MECATRON-LAREDO – Team Description Paper
Rescue Major, Robocup 2018

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Abstract. This paper presents a highlight of the implementation and program design of a rescue robot. The robot is "custom-made" in a sense that is has been built to perform the activities of moving in uneven terrain, climb stairs and detect referring signs and can feed forward the mapping and localization of the covered area. The team "Mecatron-Laredo" presents the design methodology made as a group, to obtain a rescue robot that be able to fulfill the objective to help in disaster areas.

1 Introduction

The team "MECATRON-LAREDO" is a research group of the technological institute of Nuevo Laredo, México. The group is part of the Club Mecatrón. The club has been working since 2003 and participate in the Mexican Tournament of robotics in different categories. In 2015, the group participate in the category of rescue major for the first time and obtain second place.
Since this year, they made some modifications to the physical structure to make it climb stairs. (The 2015 robot was unable to climb the stairs).
The group has been working in:

a) Design the mobile base to be able to climb stairs and ramps.
b) Design parts using 3D simulation tools to obtain a center mass analysis so the robot can climb the stairs without falling. Also some parameters for the motor characteristics of each degree of freedom.
c) Implementation of a vision system to recognize hazmat labels.
d) Implementation of sensors to identify random number strings.
e) Apply a thermal sensor in a teleoperated system.
f) Identify the CO2 concentration and motion detection.
g) Create 2D and 3D maps in teleoperated system.
h) Implementation of robotic arm in the mobile platform.

This short paper gives an overview of the team work. Presents the design prototype hardware, the programming and the vision system in its current state. Also this with the aim to participate in Robocup 2018, Montreal, Canada.

Commitment
The team MECATRON-LAREDO commits to participate in RoboCup 2018 in Montreal (Canada).

2 Implementation of Mobil Structure

The first design (figure 1), was made in Autodesk inventor. It has 6 wheels arrange in a form that can be control separately. This type of arrange allow the robot to climb stairs and follow a path in uneven terrains.

Figure 1: First design in Autodesk inventor.

Figure 2: PVC prototype.

A small prototype was made with PVC to check the movements and provide information about the degrees of freedom needed in each wheel.(Figure 2). The general diagram of the project design for the rescue robot is shown in figure 3. It shows the main parts: The communications: This part include the human interface. The sensors that include the vision system, CO2 system and the thermal sensor. The control, base in PWM and coordinated movement for each wheel. The design part that is the based for all the actions made in the implementation of the robot.

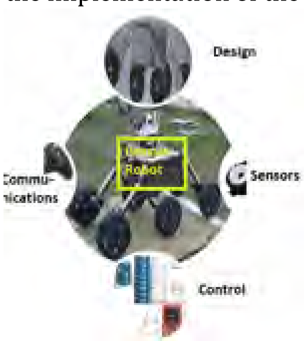

Figure3: General Diagram of robot project.

We use PTR ¾ and nylamid for the structure. A center mass analysis was made to assure the stability of the robot when it climb the stairs.
The figure 4, shows the first test made with the structure. After this successful test, all the activities focus in test the robot with different obstacles like pipes and debris.

Figure 4: First test of the structure climbing stairs.

3 Image detection and mapping

For the vision system, a Webcam Logitech C110 and a pixy camera are used to recognize hazmat labels. The information is send to the remote computer and also, color-led was implemented in the robot to sign when a label is detected.

Figure 5: Example of “Flamable Gas” label detected.

A centroid method algorithm is used to recognize each label and other images needed in the robot path. An example is shown in figure 6.

Figure 6: Centroid of images, program example.

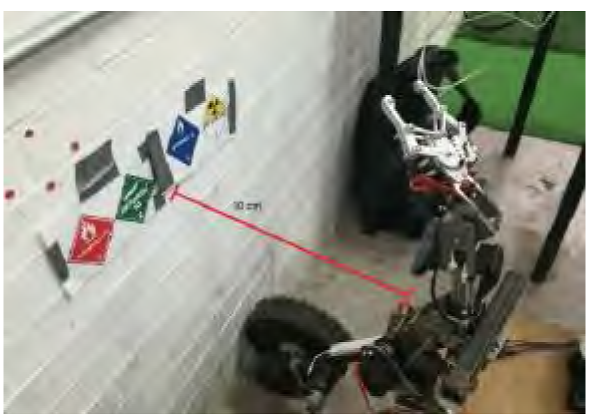

Figure 7: Robot detecting different labels.

Figure 7, shows the robot detecting different labels. Figure 8, shows the data send to a remote computer and also the leds that are in the robot that get on when certain label is detected.

4 Sensors

To obtain a thermal image, an Adafruit AMG8833 IR is used. To help the mapping system, a Duinopeak NEO-6M GPS Shield is used to obtain a real time GPS data.

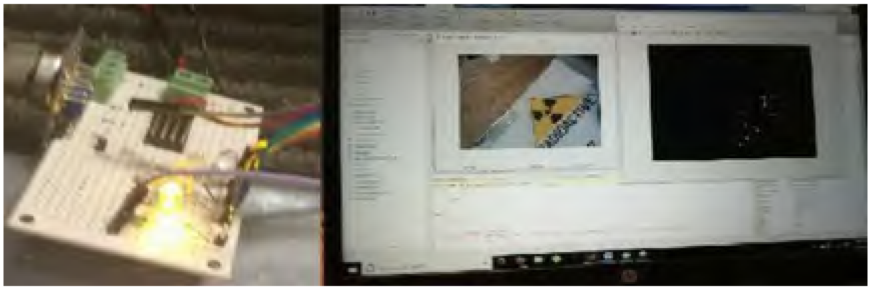

Figure 8: Information sent to remote computer.

