RoboCup Rescue 2019 Team Description Paper TecnoBot

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Info
Team Name: **TecnoBot**
Team Institución: **Tecnológico Nacional de México/Instituto Tecnológico De Nuevo León**
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Team URL:

Abstract
This project shows a prototype of a reprogrammable multifunctional rescue robot capable of manipulating materials, parts, tools or special devices according to programmed variable trajectories and perform various tasks, developed by students of the Tecnológico Nacional de México/Instituto Tecnológico de Nuevo León.
The robot has two flippers in the front and two more in the back for better access to the area where the victims are or where the robot is required, the robot also has multiple sensors that make it suitable for tasks that go beyond the rescue of people in disaster areas.
***Index Terms*—Rescue Robot, Artificial Vision, Manipulator, RFB, Passive gripper .**

I. INTRODUCTION

This project was born as a prototype test bench for the mechatronics engineering master's department of the Instituto Tecnológico de Nuevo León in order to do to bring it to a successful conclusion, and that is what is described in this article.
But as progress was being made the opportunity was seen for the robot to be used for tasks that are dangerous to

humans, such as rescue tasks, It was necessary to expand the scope and objectives of the project in order

. SYSTEM DESCRIPTION

Eco the main robot can move through different terrains, its 4 flippers allow it to become immovable when it reaches areas difficult to access.

The eco robot (fig.1) is the main tracker along with its 4 independent flippers for your best exploration performance after the earthquake. Eco has been focused to navigate non-uniformly on different terrains, open doors, climb stairs, lift debris and transport people. It has a 5-axis articulated arm which allows you to interact to place or pick up objects. The robot has a kinematic control,

1) Locomotion: The mobile Robot is tele-operated from a control cabin. Its size is "70" cm long "50" cm wide and "60" cm. Compact height for your dexterity in operation with its 4 flippers grows 25 cm, see Fig 1.

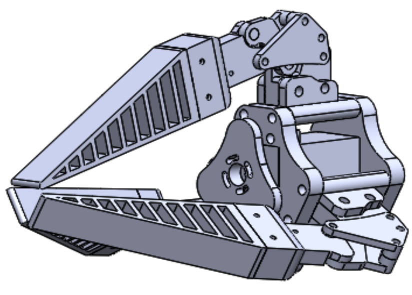
(fig.1) Robot Eco

The weight of the Robot is 35 kg, Eco has a wheel drive system called caterpillars that allow better travel in complex terrain Based on the above characteristics, "Eco" can travel stably.

2) Motor gearbox:
The gearbox has a worm screw that
Built into the crawler drive unit, the flìper is attached to the main drive shaft, the worm drive mechanism helps the robot not to move on steep slopes and steps to an energized state.

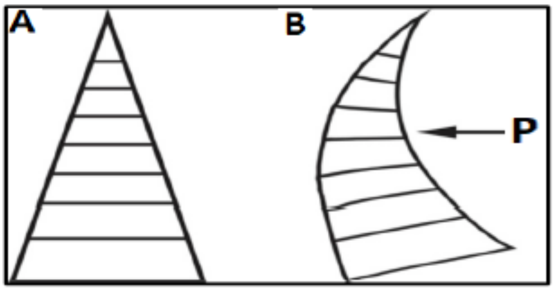
Manipulator arm:
The manipulator arm of the "Eco" has the following characteristics.

Articulated hand:
The tip of the "ECO" arm is an articulated hand with three fingers (fig.2). The design is inspired by the FESTO system adaptable gripper DHDG[1].



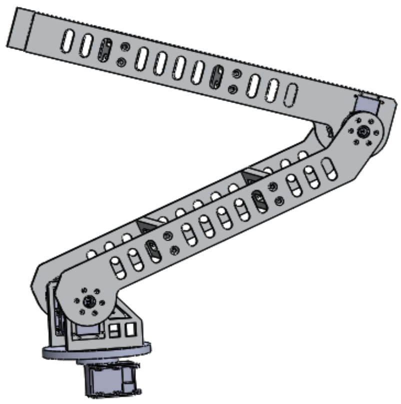
(fig.2) Mano articulada de tres dedos

The fingers are opened and closed by means of a servomotor, these hold the objects firmly regardless of the physical structure of it. This is due to the flexible filament material from which they were manufactured and a gripping mechanism formed by Fin Ray Effect [2], is described by the deformation of a V-shaped rib structure through an applied force P illustrated in (fig.3). The non-deformed structure is shown in A and the deformed structure is shown in B.



(fig.3) Principio de funcionamiento del Fish Fin Effect

Articulated arm:
As shown in (fig.4), this arm has a total of 3 degrees of freedom of rotation in the joint. The arm has a length of up to 87 cm, and when combined with a caterpillar can reach almost the same height as a human shoulder.



