

# PIONEROS MEXICO Team Description Paper

## ROBOCUP 2011 Istambul

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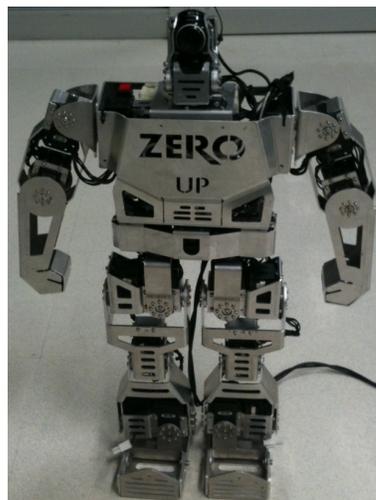
**Abstract.** Here we describe the design and realization of humanoid robots designed and manufactured by students, able to play soccer and make several tasks as walking, identifies objects like a soccer ball and approaches to it and kicks it. Also there will be described not only its primary functions, but all the constraints presented along and characteristics of our design like sizes, components, specifications and design of the structure and electronic system. We are presenting two robots, the player and the goal keeper as second player. This could be the forth time we participated in this League with redesigned and improved robots.

### 1 Introduction

From the beginnings of robotic men had been trying to emulate the movements of human beings. The actual challenge of robotic is to equal the mobility of the human beings, making movements of great complexity and precision. With this project we pretend to develop prosthesis with the objective and possibility that an invalid person could walk again and recover great part of mobility.

Because of the necessity of automation, technology and control have been developed because a lot of tasks or processes are performed via robots, replacing men and keeping always the simplest and most comfortable way to do things, many ideas can be achieved thanks to these machines. As robots are flexible enough to develop many or specific challenges, it's design, manufacturing and testing are important points to take care of.

### 2 Images of the Robots.



**Fig. 2.1.** Zero robot.



**Fig.2.2.**Zero and Oliver Robots

### 3 Mechanical Design

Our robots are build with CAD designed custom-made aluminium parts, powered by Dynamixel [1] servomotors. Each robot has twenty one (21) degrees of freedom:

Head: 2 servomotors, therefore we have 2 (DOF).

Arm: 3 servomotors in each arm, therefore we have 6 (DOF).

Waist: 1 servomotor, therefore we have 1 (DOF).

Ingle: 3 servomotors, therefore we have 6 (DOF).

Knee: 1 servomotor in each knee, therefore we have 2 (DOF).

Ankle: 2 servomotors in each ankle, therefore we have 4 (DOF).



**Fig.3.1.**Dynamixel servomotors

Zero and Oliver have Dynamixel RX64 in the lower part of the body and the Dynamixel RX28 for the upper part of the robot, and Dynamixel RX10 for camera tilt and pan in the head.

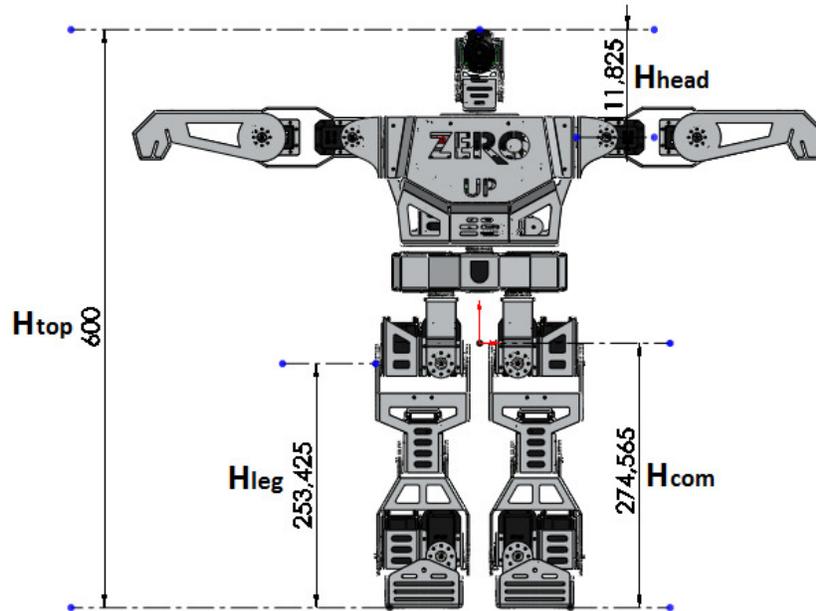


Fig.3.2. Zero Robot designed in SolidWorks®

The algorithms for walking process were made by controlling the ZMP position, calculating the point mass by direct cinematic and repositioning the point mass by inverse cinematic.

