NeuroTech Teen Size TDP

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Abstract. This document contains the RoboCup Humanoid League team Neuropac TeenSize robots description. Our team uses self-constructed robots for playing soccer. This paper describes the mechanical and electrical design, Perception of our TeenSize robot.

1 Introduction

This is the first time this humanoid robot is going to stand for qualifying in Robocup 2009 which will held in Graz, Austria. Unfortunately, we came to know about it not more than 1 month ago. So, there was not much development made in this robot. But there are some new features that will be a new addition to this year's robocup. Our design includes pneumatic actuators, solenoid valves which gives higher strength to the robot. Again, a newly developed learning process will be included which will give it a very high rate of learning capability. So it can be trained different soccer tactics easily, in less amount of time. All these things will be discussed in the later sections. Moreover this TDP was written in a very less amount of time. So there might be some information lagging or some point might be highlighted more. We assume the respectable judges will allow us to submit a new copy of TDP soon, before 28 february.

2 Mechanical Designs

Our robot used here uses handmade pneumatic muscles as in the figure below. The advantage of this muscle is that, it has greater output to input ratio. But it has been achieved at a very high cost. While the muscle is inflated it takes a large area at its vicinity. All the valves are handmade. They are constructed using wood to loose weight. Later we will replace these valves with *pneumatic logic gates* to reduce weight Rubber piping has been used as the pressure is relatively low than that of other pneumatic systems. A light weight pneumatic pump is used which is very small but can supply a large amount of air/min. As a result it makes it suitable to be used in this design. Its height is about 4.5 feet, as its construction is not complete, hence its weight cannot be mentioned at this moment. It has 21 degrees of freedom. The ankle joint consists of to DOF, knee joint consists of 1 DOF and hip joint consists of 3 DOF. The shoulder region has 2 DOF and elbow joint has 1 DOF. The total voltage that drives all the systems runs on 18 volts. 3 batteries are required each weighing 700g.

Its structure is made is steel to withstand the force exerted in each joint when this heavier design using pneumatics is implemented. Each joint consists of 2 bearings. The steels structure is connected via welding.

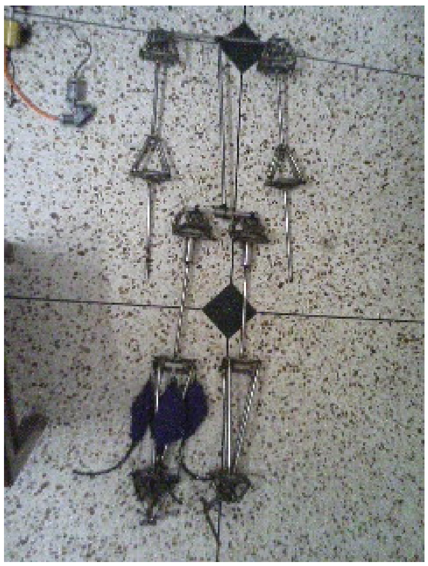


Fig. 1. Teen Size Robot

Fig 2: Artificial Pneumatic muscles

Fig 3 : Pneumatic Pump and Valves

3 Electrical Designs

The processing unit used here is a laptop computer weighing almost 3.1 KG. It has 1.9 GHz Pentium 4 processor, 256 MB ram. All the sensors, motors and muscles will be controlled through the PC's parallel port. To minimize circuit complexity they controlling circuits were simulated internally. For programming C and assembly language has been used here. 2 stepper motors has been used here for controlling the camera movement. 48 steps are made to complete one revolution. But in half step mode it can be doubled.

The robot temporarily has only one 1.3 mega pixel webcam as vision sensor. Later it will be replaced by two cameras for binocular vision. Currently 320 x 240 is being used as visual input resolution.

For driving stepper motor and pneumatic solenoid valve ULN 2803 darlington pair transistor driver IC has been used. To allow higher current for control purpose

Optocoupler is used here as rotational sensor. It senses amount of motion as well as direction of the motion.

4 Perception

Perception of this robot is under construction. We want to give it human like learning skill. We have developed a new process which will assist robot to learn very fast. The main advantage of this process is that, we don't have to tell it what to learn, it itself will identify its subject of learning. This is done by observing human psychology and narrowing it down into some simple rules that in turn results in imitation of human psychology. This architecture allows numerous inputs without any predetermined priority to them i.e. for an example, any pixel in the camera has the same priority like other sensor inputs and no distinction has to be made previously between them. There is another structural resemblance between human brain and this process is that both of them are parallel processing unit. Unfortunately implementing parallel architecture in conventional processors cannot be done directly, but executing it as an algorithm as a very highs speed can solve the problem. Later The architecture may be burned into faster FPGA in parallel with the laptop to increase performance.

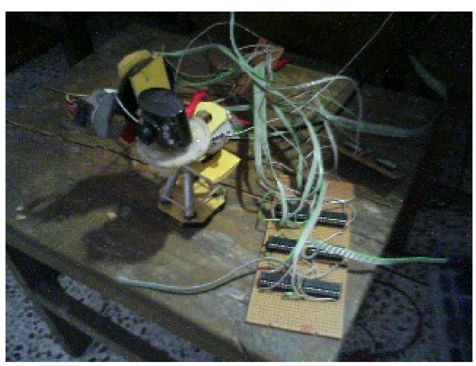


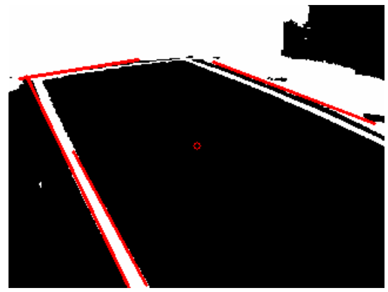
Fig 3: Visual Sensor

For visual perception image is captured through the usb port. The image contains 3 color channels RGB. As there is green field with orange ball (here red ball) hence all the pixels with red channel less than 120 will be converted into black and pixel with value in red channel greater than 120 will be turn into white (R G B : 255 255 255) As a result , this slight color correction will result in a white circular ball in a black background. This is ideal for ***circular hough transformation***. After detection of the circle the center is roughly the center of the ball. As a result the ball can be tracked easily by tracking its center.

(a) (b)

Fig 4: (a) the placement of the ball on the field. (b) the detected ball on the field using circular hough transform.

Again we have used hough transform with line detection to detect field lines for localization. But after completing the total structure localization and decision making programming will be completed.

(a) (b)

Fig 3: (a) the placement of the field lines. (b) the detected lines on the field using linear hough transform.

The main objective of this detection is that, since the robot uses parallel computing for perception and action, to calculate for all the pixels and other inputs a very very huge memory and processing power is required, which is unavailable to us. So we have decided to minimize the surrounding environment by detection necessary objects like field, ball, field lines, opponent and own team players by another program and then after calculating there respective Cartesian Co-ordinates they will be provided to the parallel structure. By diminishing the number of inputs will improve very very less amount of processing than normal camera input to the parallel architecture.

We have used Opencv computer vision library to perform different image processing especially like circular hough transform.

5 Conclusion

Since this is our first time we expect that the judges will consider out work, as we have said earlier, we had only 1 month before making this progress. We are not funded by any university so out technology may seem a little disturbing, but we are working hard to improve. If we are selected then funding will not be a great problem. We hope that you will understand out situation. We will have 5 more months before the competition; we assure you in the meantime we will make good progress**.**

Reference:

1. Open Source Computer vision by intel corporation.

2. Pneumatic Artificial Muscles: actuators for robotics and automation by **Frank Daerden, Dirk Lefeber** Vrije Universiteit Brussel, Department of Mechanical Engineering