FalconBots RoboCup Humanoid Kid -Size 2014
Team Description Paper

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Abstract: Falconbots is an acronym formed from the words Falcon (Falcon) + bots (robot) since the falcon is the representative mascot of our institution.
This document describes the work done by the team FALCONBOTS to participate in the humanoid league kid -size category in RoboCup 2014. Taking into account previous experiences in the Mexican Open RoboCup, our research is based on three lines: location and location of objects in the field, robotics locomotion, and cooperative robotics algorithm. We also have a member with extensive knowledge about the rules of the competition who can also be a referee in matches. This paper shows a brief description of our work.

1. Introduction

In recent years, the object of study for most of the teams participating in RoboCup humanoid league is the correct interaction with humans in order to achieve the main challenge of this tournament, "*develop a team of fully autonomous humanoid robots that are able to beat the team that win the world cup of FIFA.*" The Falconbots team has participated in major league RoboCup competitions. For instance, we have participated in the RoboCup Mexican Open for three consecutive years where we have won the first place for two consecutive years. In addition, we have participated in the RoboCup World Championship 2011, RoboCup World Championship 2012, and RoboCup World Cahmpionship 2013. These results have encouraged us to continue working in the field of robotics and doing research on humanoid robots.

FALCONBOTS is the representative robotics team of the ITSSMT (Instituto Tecnológico Superior de San Martin Texmelucan). Our institution offers different bachelor degrees related to engineering. Computer Systems Engineering and Electromechanical Engineering, for example, are essential for the recruitment of students to become part of FALCONBOTS.

In FALCONBOTS, we have used a modified version of the DARwIn OP platform. We have increased the size of the parts of the body strategically so that the robot is not limited regarding height when comparing it with robots from other teams. We have developed locomotion algorithms to have greater stability in walking and in the movements to make the robot stand up itself autonomously. For that reason, we have decided to rename our robots using successful Mexican soccer players' names. For example, our forward's name is HUGO.

For a good traditional soccer match, we took into account three main aspects which are the basis of our research: player orientation, location of the ball and fellowship (teamwork); that is, vision, movement and locomotion, and cooperative robotics. The vision algorithms are based on probabilistic algorithms whose aim is to detect the ball, to detect goalposts, and to detect the match environment (soccer field). In addition, with the work of cooperative robotics based on a coupled system, we want to improve the game skills of our team of robots. In the following section, the research conducted in our laboratory is shown.

2. Mechanical and Electrical Specifications.

The mechanical structure of our robot is based on the platform OP DARwIn adapting aluminum parts and having then a height of 58 cm. The robot also has a battery compartment in the feet to maximize performance in terms of energy. Moreover, it has an extra cooling compartment in its central part, keeping its center of mass and its stability due to the new algorithm of locomotion.

Fig 1 Mechanical Desing of Falconbots

2.1 Hardware

HUGO robot from FALCONBOTS has 20 degrees of freedom, distributed as it is described below:

Degrees of Freedom Actuator
2 degrees of freedom in the head Dynamixel MX-28
6 degrees of freedom in its leg MX-28 Dynamixel x2
3 degrees of freedom in arm x2 Dynamixel MX-28
1 fitpc 2i Computer
Cm - 730 controller Robotis

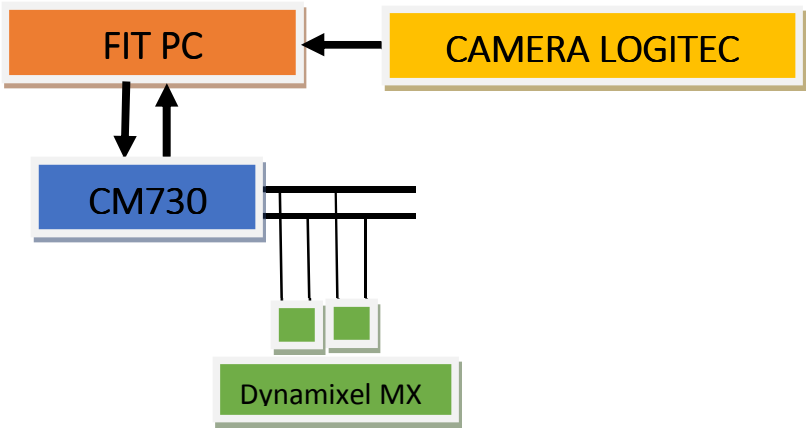

Fig 2. Electronics Architecture

Hugo is 58 cm tall and has a total weight of 3.105 kg distributed according to the new components. The camera is a Logitech HD, and the sub-controller has accelerometer and gyroscope sensors with 3 axes in each of them.

The electronic architecture is based on a fit- PC2i computer with a Dynamixel actuator CM730 sub-controller MX-28

The electronic configuration favors FALCONBOTS behavior due to the method that is implemented, which is based on “Vision- Action", a studio located in our school.

3. Software.

HUGO was optimized with Lubuntu 12.04 operating system to implement complex algorithms of location and vision since this system saves processing resources to be used in other actions.

3.1 Locomotion.

HUGO's locomotion algorithm is based on a model of predictive control, in order to optimize the robot's walking and to make it more stable in the field. Due to the height increasing, retrieval techniques are used to make the robot keep stability when being in contact with another robot or obstacle, or because of the defective condition of the field. These techniques are based on recovery methods implemented in other robots, which use impulses according to accelerometer readings.

3.2 Vision

The vision algorithm that HUGO employs is based on probabilistic methods for recognizing the ball. It uses colors in the HSV color space and a simpler version of the algorithm of Hough Transform to differentiate objects. The recognition of the goals and the field are based on a simple method of recognizing edges and areas of interest, which is very useful for differentiating the goal from other objects of the same color.

3.3 Localization.

HUGO performs the location of objects by using the Monte Carlo locating method. We, then, have taken into account the closest field lines to a specific goal and have also used a particle filter to identify the enemy's goal. Likewise, we have used the gyroscope readings to verify the effectiveness of the particle filter.

3.4 Cooperative Robotics.

Cooperative robotics is used in the design of an algorithm for cooperating and making decisions between two or more robots. This works when one of the robots is watching the ball or is close to it. It then makes decisions in the match by performing the defined actions of shots or passes while the other robots keep their strategic position to wait for any other subsequent action to the control of the first robot. This helps to save extra resources of the robots

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Conclusion.

This paper addresses the research work carried out by the Falcobots team. We hope to have a more outstanding participation than the previous ones at the RoboCup World Championship 2014, which will be held in Brazil. For further information about the lines of research at our Institution, visit our web site http://www.itssmt.edu.mx/Estudiant/Robotica/parp.html

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