EDROM Humanoid - Team Description Paper 2013

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Abstract. This paper describes the development, architecture and programming of the project humanoid, by the group named EDROM, from the Federal University of Uberlândia, Brazil. Hope, Lena, Kate and Rose are robots competing on the RoboCup 2013 Humanoid KidSize Category. The main ideas for the robots to complete its task are shown here.

Keywords: Robots, Humanoid , RoboCup, UFU, EDROM.

INTRODUCTION

EDROM (Equipe de Desenvolvimento em Robótica Móvel) is a team that develops automated robots in the Federal University of Uberlândia, Brazil. This team already developed the projects Marta and Hope for the Brazilian's Robotic Competition (CBR) in 2011 in the RoboCup Humanoid league. However the homemade Marta project has been discontinued and Hope has been improved with new controller and camera. In the year of 2012 the project Hope was improved with two other players, Kate and Lena, and a fourth player, Rose, as a backup. Our team commit to participate in the RoboCup 2013 Humanoid League competition and we commit that one person from the team will have sufficient knowledge of the rules and available as referee during the competition.

The category chosen by the team is the RoboCup Humanoid Kid Size, which allows up to three robots playing and two substitutions per game. The height allowed to the robots is from 30 to 60cm. The main purpose is to score goals, to do that, the robots have to walk straight, to turn, to kick, as well as identify its position in the field, the opponent and the ball.

The robots were made based on the commercial Bioloid kit. As its controller could not support a camera, we decided to change to a more powerful one, which will be discussed further on. The battery was changed as well. The one that comes with the Bioloid kit is only 900mAH, therefore we changed to a Li-Po battery with 2200mAH, and it will be well explained later.

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Besides the 18 servo-motors AX12 originally found in the Bioloid kit, was added two more for the head movements, and they are controlled by PWM.

The Competition

The competition is based on a field of 600cm X 400cm, with two yellow goals, with a height of 80cm, Fig. 1 [1-2].

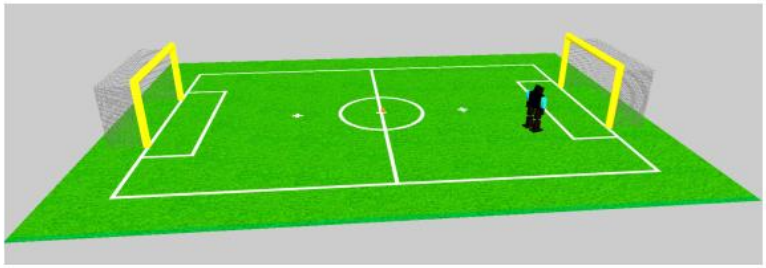


Fig. 1. Match field [1-2].

The ball is a standard size orange tennis ball. A match is played by two teams, each consisting of not more than three players, one of whom must be designed as a goal-keeper.

The robot must be human-like with two legs, two arms, one head, that have to be attached to the trunk. They must be able to walk upright on the legs.

The height of a robot must be between 30cm and 60cm, and given the height of the robot, there are a series of equations to determinate the other robot's dimensions, Fig. 2. Our robots have height of 43 cm.

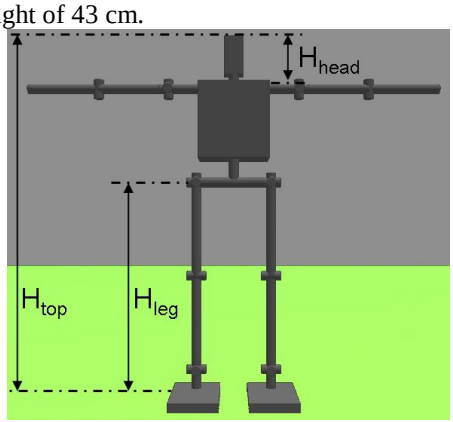


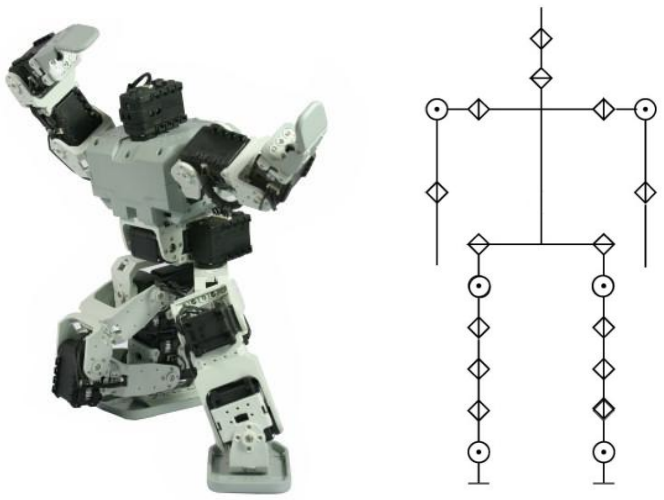
Fig. 2. Robot parameters [1-2].

