RoboCup Rescue 2016 Team Description Paper YRA

MohammadReza Jenabzadeh

Info

Team Name:	YRA
Team Institution:	Islamic Azad University Yazd Branch
Team Leader:	MohammadReza Jenabzadeh
Team URL:	http://yra.ir

***Abstract*—In the present article members of YRA team from Islamic Azad University, Yazd, Iran are introduced and some brief explanation on Rescue robot such as mechanical parts, pieces and electronic boards, applied sensors, intermediate softwares, the quality of control and communication between operator and robot are discussed.**

***Index Terms*—RoboCup Rescue, Team Description Paper, YRA.**

Fig. 1. YRA Tele Operationl Rescue Robot

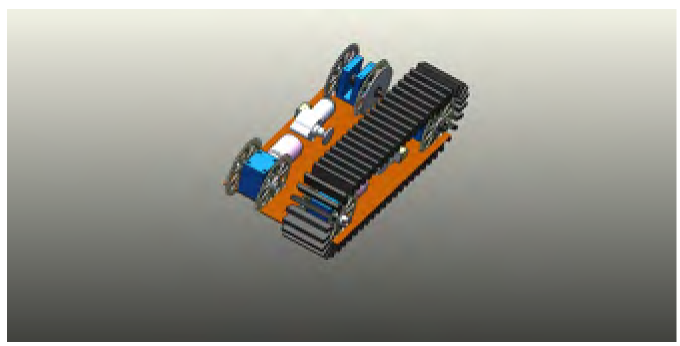

Fig. 2. Motors and straps

I. Introduction

YRA ROBOTIC TEAM, after getting various honors in different country's competitions, and enjoying university authorities support, took part in CHINA 2008, GRAZ 2009, Singapore 2010, Istanbul 2011, Mexico city 2012, netherland 2013, Brazil 2014 and CHINA 2015 robocup competitions. In the Istanbul 2011, concerning experience achieved through the previous round of the game, YRA, among other participants, could achieve a 1'st place in Best in class Manipulation field. Now, the YRA is accomplishing robot-promotion program comprising adjustment of deficiencies observed at previous competitions, in a challenge to have an active and successful presentation in the IRANOPEN2012-2015 and RoboCup2012-2015 competition on Rescue Real and "Best in class" fields. In continue, a more description of members would be presented and a more detail about our robot and how it works would be revealed.

II. System Description

A. Hardware

Refer to the Tables I , II and following as well as Table V in the Appendix.

- Locomotion : Robot propellant force is maintained by motors, that their power for reinforcement is given to the gearbox and gearwheels of robots, and that these gearwheels will move the straps and lead to the mobility of robot. Movement of robots arms is empowered by separate motor and gearbox. Appendix B covers more complete information on the subject.
- Electronics, including micro-controllers, etc. : AP transfers data to a PIC-based microcontroller system, where after processing; necessary signals are passed for control of robots moving motors, arms and cameras motors.
- Manipulation/ directed perception : A 5DOF arm is used for camera up and down motion capability and maintains more complete domination upon environment. It can set camera 90 centimeters higher than robot level. In addition a Hall Effect sensor is used for determining arms situation and better control of robot.
- Sensors : Infrared and CO_2 sensors are used for determining injured-persons temperature and quantity of CO_2 in environment respectively. Moreover, robots installed microphones are used to determining possible sound of injured-persons. In order to define injured-person(s) status (including movement, situation, being over the surface or under debris and) as well as reading the assigned label, an installed camera on robot with zoom capability would be used.

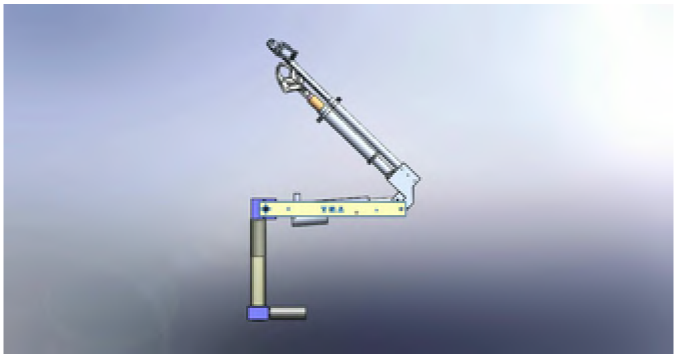

Fig. 3. 5DOF arm

Fig. 4. Microcontroller Board

B. Software

Refer to Table VI in the Appendix.

