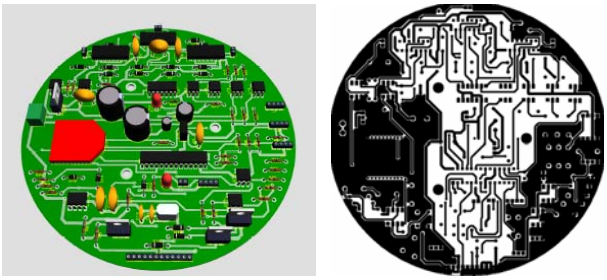

Fig. 7. Layout of the electronic circuit.

IV. Strategy Program

The strategy program developed in Delphi® includes:

- the communication protocol, used to data transfer between a personal computer and the robot;
- tests platform based on the interface presented at Figure 8;
- adjust of PID parameters for motors control;
- calculus to obtain the speed vectors at each motor based on the speed (and on the needed angle) to act at robot omni directional wheels; etc.

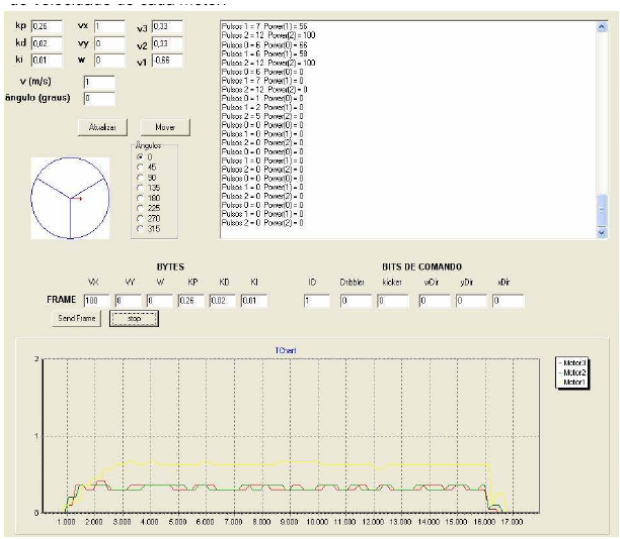

Fig. 8. Strategy Program Developed in Delphi®

The communication protocol is transmitted twice and includes the variables VX (speed of motor X), VY (speed of motor Y), VW (speed of motor W), the PID parameters

KD, KP and KI, the identification of the robot to be controlled (ID) and commands for the dribbler and the kicker systems.

The dedicated software was developed in a dsPIC microcontroller.

The intelligence of the strategy team has been developed based on the experience of our participation in several competitions at IEEE Very Small Robot Soccer [3], [4], but fixing some parameters as, for instance, dimensions of the field and the ball, the speed of the robots, and the number of robots among others.

The vision computational system is based on SSL-Vision and can be used in Linux or by means of a virtual machine. Informations about the system and the rules of competition can be obtained at http://small-size.informatik.uni-bremen.de.

V. Conclusion

This TDP (Team Description Paper) describes the overall system developed to take part on RoboCup SSL (Small Size League) including the structure of our robots, the electronic circuits, the strategy software running in the computer, as well as the microcontroller software, among other characteristics of the team. Surely, others groups would be interested in reading about.

Many steps have to be accurately developed until the effective participation in the competition. By the way, the initial projects have been already developed and the steps ahead are being forwarded.

Acknowledgment

The authors thank the Instituto Mauá de Tecnologia – IMT for sponsorship, scholarships for Scientific Initiation students and financial support to the project.

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