Elecatrón-Laredo – Team Description Paper
Humanoid Kid-Size League, Robocup 2019

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Abstract. In this paper, a general explanation in advances of the implementation of vision systems on Kid-size humanoid robots for playing soccer is presented. The team "Elecatrón_Laredo" presents the characteristics of the robots to get ready for the participation in the upcoming 2019 competition.

1 Introduction

The team "Elecatrón-Laredo" participated in the Robocup 2018 representing the Club Mecatrón of the technological institute of Nuevo Laredo, México. This was our first time in the tournament. Even though the robots didn´t perform as we expected, we acquired a lot of highlights in the changes that our robots needed but most of all we realized the need for a more advanced vision system for the robots.

The group has been working dynamically. The team participated in the Mexican Robotics Tournament 2018 that was held in Monterrey, Nuevo León. The team has also participated with an exposition for primary, secondary and preparatory schools in the COBAT innovation show, in October 2018.
The funds have been an issue, the club has made some activities to buy the components needed for the upgrades. The efforts were focused in the design of a vision system with the help of neural networks.

Commitment
The team ELECATRON-LAREDO commits to participate in RoboCup 2019 in Sidney (Australia) and to provide a referee knowledgeable of the rules of the Humanoid League.

This year, the group has been working on:

a) Designing a neural network system for the robot. This aims to locate the ball in less time.
b) Analyze the center of gravity of the robots while playing soccer.
c) Designing 3D pieces for the robots to make them more robust.

2 Hardware Overview

The specifications of the robots are shown in figures 1-3. The type of the robots is bioloid. The robots use CM-5 and CM-530 control modules.
Each robot has a gyro sensor providing information through serial communication that allows the program to know when the robot has fell down or changed direction. Basically, when the robot tilts and angular velocity increases in a specific direction, the servo motor's value can be adjusted in the opposite direction to straighten the robot.

ROBOT NAME: TACO		
Specification sheet		
Measurement chart.		
Weight	2.017 kg. – 4.4467 lb.	
Height	42.7 cm. – $16^{13/16}$ in.	
technical SPEC		
Motor type	DYNAMIXEL AX-12ª	
Degrees of freedom	20	
Sensor type	GYRO GS-12 HaViMo camera (2.0,3.0)	
CPU	CM- 530	
Walking speed	17 cm./s.	

Figure 1: Robot “TACO”

ROBOT NAME: TITO	
Specification sheet	
Measurement chart.	
Weight	1.912 kg. – 4.2152 lb.
Height	43 cm. – 16 15/16 in.
Technical SPEC	
Motor type	DYNAMIXEL AX-12A
Degrees of freedom	20
Sensor type	GYRO GS-12 HaViMo camera (2.0, 3.0)
CPU	CM- 530
Walking speed	17 cm./s.

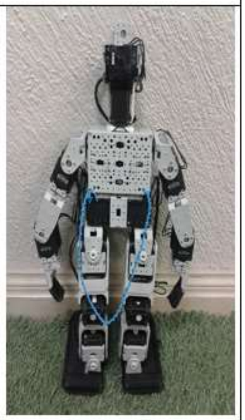

Figure 2: Robot “TITO”

ROBOT NAME: TORO	
Specification sheet	
Measurement chart.	
Weight	1.806 kg. 3.9815 lb.
Height	43.6 cm. – 17 1/4 in.
Technical SPEC	
Motor type	DYNAMIXEL AX-12A
Degrees freedom	20
Sensor type	HaViMo camera (2.0,3.0)
CPU	CM-5
Walking speed	17 cm./s.

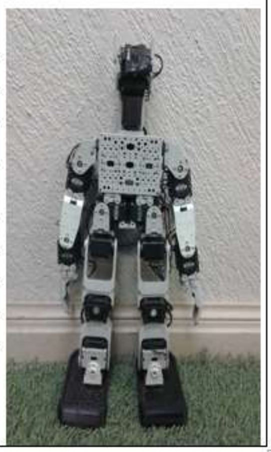

Figure 3: Robot “TORO”

General description of the robot parts are indicated in figure 4.

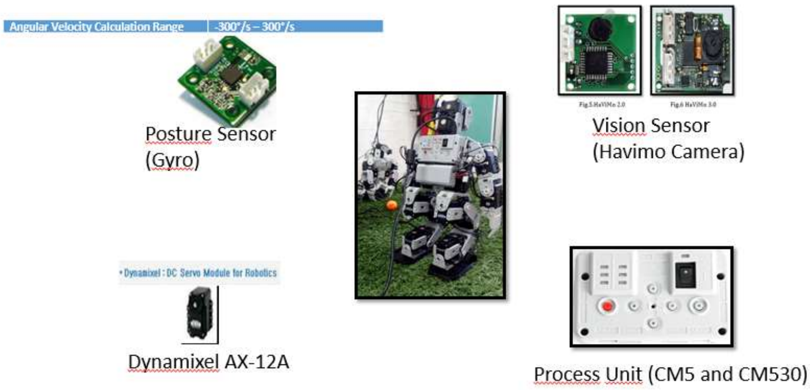

Figure 4: General description of robot parts

One of the modifications made for the robots were their feet. Figure 5a shows the look of one robot before the change. On figure 5b we can see the look of the robot after the change. This modification had to be made to greatly improve the stability of the robot walking on the green carpet.

