A Robotic Classifier System Including Computer Vision

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***Abstract*— This paper describes the development of a robot including computational vision system by the MauaBots team, from "Instituto Mauá de Tecnologia" in order to participate in the IEEE Open category of LARC (Latin American Robotics Competition) in 2010.**

I. Introduction

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

The promotion of robotics competitions provides a great incentive for students and promotes the stimulus to the development of researches.

Within this context, during the year 2006, the Maua students constructed the first robot using local vision system, as illustrated at Figure 1. The robot used a solution developed by the Carnegie Mellon University: the CMUCam2.

Today, the robot being built to join the robotics competition in Open category will also use the CMUCam2.

This paper describes the solution being developed by MauaBots team, the structure of the robot being built and the computer vision system used.

Fig. 1. Robot of Open category – 2006.

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II. The Competition

In the IEEE Open category the goal is to build a program for autonomous robot to perform relatively complex tasks, without human intervention. Each year the task to be performed by the robot is different, but generally involve the detection of obstacles, the mapping on the environment and identifying objects by color and move them. This year the main goal is build a classifier robot designed to perform the classification of objects composed by cubes with five different colors: cyan, red, yellow, green and magenta. The robot must have moving parts that allow handle the objects that are initially distributed in groups of 12 units of each color stacked in the "producer's zone" as illustrated in Figure 2.

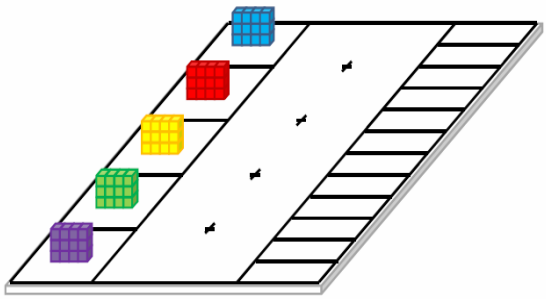

Fig. 2. Competition scenario – Initial positions of objects.

The robot must locate and move the objects and put them in the "vendor's zone", forming small rows composed by 05 objects, one for each color, lined up properly in the correct order, as illustrated in Figure 2.

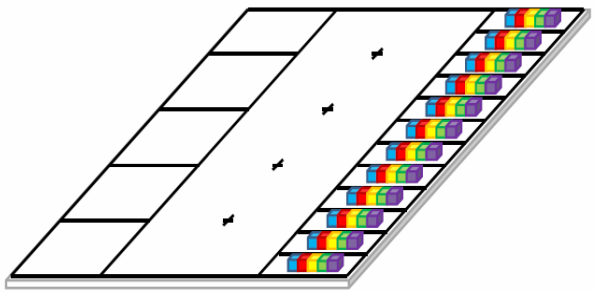

Fig. 3. Competition scenario – Final desired positions of objects.

The scenario was designed in Maua Institute of Technology for test the programming in robot.

III. The Robot

The robot being built for the competition is illustrated at Figure 4. The robot has structure constructed using aluminum and mechanical arm mounted with acrylic plates. The movement of robot is achieved by moto-redutor drives and using omnidirectional wheels. Thus, is possible to move in all directions with agility and relatively high speed. Figure 5 illustrates the motor used and the omnidirectional wheels developed.

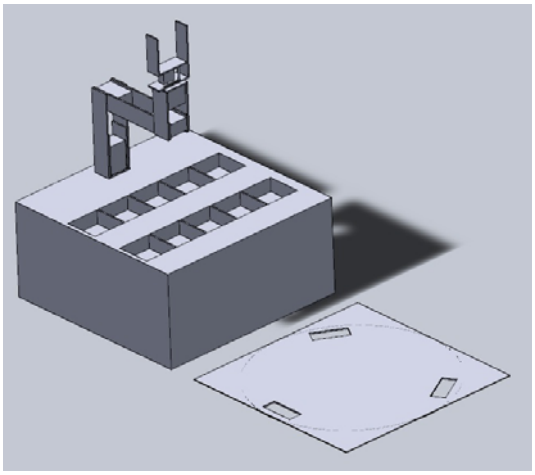

Fig. 4. Design of Robot for IEEE Open Competition.

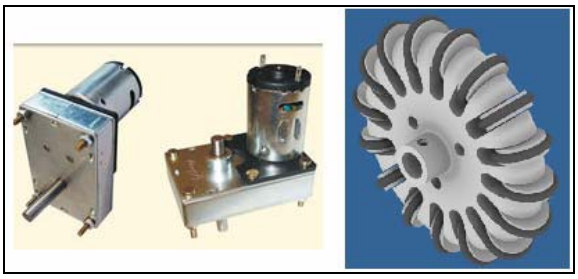

Fig. 5. Moto-redutor and omnidirectional wheel.

On the mechanical arm there are three servomotors that allow 3 DOF (degree of freedom) and turn more easily the transfer. Figure 6 illustrates the servomotors used on mechanical arm. Using these servomotors is possible handle the objects and put them on the hole, in the base of robot. In order to hold the pieces a clamshell, built in acrylics but also using LEGO bricks, is used.

Optic sensors are used to identify the line marking the floor and allow the robot be located within each region of the scenario.

Fig. 6. Servomotors used in mechanical arm.

IV. The Computational Vision System

The computational vision system is developed using a CMUCam2 (Figure 7). The image processing is relatively easy using this solution because it has features that simplify the search for objects. It is possible isolate one color and the CMUCam2 return by serial communication the relative position of the object detected within the field of vision.

Fig. 7. CMUCam2.

V. Electronic Circuit

The electronic circuit and the programming for application it will be developed using the board Arduino 2009 (Figure 8) that can be programmed directly by USB.

The drive of moto-redutors consists of integrated circuits L298 that allow to control by PWM and control signals the speed and direction of rotation for motors, and consequently the speed and angle for the movement of robot according to the signals produced by sensors and camera.

Fig. 8. Arduino 2009.

VI. Conclusion

This TDP (Team Description Paper) presented describe the robot being built for participating in IEEE Open robotic competition including the mechanical structure, the electronic circuit and the computational vision system used, among other characteristics that others teams would be interested in reading about.

Many steps still to be accurately developed until the effective participation in the competition. But, the initial projects have already been developed and the next steps 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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