HANIF Rescue Robot Team

Navid Ghaffarzadegan[1], Sadegh Dabiri[1], Arezu Motevalizadeh[1], Mohammad Hossien Fardad[2], Mohammad Hossien Taghavi[3], Amir Salman Avestimehr[3], Ali Azimi[1], Hadi Emamifar[1], Sareh Ebrahimi[1], Sina Rastad[1], Peyman Shariatpanahi[3], Mohammad Najmzadeh[3], and Ali Sharifi[2]

[1] HANIF Rescue Robot team, Mechanical Engineer, YSC, Tehran 14766-46477, Iran
navid@aban.ysc.ac.ir
[2] HANIF Rescue Robot team, Computer Engineer, YSC, Tehran 14766-46477, Iran
fardad@ce.sharif.edu
[3] HANIF Rescue Robot team, Electrical Engineer, YSC, Tehran 14766-46477, Iran
avestimehr@ee.sharif.edu

Abstract. Geographical location of IRAN is on one of the most dangerous earthquake lines, and every year earthquakes which are both common and fatal, happens. One of the HANIF Robotics projects is to design, construct and control of rescue robots. HANIF Robotics is divided into three subgroups; Mechanical Engineering Software Engineering and Electrical Engineering. Outstanding skills of HANIF robots are dynamical analysis based design, positioning with sonar and encoder data and user friendly and full controled interface.

1 Introduction

1.1 About YSC

YSC is a well known research center in Iran to educate researchers in the appropriate fields. In addition to training Iranian National Scientific Olympiad Team, YSC provides the facility needed for university students to do scientific researches especially in the field of Mechanical, Computer & Industrial Engineering. HANIF Robotics is a subgroup of YSC working on robotics.

1.2 Project Description

Geographical location of IRAN is on one of the most dangerous earthquake lines, and every year earthquakes which are both common and fatal, happens. Working on rescue robots is necessary in detecting victims, which could help rescuers to rescue more human lives.

Our aim in this project is design, construct & control of an autonomous robot which could be able to move around in an unstructured environment and could detect victims in hazard areas. Participating in Robocup Rescue competition is a situation to challenge ideas in this field. Our team is divided into three sub teams:

- Mechanical engineering students group.
- Computer software engineering students group.
- Computer hardware engineering students group.

2 Mechanical Architecture

Hanif Rescue Robot Team uses three robots. Each robot is designed for different rooms. Each and every one of robots contains a manipulator which controls the camera. As an example of mechanisms, Orange room robot will be described. The orange room rescuer is a snake robot. This robot is driven using six driver wheels and each wheel could be controlled separately. Because of the driving gear mechanism of the robot it can climb up steps and other obstacles.

In order to keep this movability and yet carry the batteries and the terminated laptop, the body section was connected to driving gear using a four-bar linkage. First a general computer simulation of the mechanism was done using working model software. In order to achieve the best design between servo motors power and size, size optimization was inevitable. Size optimization was done using programs which where developed by HANIF Rescue Robot Team. A test prototype was built on results bases. Some parameters were adjusted so that the robot could climb a step with a height greater than its own wheel diameter.

3 Hardware Architecture

3.1 Control

There are two main parameters which must be controlled:

1. The motion of robots. Each Robot has two or more DC servo motors for movement .All motors must run at equal speed to achieve straight motion. To change the direction, different speeds should be assigned to servo motors.
2. The situation of the camera. Two stepper motors are being used to change the yaw and pitch angle of the camera to achieve a complete vision over robot. A driver circuit is designed for each motor and the computer manages the process through an I/O port.

3.2 Positioning

Two important objectives to notice: first, preventing probable collisions with side walls, and second, understanding the location of the robot in order to estimate the position of victims. To perform the primary objective, several infra red (IR) sensors are placed on different sides of the robot. The other objective could be handled in different ways: In a flat room (the yellow zone) an encoder is attached to each wheel and it's used for calculating the relative position from the starting point. But this approach is not proper in uneven rooms (orange and red zone). In those cases, distance calculation from side walls would be useful and this could be done by sonars.

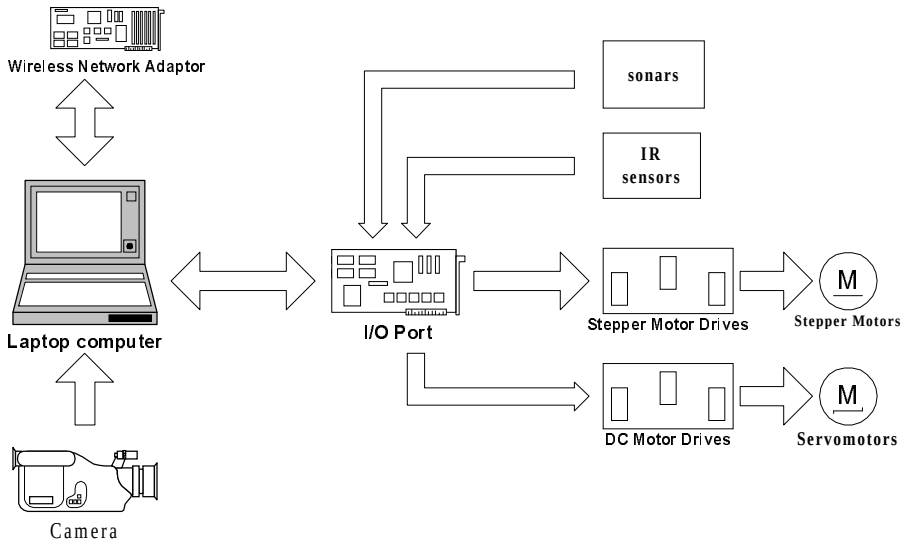

Fig. 1. Diagram of Hardware Architecture

4 Software Architecture

The objective of software team is to develop a software to control robots in test fields. There are two main objectives:

- The first objective is to develop a software that can help operator at a remote computer to simultaneously control robots and find victims. The most important part in this section is an interface design which helps the operator to guide the mission at the fastest speed. So controller program must be semi-intelligent. It must have the ability to perform none-creative tasks automatically. The software has three main parts:
  1. The first part delivers robot vision media streams to the main computer and displays them. Although there are three robots that must be controlled simultaneously, our communication is based on wireless LAN bandwidth restrictions. This forces us to perform fast video compression. Since the program runs under Microsoft Windows Platform, using Microsoft technologies is an advantage. We use IP protocol for communication between robots and the operator computer. For video transmission there are three choices Microsoft Windows Media Technology, Microsoft DirectX Media (DirectShow) and Microsoft NetMeeting API.
  2. The second part is map management. Main goal is a map with marked location of victims. This part of software can help operator to make a computer generated map with marked location of victims with high accuracy details.

3. The third part of the software is the main controller. In addition to basic motion and camera panning commands, this part has a set of semi-intelligent commands to help the operator performing tasks faster.

– The second objective is to develop an intelligent program that can control robots without operator especially in the first field. Positioning and path planning in this field can be performed automatically and software can use sensors and image processing techniques to detect the exact position of victims. In the simple fields without complex equipment using encoder and possibly sonar sensors can help the software in exact positioning. Detection of victims also can be performed with color contrast, shape analysis and probably motion detection.

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