# *IAUYAZD Team Description 2013*

## Humanoid KidSize League

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**Abstract.** After 4 years of research and participation in various Robocop events, IAUYAZD Humanoid team has been able to make tremendous improvements. This year, two Darwin-OP robots joined our team. We applied a new dynamic walking method on our previous robots and we have improved the default walking method of Darwin-OP robots. We have added new static motions to improve player's efficiency during the game such as three various kicks, sidekicks, ball-picking, and diving. A new approach toward vision has been added based on fuzzy segmentation; as a result, our robots are able to detect all objects in the field in various light conditions. The robots are able to localize themselves with landmarks and filed lines. Here we present our team description for the 2013 Netherlands competitions.

## 1 Introduction

The IAUYAZD humanoid team started in 2009 in the Yazd Robotic Association at Azad University of Yazd, which has had a successful and long history in RoboCup with the IAUYAZD rescue and de-miner teams. Till 2010, we had participated in several domestic competitions and our first participation in an international competition was back in IranOpen 2010 and after that IranOpen 2011 in which we got the second place in technical challenge and we had also participated at RoboCup 2011 and in the next year we got the forth place at IranOpen 2012.

At first we started with Bioloid[1] robot platform manufactured by Robotis Company[2]. We had made various modifications to the Bioloid platform in order for the robots to become ready for the competitions. These modifications included adding two degree of freedom in the head, using Microsoft Lifecam two-megapixel camera, using Roboard RB-110 as the mainboard, using AX-18 servos in the knee to maximize speed and shoot power. Benefiting from the presence of two Darwin-OP[3] robots which have been designed for taking part in RoboCup competitions, this year the team has concentrated on software design. We improved numerous elements such

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1 http://www.robotis.com/xe/bioloid_en
2 http://www.robotis.com/xe
3 Dynamic Anthropomorphic Robot with Intelligence - Open Platform

as vision system, static motions, dynamic walking, and implemented the robot brain with Final State Machine (FSM).

## 2 Hardware

We use Darwin-OP in our team which has been designed for humanoid kid-size competitions; therefore, we do not need to change robot hardware specifications. Here are the standard Darwin-OP specifications:

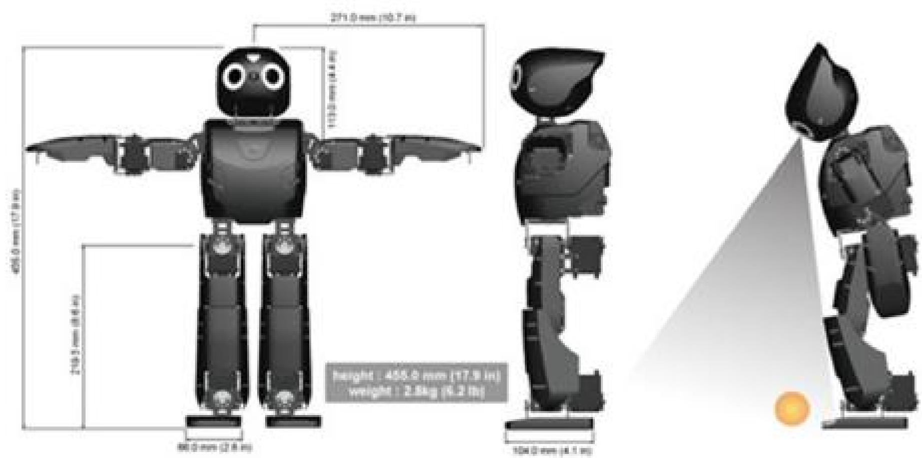

**Fig. 1.** Darwin-OP Figure

| *SPECIFICATIONS (Obtained from botmag.com [1])* | |
|---|---|
| HEIGHT | 455mm (17.9 in.) |
| WEIGHT | 2.8KGS (6.3 lbs) |
| DEFAULT WALKING SPEED | 24.0cm/sec (9.5 in/sec) DEFAULT |
| STAND-UP SPEED :FACING DOWN | 2.8 sec |
| STAND-UP SPEED :FACING UP | 3.9 sec |
| GAIT SPEED | 0.25 sec/step |
| ONBOARD PC | 1.6GHz Intel Atom Z530 with 4GB flash SSD |
| COMMUNICATIONS | 5 LEDs, 2 RGB LEDs, 6 external I/O Ports, 8 external ADC ports, 2 Mbps serial bus; 4.5 Mbps Dynamixel servo bus, |
| MANAGEMENT CONTROLLER (CM-730) | ARM CortexM3 STM32F103RE 72MHz |
| DOF | 20 |

| | |
|---|---|
| STABILIZATION | 3-axis gyro; 3-axis accelerometer |
| POWER | Standby mode for energy conservation, charger and external power adapter external power can be applied while removing battery |

**Table 1.** Darwin-OP Specifications

## 3 Electronic

Darwin-OP comes with a complete package in electronic. The fit-PC2i roles as a main controller that computes all we need. The features of the electronic section mentioned in Table1.