- mapping : A laser scanner is used for production of map, capable of determining walls and other materials on the ground and therefore is able to draw the way map correctly in such a manner that the place of injured persons would be defined by operator. Application of an accelerometer to assess amount of repositioning, and level difference in the environment would cause better and exact recognition of way-map and injured position. At the end of composition, all exploited signs of injured-persons and way-map would be printed.
- navigation and localization : Following sensors are being used in our application, compass sensor for drawing of map (HMC1052), accelerometer sensor ADXL330 and ADXL212 for estimating amount of repositioning, ultrasonic sensor for determining robot distance from walls and injured-persons, and finally laser scanner sensor for specifying way-map.

Fig. 5. Vivtim Detecting Sensors

C. Communication

To achieve a robot-operator controllable communicative environment, and get pictures, maps, and control signs in an accepted manner, we use competition-site-approved standards. The employed AP is a product of Mikrotik co, capable of using all wireless LAN channels of A, B, and G; therefore upon the day of competition its frequency and channel would be set according to the guideline of holding committee (Appendix A shows AP technical information). Moreover, a remote control key with frequency of 45KHZ and a 16 digit code is being used to ensure the correctness of data. Remote control key is tested in a real environment and is sufficiently persistent and reliable.

D. Human-Robot Interface

Robot is controlled by a joystick connected to operators computer. Next, controlled data are sent in a form of data package to AP sensor by using intermediated designed software. AP transfers data to a PIC-based microcontroller system, where after processing; necessary signals are passed for control of robots moving motors, arms and cameras motors. Robots various activities are controlled by operator which include: back and forth and turning motion, arm movement, and cameras rotation. Recognition of injured persons, vital signs investigation like temperature, CO2, injured movement and his/her voice, label reading by sending sensors data, and pictures of installed cameras on robot through AP are sent to two operator controlled laptops therein we may produce related lists easily.

E. Set-up and Break-Down

Our robot is started by an operator, through a remote control device, and is ready to operate after passing 4 minutes (it is needed for AP to initiate a safe communication with computer). The weight of robot is relatively high (about 30 KG) therefore it is difficult to be repositioned by only a single operator. However, we hope, reducing the weight within the due time before starting-time of the competition, by applying some modification in such a manner it can be handled by an individual person. With respect to intermediatory circuits and other parts and instruments used in the device, it is less likely to face a difficulty or fault during the contests; however, in case of any problem there are ready- spare parts to be replaced quickly.

F. Experiments

For better utilization of robot and acquiring enough skills, a site similar to the competition ground according to current standards, should be built and the operator should also enjoy

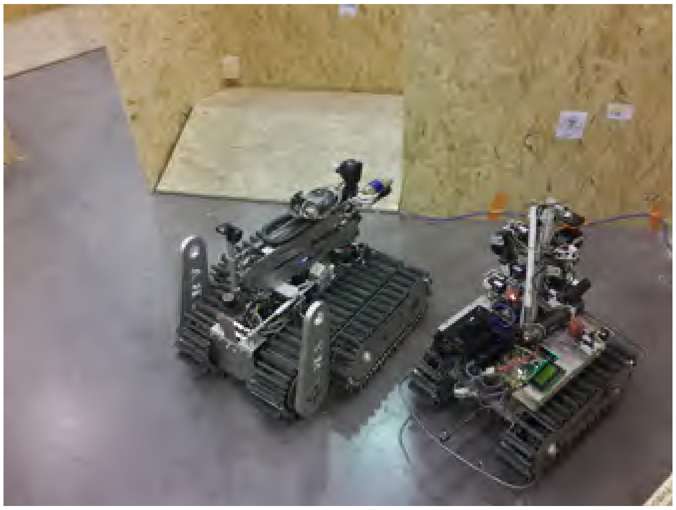

Fig. 6. Autonomous and Tele operation Robots

enough practice to guide robot in appropriate environment and encounter related problems as well. By doing so and continuing our exercises, YRA team tries its best to prepare itself for the competition. Beside, it experienced two participation practices in IRANOPEN competitions and maintained a very good advantage up to now.

G. Application in the Field

With respect to accomplished exercises in the experimental filed, our robot possess a high maneuver power in passing various obstacles and cameras and some sensors that should be installed over robot would only be damaged upon falling over a high position (like stairs) or collapse of debris on it in a real environment. Therefore, if it might be protected against theses dangerous situations, a better practical application would be revealed in a real environment.