## 4 Electronic Specifications

### 4.1 Control system

Zero and Oliver are controlled by a Fit-PC [2], see Fig.4.1. with a Windows Xp® embedded operative system, designed specifically for this application.

The features of the Fit-PC2 are:

- Full-featured PC single board computer, tiny and power saving
- Intel Atom Z530 CPU @ 1.6 GHz
- Intel US15W chipset
- 1GB DDR2

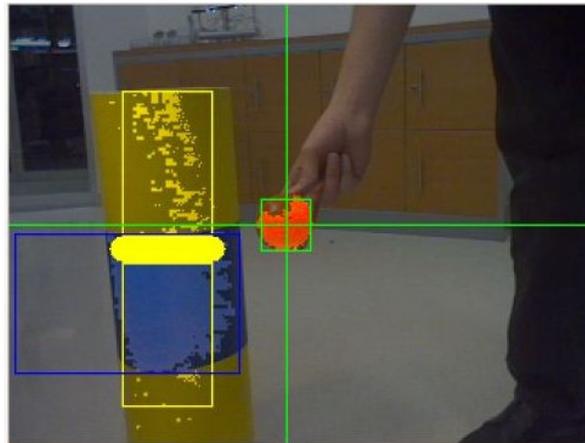
- 802.11b/g/n WiFi
- Six USB 2.0 ports
- GPIOs
- Single 12V supply, 6-9.6W, fanless operation
- Dimensions - 104 x 100.7 x 22.9 mm



**Fig.4.3.** Digital compass

#### **4.2 Vision system**

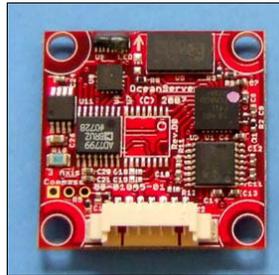
The main sensor placed on the robot's head is a webcam Logitech E3500 with VGA Resolution (640x480 pixels) and 30 frames per second by USB. The images are processed with OpenCV applying principles of morphology for object identification by shape and color. see Fig.4.2.



**Fig.4.2.** Vision system. Object identification.

### 4.3 Digital compass

We also are using a Solid State Tilt Compensated 3 Axis Digital Compass that provides information about the orientation of the robot and acceleration in 3 axis, so it can know at all time where the opposite goal is in a soccer field. This sensor provides information that helps the robots in orientation, to keep them in balance and to detect when a robot falls down. We are using the OS5000-US 3 axis digital compass [4] designed by “OceanServer”, see Fig.4.3.



**Fig.4.3.** Digital compass

## 5 Conclusions

In our last participation in the tournament, Robocup 2010, we realized that we could improve mechanical, electronic and control features. The result of those improvements is Zero reloaded. We began its development in 2010, and we are ready to achieve in Istanbul a better result.

This project made us realize the great complexity of the human nature, not only in its body, but also in its behavior. Trying to emulate a human person has been a great challenge. We gain experience in many science fields like: mathematics, electronics, control and mechanics. It let us discover our different capabilities as well as our weaknesses.

The teamwork is our better strength because we had a lot of problems along the project that we had to solve sometimes briefly, and the way we solved them, which we consider the best one, was the teamwork, since although we were divided in three parts; control system, electronics and mechanics; we helped each other in difficult situations and we never forgot that we were a team. This is not an easy project and it demands many time and sacrifice.

It also help us to understand more about development of prosthesis and the advantages that this offers to does people that need to recover their movements. A very important thing is the fact that we received complete support from our University, part of the budget was supported by them and other resources like electronics and tool labs, computers, software. Another part of the budget was support by sponsors.

## **References**

- [1] Dynamixel servomotors, <http://www.robotis.com/>
- [2] Fit-PC2 Single board PC, <http://www.fit-pc.com/web/>
- [3] Windows XP Embedded OS, <http://msdn.microsoft.com/es-mx/windowseembedded/>
- [4] Ocean Server digital compass, <http://www.ocean-server.com/compass.html>

Logitech Quickcam E3500

Ocean Server OS5000-US Manual

Humanoid League Rules 2010

## **Contacts**

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