Persian Gulf Robotics 2009 Teen-Size Team Description

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Abstract. This document describes the specifications and functions of the humanoid Robot which is developed by Persian Gulf Team as a platform for research .we won the first place at Iran Open2008 Competitions .The robot will attend in TeenSize League of **Robocup** competitions in **2009, Graz, Austria**.

1 Introduction

The Persian Gulf Humanoid Robot Project has been running at Khorasgan University and sponsored by Bonyad Shahid Isfahan organization, Iran, since 2006. Since then we have started the humanoid robot project, and now we focus our research interests in mechanisms of humanoid robot, bipedal locomotion, robot vision, self-localization and multi-robot cooperation.

2 The Robot

Fig 2.1-Persian Gulf Humanoid Robot

Table 2.1. Specification of robot

<table>
<tr><th>Team Name</th><th>Persian Gulf</th></tr>
<tr><td>Actuators</td><td>Dynamixel RX 64 & DX 117& RX-28</td></tr>
<tr><td>DOFs</td><td>
<table>
<tr><th>Joint DoF</th><th>DOF</th></tr>
<tr><td>Head</td><td>Yaw×1</td></tr>
<tr><td>Shoulder</td><td>Pitch×2</td></tr>
<tr><td>Hip</td><td>Roll×2
Yaw×2
Pitch×2</td></tr>
<tr><td>Knee</td><td>Pitch×2</td></tr>
<tr><td>Ankle</td><td>Roll×2
Pitch×2
Total 15</td></tr>
</table>
</td></tr>
<tr><td>Height(mm)</td><td>1130</td></tr>
<tr><td>Computing Units</td><td>HP iPAQ hx2790 Pocket PC – CM2+ Processor Board</td></tr>
<tr><td>Camera</td><td>HP iPAQ PhotoSmart Mobile Camera</td></tr>
<tr><td>Walking Speed (m/sec)</td><td>0.2 m/s</td></tr>
<tr><td>Weight (kg)</td><td>3.1 kg</td></tr>
</table>

2.1 Mechanical Design

Fig. 2.1 shows our newly developed kicking the ball. The robot is 1130mm high and weights 3.1Kg including Pocket PC and batteries. It has 15 DoFs : 3 in each leg,1 in each arm, 1 in the head and 3 in the hip.

Table 2.1.1.DOFs of robot

Joint	DoF
Head	**Yaw×1**
Shoulder	**Pitch×2**
Hip	**Roll×2 Yaw×2 Pitch×2**
Knee	**Pitch×2**
Ankle	**Roll×2 Pitch×2**
Total	**15**

All the actuators are Robotis RX-64,Robotis DX-117and Robotis RX-28. Table 2.1.2 shows the specification of each actuators.we have used alominum material because it was light, strong, easy to work with and cheap.

Table 2.1.2. DoFs

Properties	RX 64	DX 117
Weight(g)	116	66
Gear Reduction Ratio	1/200	192.6

Input Voltage	18	12
Final Max Holding Torque(kgf.cm)	64	28.89
Sec/60degree	0.162	0.172
Manufacturer	Robotis	Robotis

2.2 Equilibrium Formulas

The robot's equilibrium system is divided into two parts: static and dynamic.

The dynamic equilibrium system is been used in this robot. As the robot's equilibrium is not conform with reality, the desired equilibrium is got through received data from sensors. In both kinds of equilibriums the resultant of forces on the whole robot has to be put on the support leg .(Fig 2.2.1)

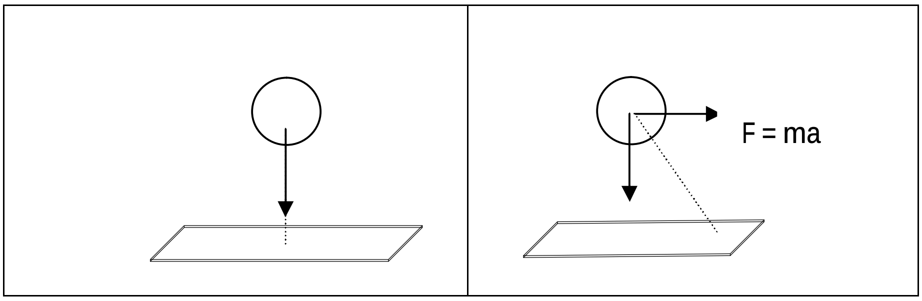

Fig 2.2.1

As in dynamic equilibrium, mass should not be restricted to the robot's sole, one has to make an acceleration at horizon's direction and keep the resultant of forces at robot's sole with controlling and creation of acceleration.