(fig.4) Articulated arm 3 degrees of freedom

A. Hardware

Se utilizó los actuadores Power modelo HD-1235 MG, un servo digital de alta tensión de calidad Premium con una fuerza masiva para los requisitos de alto par. Este servo digital cuenta con una fuerza de 555 oz-in de torque. Este dispositivo está construido con componentes de alta calidad con engranajes metálicos y opera a un voltaje más alto que los servos promedio.Se requiere un voltaje de 6-7.4V DC para su funcionamiento.

Gas Sensor MQ135:
This type of sensor is electrochemical, and its operation consists of varying its resistance when exposed to certain gases; such is the case for the MQ135, which is sensitive to carbon dioxide (CO2). The sensor is shown in (fig.5). Internally, the sensor has a heater that increases the internal temperature and thus reacts with the gases in question, causing a change in the analog value. This sensor operates with 5 VDC [3].

(fig 5) Sensor MQ135

Temperature and Humidity Sensor DHT22:
It is a digital sensor that is calibrated from factory, this sensor is shown in (fig.6). It consists of a capacitive sensor to measure the relative humidity of the air; it also consists of a thermistor to measure the surrounding air and, with this data, it is possible to calculate the temperature. As mentioned, the module displays the data by means of a digital signal via the data pin. This module can census new data every 2 seconds and operates from 3.3 VDC to 6 VDC and is very low cost [3].

(fig.6) Sensor DHT22

Thermal camera AMG8833:
This camera consists of a set of 8x8 IR thermal sensors. The camera can perform 64 infrared temperature readings using I2C protocol. This camera can measure temperatures from 0°C to 80°C with an accuracy of +/-2.5°C. It can detect objects at a distance of 7 m. 5VDC [4] is required to power this device. see (fig.7).

(fig.7) Thermal camera AMG8833

B. Software

Arduino open source software was used to make it easier to write the code and load it into your IDE where it ran on Linux. The Atmega2560 microcontroller was used in this software.
The Processing[5] IDE was used to use the interface.
The interface consists of several windows, which includes real-time graphs of the sensors that make up the robot, in the upper right of the interface is located the window where the simulation of the robot is performed in 3 dimensions[6], which will determine its correct operation just by activating the robot, in the upper left part of the interface there is the visualization window of the camera connected to the manipulator robot where it will be shown

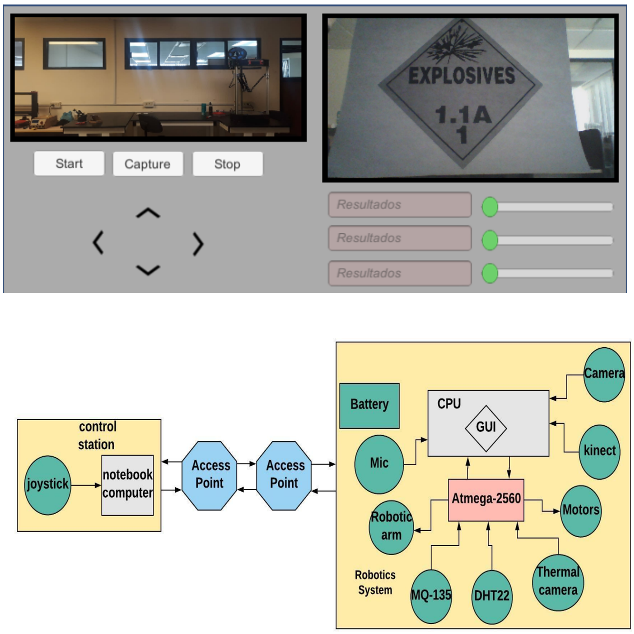
which areas the "echo" robot will be passing through, also this GUI has interconnection with the sensors and codes in charge of carrying out the 3D mapping.

C. Communication

The communication between the control station and the robot takes place through a wireless network using technology based on the IEEE 802.11 ac protocol. For the visualization of the video VNC technology is used which uses the RFB protocol to transmit screen pixel data from one unit to another through the wireless network and thus send in exchange control events.

D. Human-Robot Interface

The system between the operator and the robot is illustrated below, we have created a GUI (fig.8), which allows the user to have total and precise control of all the tools available in the robotic prototype as well as the robot in a very easy way.



(fig.8) GUI

III. APPLICATION

A. Set-up and Break-Down

The setup of our robot is very easy to use, is a self-loading system so that any computer equipment whether laptop, desktop computer and even a mobile device can be used to control the robot.

B. Experiments

Field tests have been carried out, where the robot is requested to move different pieces of different mass, valves, carry out inspection tasks, as well as transit through different terrains very similar to real conditions.

IV. CONCLUSIÓN

We have concluded that the development of the robot can act in situations of different natural disasters in urban and rural areas. The appearance of this type of technology is relatively new, although it is still necessary to advance in both hardware and software to increase the quality of detection in identificaciones multiple efforts are being made in this direction and it is expected that sensors and processing software will emerge confiables to integrate directly into this project.