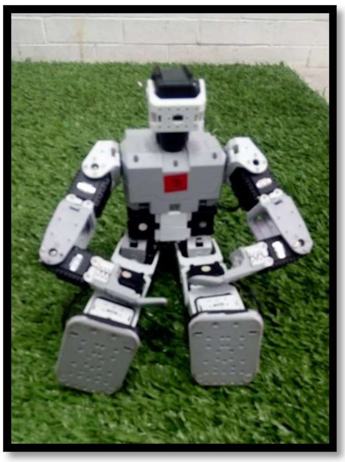

Figure 5a. Before the change of their feet

Figure 5b. After the change.

3 Vision system

The vision system is based on HaViMo cameras. The 2.0 cameras sample pictures with a resolution of 160x120 pixels with a framerate of 19 fps. and the HaViMo 3.0 samples pictures with a resolution of 2 megapixels with an ARM Cortex M3 as the main processing unit.
For the image to be ready to the training, it has to be processed in grayscale. We use gaussian filters to prepare the images taken by the camera. One of the approaches is to locate contours of the image.
The process of choosing which movement will be made is based in neural networks.

The NN algorithm is trained with sigmoidal activation functions to detect the ball and field markings. Convolutional neural networks has been one of the most influential innovations in the field of computer vision. Part of the program applied in the goal of classification giving an image is shown in figure 6.

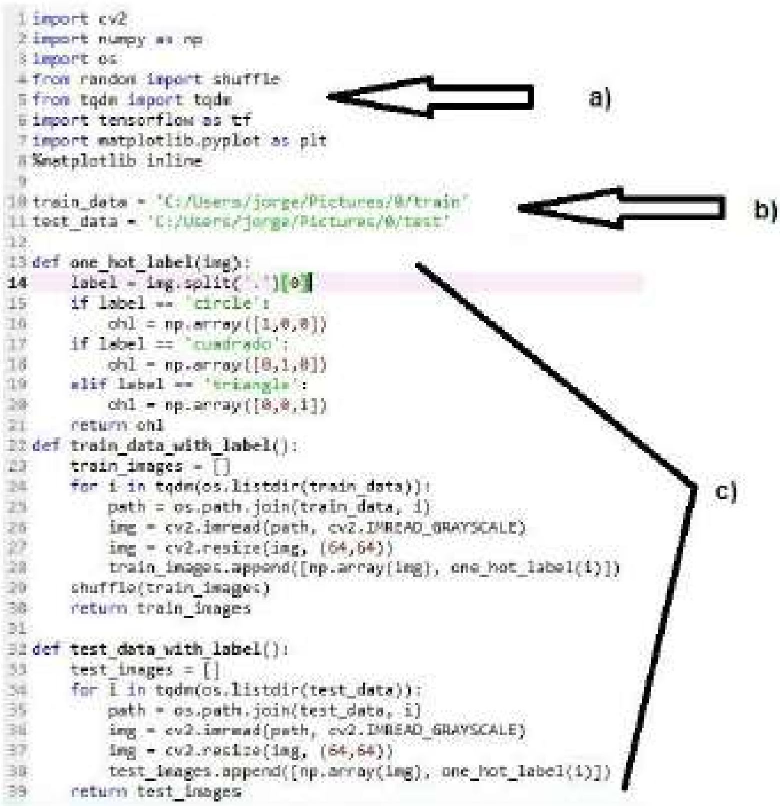

Figure 6: Convolutional Neural Networks partial PROGRAM

At this time, our investigation is centered in training the robot to detect the ball and the markings on the field. An initial filter has been added to process and classify the images more quickly so the robot can make a decision.

The block of decision-making developed is based in the algorithm show in Figure 7. At this time this part is fed with the output of the NN.

Depending on the case, the servomotor that functions as the robot's neck performs horizontal movement of the camera. It rotates to one side or the other to follow the ball.
• If it is centered in front of the robot
    ○ Take a step forward
    ○ If the ball is near the robot a certain distance
        ▪ If the ball is centered

- Kick the ball
- Else //Adjusts the position
  - If the ball is to the right
    - Take a short step to the right
  - If the ball is to the left
    - Take short step to the left

If the ball is not detected, the function *búsqueda_enfrente* is called.

Figure 7: Algorithm for decision making.

Figure 8: Localization of field markings

Conclusions: This paper shows the general highlights of the advances of the team in preparation for the upcoming competition in 2019. It is an ongoing work to train the NN to acceptable levels of ball and field markings recognition.

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