Appendix A
Team members and Their Contributions

- MohammadReza Jenabzadeh Team Leader,Advisor, Software
- Seyed Ali Mohammad Mansouri-Tezenji Electronic
- Hadi Sadeghpour Mechanical
- Arsham Belivani-Ardakani Software
- Milad Mohammadi Mechanical
- Jamal Beheshti-Firoozabadi Mechanical
- Mohammad Hossin Karimi Electronic
- MohammadMehdi Bagheri-Fahraji Electronic
- Reza Ebrahimi-Ghale-Ghazi Mechanical

Appendix B
CAD Drawings

Appendix C
Lists

A. Systems List

B. Hardware Components List

C. Software List

TABLE I
Manipulation System

Attribute	Value
Name	Omid
Locomotion	tracked
System Weight	85kg
Weight including transportation case	100kg
Transportation size	0.6 x 0.6 x 0.5 m
Typical operation size	0.55 x 0.8 x 0.5 m
Unpack and assembly time	250 min
Startup time (off to full operation)	10 min
Power consumption (idle/ typical/ max)	100 / 300 / 1000 W
Battery endurance (idle/ normal/ heavy load)	60 / 40 / 35 min
Maximum speed (flat/ outdoor/ rubble pile)	1 / 0.5 / - m/s
Payload (typical, maximum)	15/ 30 kg
Arm: maximum operation height	150 cm
Arm: payload at full extend	3kg
Support: set of bat. chargers total weight	4.5kg
Support: set of bat. chargers power	1,200W (110-240V AC)
Support: Charge time batteries (80%/ 100%)	70 / 100 min
Support: Additional set of batteries weight	8kg
Cost	13000 USD

TABLE II
Autonomous System

Attribute	Value
Name	Arezo
Locomotion	tracked
System Weight	31kg
Weight including transportation case	40kg
Transportation size	0.6 x 0.6 x 0.5 m
Typical operation size	0.5 x 0.5 x 0.5 m
Unpack and assembly time	150 min
Startup time (off to full operation)	5 min
Power consumption (idle/ typical/ max)	100 / 200 / 800 W
Battery endurance (idle/ normal/ heavy load)	80 / 50 / 40 min
Maximum speed (flat/ outdoor/ rubble pile)	.3 / 0.2 / - m/s
Payload (typical, maximum)	10/ 15 kg
Support: set of bat. chargers power	1,200W (110-240V AC)
Support: Charge time batteries (80%/ 100%)	70 / 100 min
Support: Additional set of batteries weight	8kg
Cost	10000 USD

TABLE III
Aerial Vehicle

Attribute	Value
Name	Reyhan
Locomotion	quadcopter
System Weight	3kg
Weight including transportation case	6kg
Transportation size	0.6 x 0.6 x 0.5 m
Typical operation size	0.5 x 0.5 x 0.2 m
Unpack and assembly time	30 min
Startup time (off to full operation)	2 min
Power consumption (idle/ typical/ max)	200 / 250 / 400 W
Battery endurance (idle/ normal/ heavy load)	30 / 15 / 10 min
Maximum speed	6 m/s
Payload	0.25 kg
Cost	2000 USD

TABLE IV
OPERATOR STATION

Attribute	Value
Name	Operator Station
System Weight	10kg
Weight including transportation case	15kg
Transportation size	0.6 x 0.6 x 0.4 m
Typical operation size	1 x 0.8 x 0.5 m
Unpack and assembly time	3 min
Startup time (off to full operation)	1 min
Power consumption (idle/ typical/ max)	300 / 500 / 500 W
Cost	1000 USD

TABLE V
HARDWARE COMPONENTS LIST

Part	Brand & Model	Unit Price	Num.
Drive motors	Buehler 1.61.113 200 W	125 USD	4
Drive gears	Worm Gear Rediuser	75 USD	2
Drive encoder	internal Encoder	-	6
Motor drivers	MD03	100 USD	6
DC/DC	Mornsun	40 USD	4
Battery Management	?	?	1
Batteries	iMax Li-Po	60 USD	10
Micro controller	Atmel Atmega 128	30 USD	1
Computing Unit	Nuc intel	700 USD	1
WiFi Adapter	Mikrotik Metal	100 USD	3
IMU	Microstrain 3DM GX1	1500 USD	1
Cameras	pinhole	30 USD	8
PTZ Camera	Vivotek	300 USD	1
Infrared Camera			
LRF			
CO_2 Sensor		200 USD	1
Battery Chargers	iMax B6	50 USD	8
6-axis Robot Arm	?	?	1
Aerial Vehicle	dji wookong	400 USD	1
Rugged Operator Laptop	Lenovo ThinkPad E530	800 USD	1

TABLE VI
SOFTWARE LIST

Name	Version	License	Usage
Ubuntu	14.04	open	
ROS	jade	BSD	
OpenCV [?], [?]	2.4.8	BSD	Victim and motion detection
Hector SLAM [?]	0.3.4	BSD	2D SLAM
Proprietary GUI	0.2	closed source	Operator Station
Zbar	0.1	GNU LGPL	Qrcode detection