When the mass is behind is behind the support leg, he acceleration should be created at positive direction, but when the mass is in front of the support leg, we have to make a negative acceleration with backward movement of the upper part of the body for putting the resultant of forces on the support leg's sole.(Fig 2.2.2)

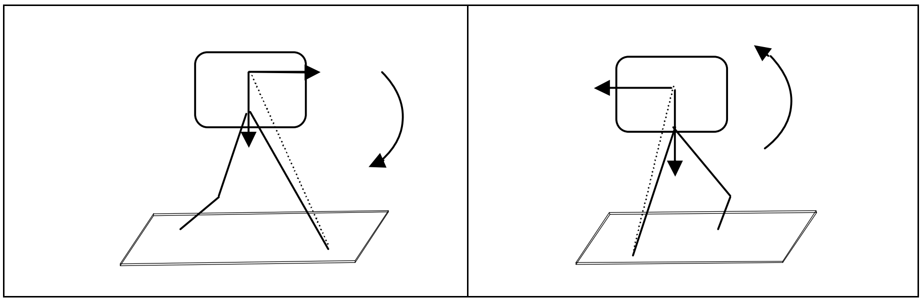

Fig 2.2.2

When we say creation or controlling of the acceleration is desirable that according to the sensor's data analysis we have: (Fig 2.2.3)

$$F1+F2=F3+F4 \qquad (1)$$

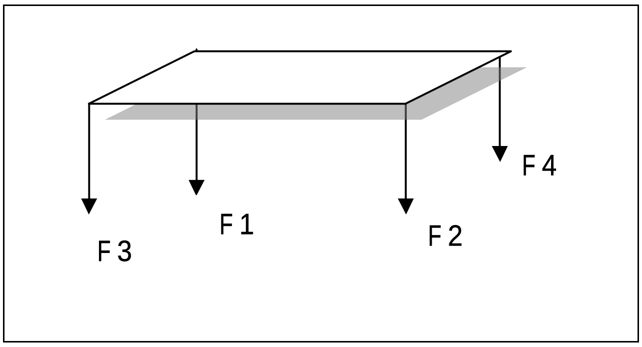

Fig 2.2.3

And when we can say that the pivot's angle is desirable that we have:

$$F1+F2=F3+F4 \qquad (2)$$

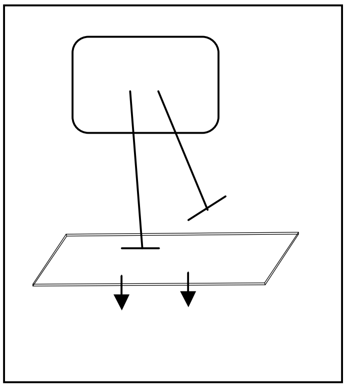

Fig 2.2.4

3 Electrical Design

Regarding to the robot's dynamic design, electronic part is divided into two parts :