Each match lasts two equal periods of 10 minutes, with an interval of 5 minutes at half-time.

The team with the greater score is the winner, to score a goal the whole ball needs to pass over the goal line, between the goalposts and under crossbar.

Physical structure

The robot is based on a Bioloid Comprehensive Kit, Fig. 3(a), with changes to its structure.



(a) (b)

Fig. 3. (a) Bioloid robot; (b) Joints scheme.

This robot was chosen for its strong structure, strong motors and 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. The mechanical structure was changed to fix with the dimensional rules of RoboCup 2013.

The chosen controller was Roboard RB-110, Fig. 4, for its capacity to support Linux, which will be used along with several libraries, like OpenCV and RoboIO. The controller has 1Ghz, and 250Mb DDR 2 memory, it accepts a SD micro card to be its "Hard Drive".

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

As can be seen, this controller can be treated as a computer. There is a graphic card as complement, which goes in the Mini PCI input, Fig. 5(a). The communication will be done with mini PCI WiFi, Fig. 5(b).

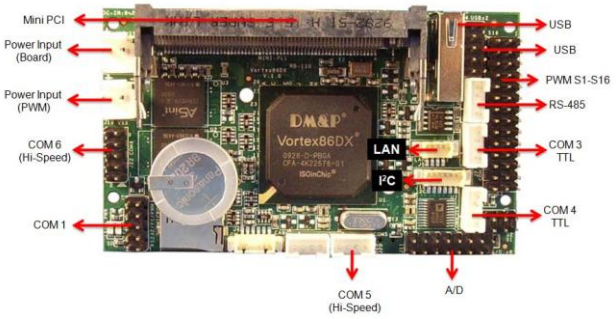


Fig. 4. RB-110.

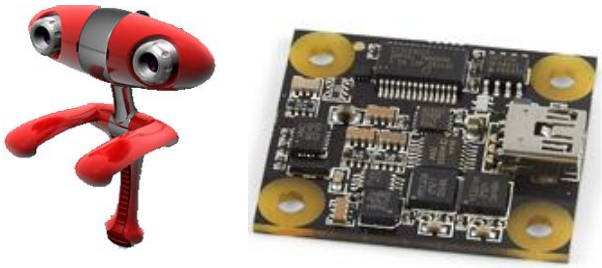
(a) (b)

Fig. 5. (a) Mini PCI card for RB-110; (b) Mini PCI WiFi card.

The camera Minoru 3D was chosen so, that the distance can be easily calculated, it will give the robot a better knowledge of the environment.

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, Fig. 6(a).

The compact sensor used is a PhidgetSpatial 3/3/3, it has a Compass 3-Axis, Gyroscope 3-Axis, Accelerometer 3-Axis, Fig. 6(b). The functions compass is not used. It is used to determinate if the robot is falling or has fallen, taking the necessary action to reverse this situation.



(a) (b)

Fig. 6. (a) Minoru 3D Camera; (b) PhidgetSpatial sensor.

Two Lithium-Polymer batteries were used for being lighter than the others with the same capacity. The first one is for the controller, Fig. 7(a). It has 7.4V and 800mAh, and another one that will be used to move everything else and weights 163 grams and has 11.1V and 2200mAh, Fig. 7(b).

(a) (b)

Fig. 7. (a) Controller's Li-Po Battery; (b) System's Li-Po Battery.

Assembly

The main part of the robots is made of the Bioloid kit. There are two parts that were taken off, the original head, and the CM-5 controller.

We based the head's assembly on the human's head, trying to imitate its movements, which were made with two micro servo-motors. To lock them we used a couple of aluminum parts. And on the top the Minoru 3D Camera was attached, Fig. 8.

The Figure 9 shows the women robot HOPE.

The RB-110 controller, and the two batteries were carefully placed inside the robot's trunk, along with power cables, USB cables, motor cables, PWM cables and the PCI mini Graphic card/wireless card. To protect all of it, we used an acrylic plate. Just beneath the RB-110 was placed the 2200mAH battery, Fig. 10.

Figure 11 shows the team humanoid robots EDROM used in LARC (Latin American Robotics Competition) in the year of 2012.

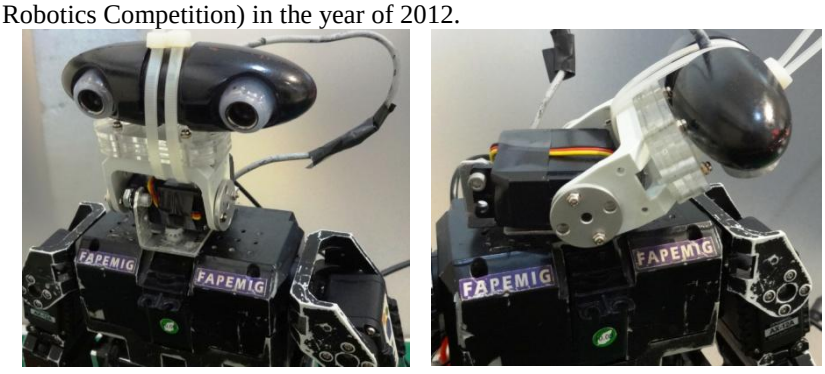


Fig. 8. Neck assembly ROSE.