We have CM730 to communicate with all low level devices such as Actuators and IMU. Fig 2 shows the relations between our electronic parts.

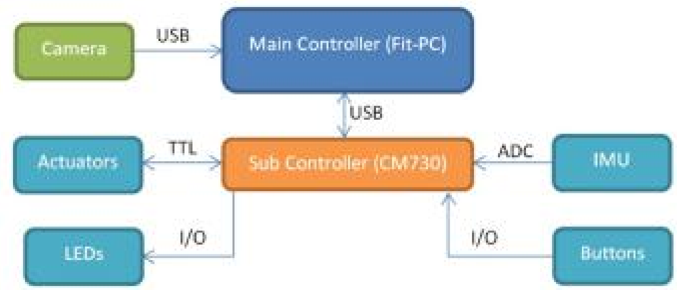


**Fig. 2.** Electronic Block Diagram

## 4 Software

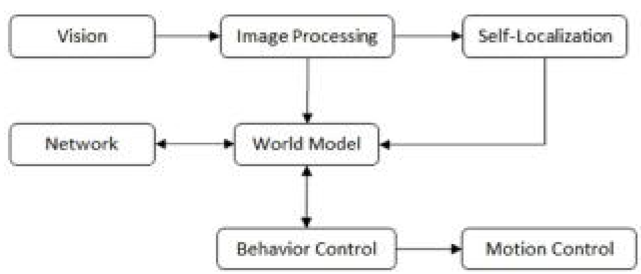


**Fig. 3.** Software main sections

Figure 2 shows the main parts of robot software as a block diagram. Most of the parts run on parallel threads and interact with each other by sending data structures and data stored in world model.

A user interface have been created as an interface for communicate with robots that it Receives and displays logs, game controller data, replies and exchanging world model that robots send over network. And also sends commands and requests to robots.

### 4.1 Image processing

For Robocop 2013 we improved a fuzzy based segmentation algorithm, Gaussian membership functions are used with HSV color space to create a LUT, Gaussian membership functions need to be manually adjusted, but they are almost independent in changing light conditions. We use each RGB pixel value as an index to determine first, which class a pixel belongs to, and second, what the probability of a pixel in that class is. Each class represents one of the seven colors in the field: orange, yellow, blue, green, white, cyan, and magenta. Image resolution is 320*240 pixels and the robot processes 25 frames in a second.

For object extraction, Geometral line [2] is used in order to separate filed from the surroundings; therefore, unnecessary information can be discarded. Objects currently detected are goals, landmark, ball, and filed lines.

### 4.2 World Model

The World Model consists of a set of models and variables. The World Model is updated using data provided by image processing results, localization, game controller, team mate's data over network and behavior controller. Using the previously mentioned data, world model tries to build a model of the outside world, including the objects on the field, the state of the robots, game state, configuration data, and some parameters of behavior controller module.

A subset of data from World Model is exchanged among robots over network. This data integrates with each robot World Model to obtain an accurate image of world around and select the best role for players in the game.

### 4.3 Network

Network module used to receive game controller data and communication among robots and logger system. All transactions over network use UDP protocol.

### 4.4 Behavior control

Using the data provided by the World Model, behavior controller moderates strategy of game and movements of the robot. Behavior controller uses Finite State Machine as a base on which game strategy is defined as a series of states and it uses data from World Model as variables.

## 5 Conclusion

After years of working on humanoid kid size robot, we hope that possessing Darwin-OPs will enable us to fully apply the result of our research on these standard robots. We have also embarked on the voyage to build a hardware platform peculiar to us we will endeavor to apply the outcome of our hard work on the robots for the RoboCup competitions the team wishes to take a step, howsoever small, to upraise the robotic science .

## References


1. Hong, Dennis. "Robotis DARwIn-OP Raises The Bar" May 12 2011: http://find.botmag.com/500105.
2. Gonz´alez S´anchez, Tom´as. *Artificial Vision in the Nao Humanoid Robot.* Diss.Rovira i Virgili University, 2009.