3.1 Strong Network : including Actuators, Behaviuor Control and Power . Fig 3.1.1 show strong network.

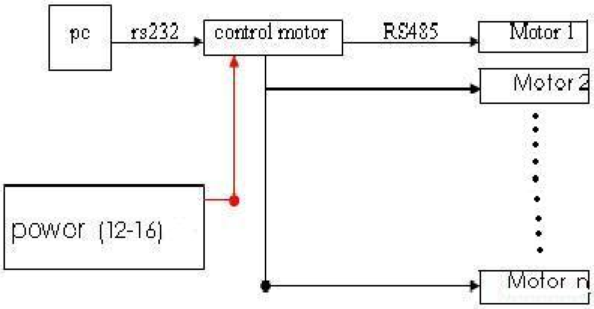

Fig 3.1.1. Show Strong Network

3.2 Control Network : including Sensors Network and Actuators feedback Network. . Fig 3.2 .2 show control network

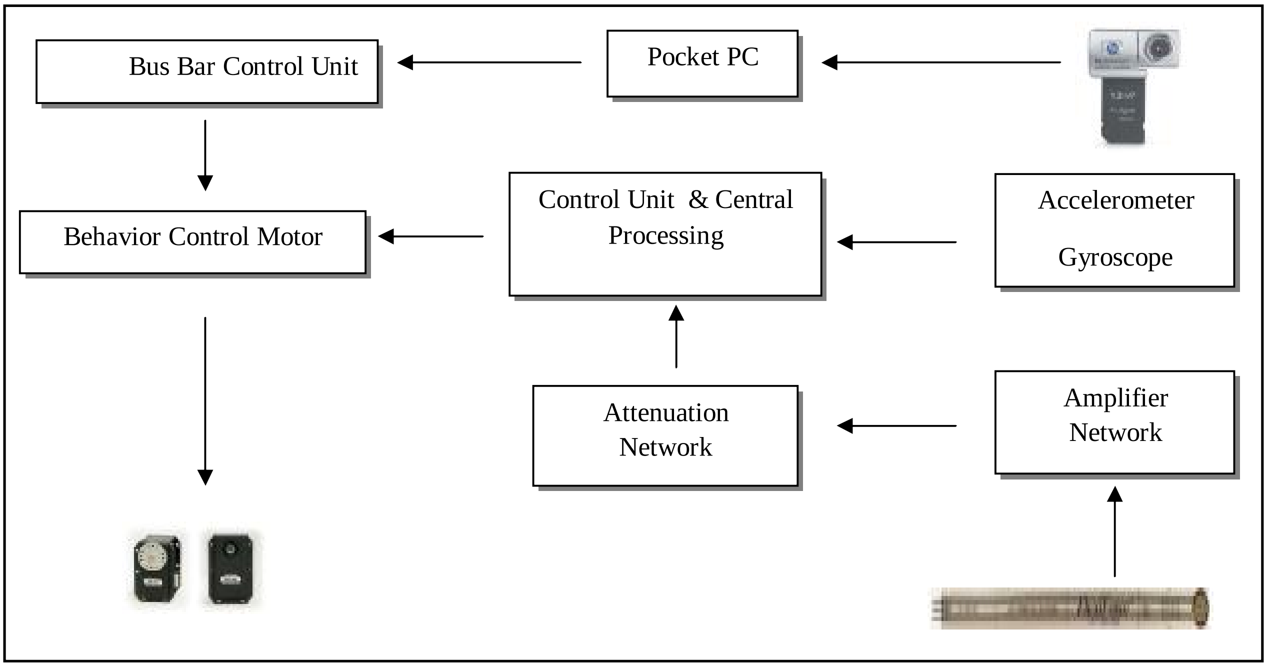

Fig 3.2.2. Show Control Network

Main parts of electrical design could sort by following list :

1-Main Board (Central Processing Unit)

2- Actuators Control Board

3- Actuators

4- Feedback Network

5-Power and their Network

4 Vision

The vision module consists of two parts. On the aspect of hardware ,HP PhotoSmart camera is employed as vision sensor. And we have two tasks in the software, object recognition and relative position estimation.

4.1 Vision Sensor

For robot, a camera is used. camera is connected to the Pocket PC via a SD port. And image series of a resolution of 320×240 can be provided in real time by up to 10 frames per second.

4.2 Learning Color Object

In this part we take a photo from playground that contains our desired object ,then evaluation would be done and then it added to the object table . At the end creation of a database of object for knowledge of vision would be accomplished.

4.3 Position estimation

As you know, according to the knowledge base when a pixel's R, G and B can be put in a particular object's R,G and B, that pixel is belongs to that object and we can convert the pixel's details to the object's details and finally we have a picture with 6 colors!

The camera's picture resolution is 240*320 pixels on which decreasing the resolution has to be done, which caused deleting undesired noises and a simpler working area.

In the next step robot's position regarding to the ball and net and penalty point is considered and compared with experimental information saved in a table called lookup table.

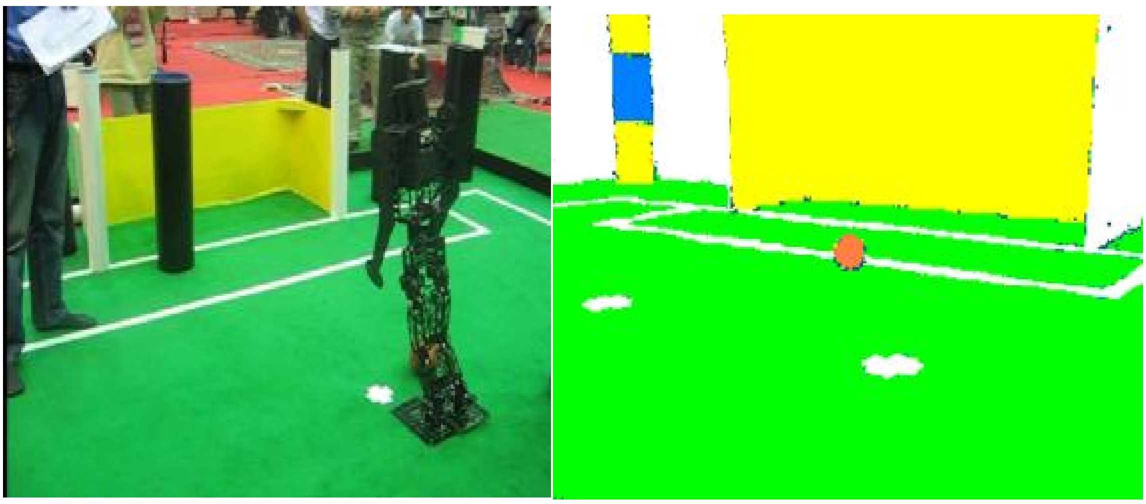

Fig 4.3.1 . Field of Play after color reduction

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