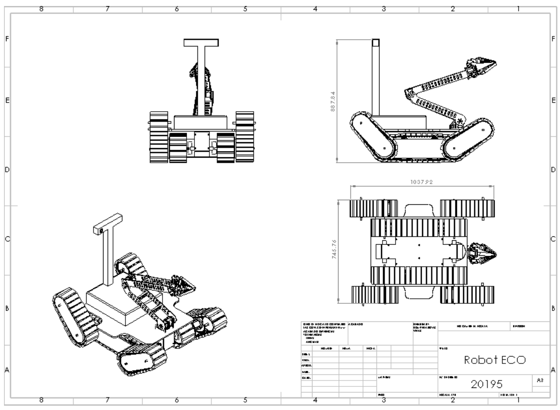
APPENDIX A
TEAM MEMBERS AND THEIR CONTRIBUTIONS

The TecnoBot team is formed by several students and researchers, belonging to the Tecnológico Nacional de México/Instituto Tecnológico de Nuevo León, The following list is in alphabetical order:

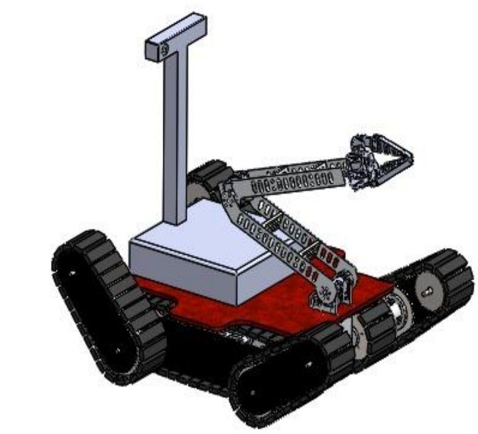
Aguilar Zarazua Luis Fernando	Mechanical Design
Fernandez Ramirez Arnoldo Apolonio	Adviser
Hernández Santos Carlos	Adviser
Macias Solis Jose Francisco	Programmer
Olivares Borja Eduardo	Electronic Design
Echeverría Pérez Alberto Daniel	Mechanical Design
Rangel Gómez Irving Gerardo	Electronic Design

APPENDIX B
CAD DRAWINGS

2D Technical Drawing is shown below (fig.9)
y 3D CAD Drawing (fig.10)



(fig.9) 2D Technical Drawing



(fig.10) 3D CAD Drawing

TABLE I
MANIPULATION SYSTEM

Attribute	value
Name	Eco
Locomotion	Tracked
System Weight	35 kg
Weight including transportation case	40 kg
Transportation size	
Typical operation size	
Unpack and assembly time	180 min
Startup time (off to full operation)	5 min
Power consumption (idle/ typical/ max)	ND
Battery endurance (idle/ normal/ heavy load)	ND
Maximum speed (flat/ outdoor/ rubble pile)	1.5 ms
Payload (typical, maximum)	3 kg
Arm: maximum operation height	87 cm
Arm: payload at full extend	5 kg
Support: set of bat. chargers total weight	ND
Support: set of bat. chargers power	ND
Support: Charge time batteries (80%/	ND
100%)Support: Additional set of batteries	3 kg
weight	1100 USD
Cost	

APPENDIX C
LISTS

A. Systems List

Table I lists several features of the tele-operative rescue robot with manipulation system.

.The Table III includes information on the operator's station.

TABLE II
OPERATOR STATION

Attribute	value
Name	ECO STATION
System Weight	5 kg
Weight including transportation case	2 kg
Transportation size	40cm x 30cmx 30cm
Typical operation size	?
Unpack and assembly time	5min
Startup time (off to full operation)	5 min
Power consumption (idle/ typical/ max)	60 / 80 / 90 W
Battery endurance (idle/ normal/ heavy	10 / 5 / 4 h
load)	140 USD
Cost	

TABLE III
HARDWARE COMPONENTS LIST

Part	Brand & Model	Unit Price	Num
servo motor	Power modelo HD-1235MG	US $34.90	5
Sensor Tempera/humedad	DHT 22	US$5.00	1
Sensor CO2	MQ-135	US$8.00	1
Cámara térmica	AMG8833	US$40.00	1

TABLE IV
SOFTWARE LIST

Name	Versión	License	Usage
ROS	KineticKame	BSD	O.S
OpenCV	4.0.1	Open	Haar: Victim detection
Ubuntu (Xenial)	16.04	Open	O.S
Processing	3.7.2	Open	

A Manipulation Systems
Refer to table I

B. Operator Station
Refer to table I Refer to table II

C. Hardware Components List
Refer to table IV

D. Software List
Refer to table V

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