EDROM Humanoid Robot Racing- Team Description Paper

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***Abstract*— This paper describes the development, architecture and programming of the project Humanoid Robot Racing, by the group of students named EDROM, from the University of Uberlândia, Brazil, Minas Gerais. Hope is a robot competing on the LARC 2012 Humanoid Robot Racing Child Size Category. The main ideas for the robot to complete its task are shown here.**

***Keywords*— Robots, competition, CBR, LARC, IEEE, Humanoid, UFU, EDROM.**

I. Introduction

EDROM (Equipe de Desenvolvimento em Robótica Móvel) is a team that develops automated robots for the Universidade Federal de Uberlândia. This team developed the project Hope for the Latin American Robotic Competition (LARC) in 2012 and the robot will also be used in the RoboCup Humanoid league and Humanoid Robot Racing.

The category chosen by the team is the IEEE Humanoid Robot Racing Child Size [7]. The proposed task in this new category is to make a humanoid robot try, from the START AREA, to reach the FINISH LINE. To accomplish the task, the robot can walk, run and even jump. In this sense are developed concepts such as motor coordination and balance of humanoid robots.

The team decided to take part of this new category especially because it is possible to use the same robot that is used to play the RoboCup Humanoid Soccer category [1]. Although it was necessary to make a few changes relative to programming and dynamic balance.

The robot was made based on the commercial Bioloid kit, however its controller cannot support a camera, thinking of that, was decided to change to a more powerful one, which will be discussed further on. The battery was changed as well. The battery that comes with the bioloid kit is only 900mAH, we changed to a Li-Po battery with 2200mAH, and it will be well explained later.

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II. Physical Structure

2.1 Bioloid

The robot is based on a Bioloid Comprehensive Kit, with a changes to its structure.

Figure 1: Bioloid robot

This robot was chosen for its strong structure, strong motors and its price. It has 18 motors, being 6 in each leg, and 3 in each arm. Each of the servos can delivery as much as 16,5Kgf*cm, and it has 0.35º of resolution.

Besides the 18 servo-motors originally found in the bioloid kit, was added two more for the head movements, and they are controlled by PWM.

2.2 Roboard Controller.

The chosen controller was Roboard RB-110 for its capacity to support Linux, which will be used to along with several libraries, like OpenCV and RoboIO. The controller has 1 GHz, and 250Mb DDR 2 memory, it accepts a SD card to be its "Hard Drive".

The Linux operating system was chosen because of its compatibility with OpenCV and it runs smoothly.

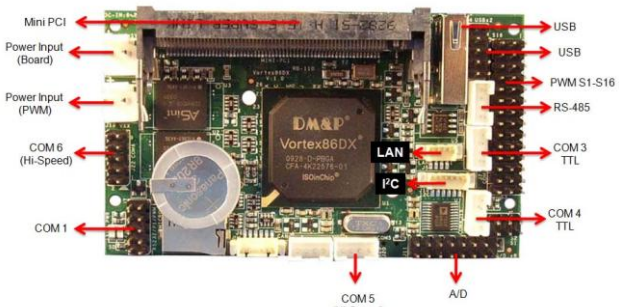

Figure 2: RB-110

As can be seen, this controller can be treated as a computer. To complement this there is a graphic card that goes in the Mini PCI input.

Figure 3: Mini PCI card for RB-110

2.3 Minoru 3D Camera.

This camera was chosen so, that the distance can be easily calculated, it will give the robot a better knowledge of the ambience surrounding it.

Figure 4: Minoru 3D Camera

The camera with two "eyes" also gives the robot a more friendly face. Whereas the competition is also about bringing robots that are human alike.

2.4 Li-Po Battery.

The battery used is a Lithium-Polymer for being lighter than the others with the same capacity, the one that will be used weights 163 grams and has 2200mAH.

Figure 5: Li-Po Battery

2.5 Sensor.

The sensor that will be used is a PhidgetSpatial 3/3/3, it has a Compass 3-Axis, Gyroscope 3-Axis, Accelerometer 3-Axis. It will be used to determinate if the robot is falling or has fallen, taking the necessary action to reverse this situation.

Figure 6: PhidgetSpatial sensor

III. ASSEMBLY

The main part of Hope, Fig. 7, is made of the Bioloid kit, there are only two parts that were taken off, the original head, and the CM-5 controller.

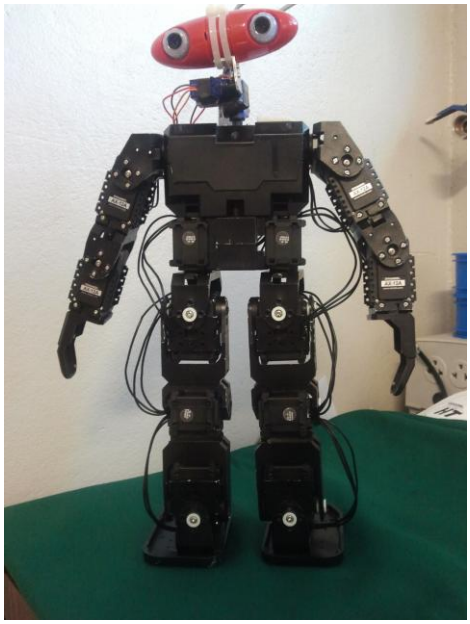

Figure 7: Hope

To assembly the head, was made necessary building its neck movements, that were made with two micro servo-motors. To lock them was used a couple of aluminum parts. And in the top of it the Minoru 3D Camera.