Figure 9: Several test to CO2 sensor

The MQ-135 module is used to detect the concentration of CO2. Several tests was made to assure the functionality of the sensor. The information of the sensor is sent to remote computer.

5 Robotic Arm

A robotic arm was design to fulfill the need for manipulation and inspection of disaster areas. A kinematic and cinematic study was made. Also, a torque study to obtain a robot robotic arm. Figure 10 shows the initial design in inventor. Figure 11, shows an example of the kinematic study made with the robotic arm designed. Figure 9, shows the robot arm extracting a pipe.

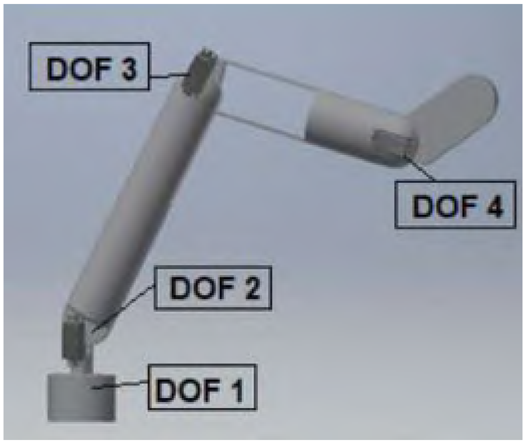

Figure 10: Robotic arm design in inventor.

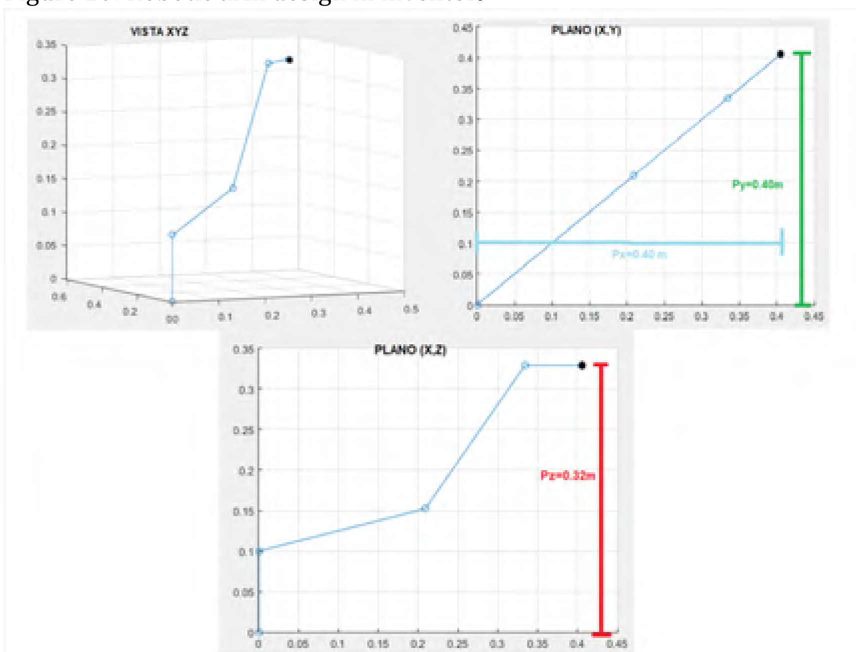

Figure 11: Kinematic study of robot arm design

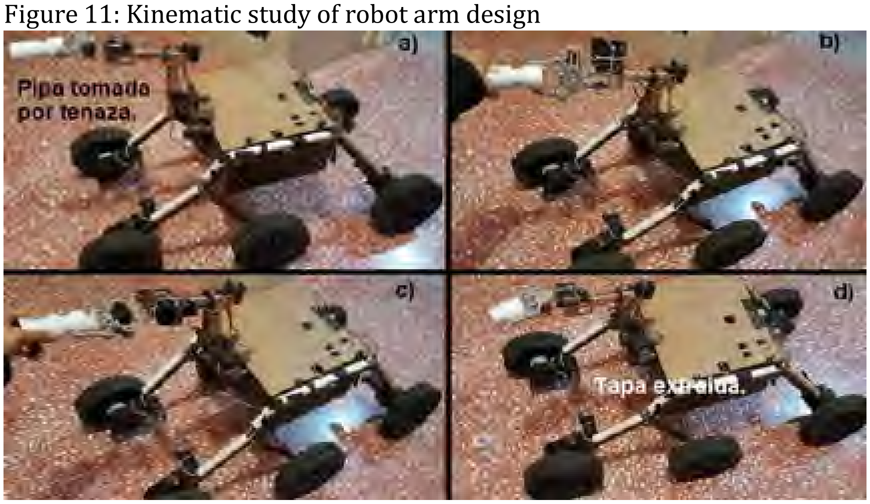

Figure 12: Pipe extracting

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