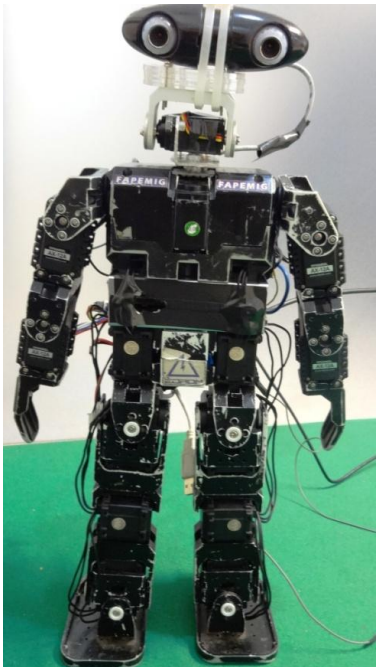


Fig. 9. HOPE.

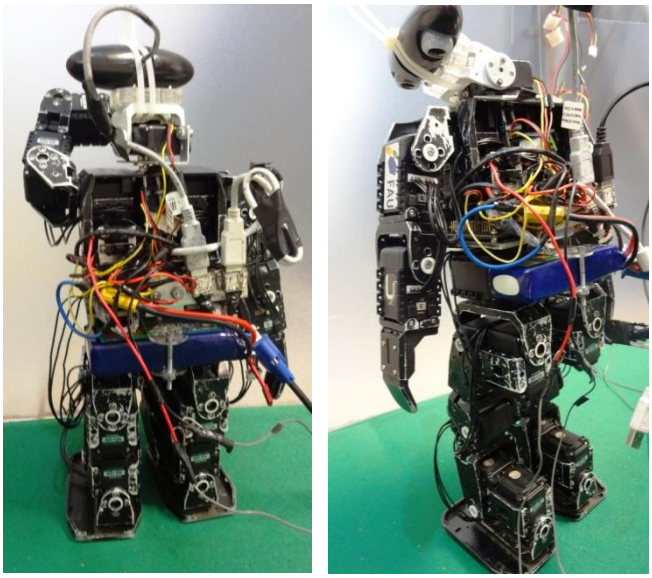


Fig. 10. Back of HOPE.

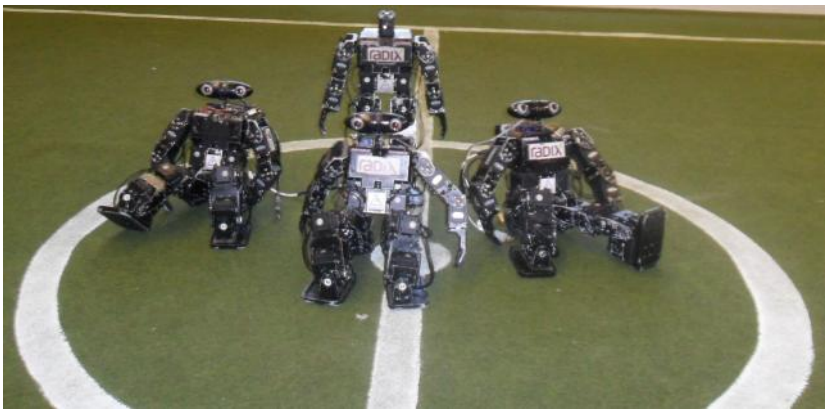


Fig. 11. The team robot EDROM.

Programming

The program code has been divided in two parts. The first one moves the servomotors using the RoboIO library. This part is made of pages, and each page has one position for each motor. To complement this part, the PhidgetSpatial sensor was used, which gives us the possibility to keep the robot upright.

The equations about humanoid trajectories feet can be found in [4-7]. In this stage we used the static equilibrium but dynamics control will be developed.

The second part of the program code is where the camera control is made. This one is where all the decisions are taken, if the robot goes right, left, kicks, or takes any other action.

In order to process all the information given by the camera, OpenCV Library is very important. Although is a free library, it's a very powerful one.

This library is capable of tracking motions, tracking colors, calculate distance of an objects given two different cameras, edge detection, face detection, and many other features that would be pretentious to try talk about them all [3]. Figure 12 shows the ball and goal identification by HOPE.

(a) (b) (c)

Fig. 12. (a) Color detection; (b) Ball detection; (c) Goal detection.

Conclusion

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

A few changes will still be made to improve the main functions so the project can be finished.

Although the team has participated in the CBR 2011, LARC 2011 and LARC2012, this will be a whole new challenge, because the robot will be different from the past year.

Acknowledgment

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