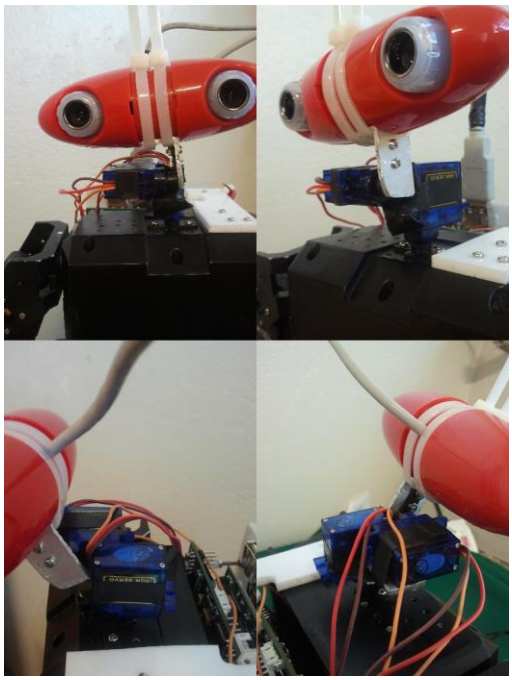

Figure 8: Neck assembly

The team tried several settings to attach the new battery and controller to the robot until reaching the current one. That's because some issues had to be considerate like the protection of the Roboard controller, the ease of removing the battery and the center of gravity of the robot, thinking in its balance.

In the back of the robot, the RB-110 controller was carefully placed, along with power cables, USB cables, motor cables, PWM cables and the PCI mini Graphic card. To protect all of it, was used an acrylic plate. Just beneath the RB-110 was placed the 2200mAH battery.

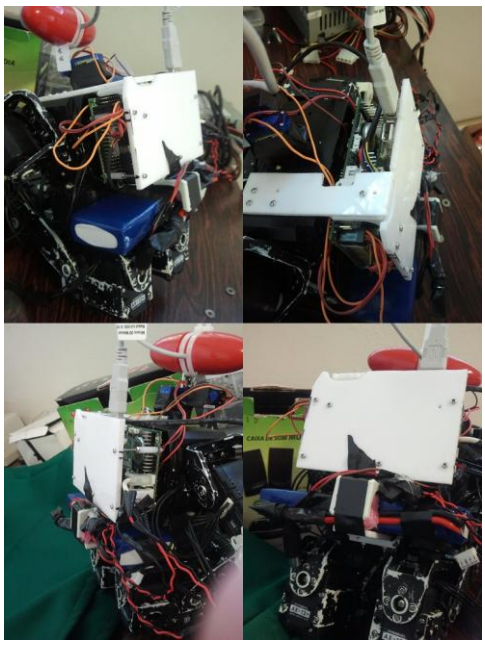

Figure 9: Hope's back

IV. PROGRAMMING

The programming has been divided in two parts, one is the part that moves the bioloid's motors, has been used RoboIO library, this part is made of pages, and each page has one position for every one of the motors. To complement this part it's used the PhidgetSpatial sensor which gives us the possibility to keep the robot upright.

The whole computer vision part of the robot was programmed in the C programming language using the OpenCV library that allows the application of specific filters on images captured by the camera [2, 6].

In order to ensure the trajectory to be straight and unidirectional the robot guides itself through the camera. It sees the central line of the scenery and follow it until the finish line, Fig. 10.

The equations about humanoid trajectories feet can be found in [3-5].

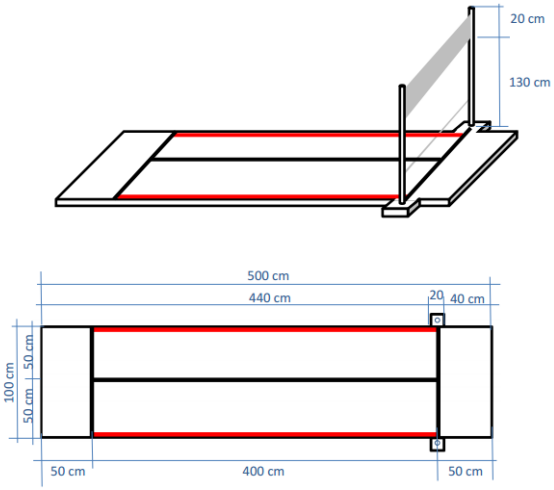

Figure 10: Scenario

According to the rules, the robot which eventually falls down can stand itself up. By reading the gyroscope and accelerometer sensors it is possible to check when the robot falls and through a sequence of moves it can rise independently and reorient in the scenery.

V. CONCLUSION

This paper presents just a brief description of what will be used by our team.

The team makes its first appearance in this category and that represents an unprecedented challenge. This new task required the team an improvement in terms of dynamic balance of the robot. It is expected that these improvements also prove effective in Humanoid Soccer category.

A few changes will still be made to perfect necessary functions so the project has been finished.

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