RoboCup2005
Rescue Robot League Competition
Osaka, Japan
July 13 – 19, 2005
www.robocup2005.org

RoboCupRescue - Robot League Team InSE. V.1 (THAILAND)

Taweedej Sirithanapipat[1],
Danucha Pasertsom[2], Pinit Khunsuwong[2], Adisak Duangkaw[2], Thongchai Photsathian[2]

[1] Thai Robotics Society Committee
Asst. Professor, Faculty of Engineering, Kasetsart University, Thailand

[2] King Monkut's Institute of Technology, North Bangkok, Prachin Buri

Abstract. The rescue robot from InSE V.1 team has inspired from the robot in Armageddon movie. The robot needs to be designed for searching and locating the victim in a hostile disaster environment. The robot must be able to move into the place that inaccessible by the human. Our team's robot won the Thailand Rescue Robot Championship 2004 contest which was the first time rescue robot contest in Thailand. The regulation for the local contest has been modified and simplified to suit the budget and effort for every teams entered the first time competition.

Introduction

3 members in InSE.V.1 team who interested in rescue robot contest are engineering students in King Monkut's Institute of Technology, North Bangkok, Prachin Buri. The team advisor is a staff at Bangkok's Campus. The first robot in 6 months name's InSE V.1 was made to compete in Thailand Rescue Robot Championship 2004 organized by the Thai Robotics Society and sponsored by the Siam Cement Group (Thailand), first time rescue robot contest in Thailand, see Figure 1 to Figure 5. InSE.V.1 stands as the winner. We design the robot InSE V.1 for searching victim in difficult place to access and identify the victim situations to the rescue team members. We use the common electronics and mechanic equipments that easy to buy off the shelf in the market, because of their availability and reasonable deals.

1. Team Members and Their Contributions

- Team leader : Mr. Danucha Pasertsom
- Operator : Mr.Pinit Khunsuwong
- Mechanical design: Mr.Adisak Duangkaw
- Controller development : Mr.Thongchai Photsathian

Supervised by The Thai Robotics Society and financial supported by the Siam Cement Group (THAILAND)

2. Operator Station Set-up and Break-Down (10 minutes)

The robot setup is divided in 2 main tasks :

1. Control room setup
2. Robot setup

The operation setup procedures are described as

1. Control room preparation such as computer and peripherals setup, communication devices setup, and bring the robot to the starting point, this takes approximately 3 minutes.
2. Check all sensor and communication systems to make sure they work at the right manners along with the command from the control room, this takes approximately 2 minutes.
3. Verify by the operator from the control room by transmitting and receiving the data from the camera and all sensors interact with the robot for calibration, this takes approximately 5 minutes.

3. Communications

For connection between control room and the robot, we design the connection with 2 types.

1. The connection for control robot by remote control. We use frequency range 72 MHz (7 channels)
2. The connection for receive and send the data from sensors, CO2, Digital compass, Temperature sensor, Pulse encoder and Motion Picture signal use Microcontroller for adjust data to Ethernet I/O. Ethernet I/O will send data from Microcontroller by Wireless LAN network and use Access point frequencies range 2.4 GHz. for receive and send data.

Rescue Robot League	
InSE V.1(Thailand)	
Frequency	Channel
IEEE 802.11b/g 2.4 GHz	1,6,10
72 MHz	7

This will be changed according to the final official Rescue Robot League Competition.

4. Control Method and Human-Robot Interface

The operator will acknowledge the sensor data via the computer monitor. The graphic user interfaces of the sensor signals will show the values of the temperature, CO_2 level. The motion and sound can be detected by the camera casting on the monitor. This will enable the operator to remote control the robot to search and identify for the victims in the hostile area.

5. Map generation/printing

There will be a semi-automatic generating the map to search for the victim :

1. Automatically generate the map on the computer using the encoder attached to the wheel combined with the digital compass for telling the direction and position of the moving robot.
2. Manually annotate the interest item such as the victims and other objects on the marked grid on the map.

6. Sensors for Navigation and Localization

InSE.V.1 robot uses digital compass, using the changing in earth electro-magnetic field and the processing of the microcontroller, the signal from the digital compass is processed and transmit via the I^2C architecture, to specify the position of robot in competition area and read the encoder form the motion of wheels to compute the distance and the direction to move to the victim.

7. Sensors for Victim Identification

We put up the sensors such as infrared thermometer into InSE V.1 for look for the victim and check the temperature of the victim that they still alive. The infrared radiation type of temperature sensor is installed on the robot. Without any contact to the object, this temperature sensor measurement ranges from -40 ˚C to 600 ˚C.

The CO_2 sensor can measure the concentration of the CO_2 gas in the range of 350–100,000 ppm. The output signal is passed through the amplifier, signal conditioner and then converted from analog to digital output.

The video camera is used to capture the motion and sound of the alive victims in the arena. The omni direction microphone installed with the camera will send back the background sound to the operator in the control room to identify the victims.

We use ultra-sonic for specify the position and distance between the robot and the victim. The data from sensors will send to control room. The data will manage by Process Control Unit connect with Wireless Access Points for send the data to control room. The electronic architecture communication chart is shown in Figure 11.

8. Robot Locomotion

Equipment	weight (kg.)
DC motor x5	5
Stepping motor x1	1
2 gear wheels	1
2 Chains	2
shaft x1	1
Body	3
Hand	1
total	14kg

9. Other Mechanisms

We design the robot have 8 wheels. 6 wheels are on the body and 2 wheels are on the hands of the robot. The robot can move to difficult surface and 2 wheels in front of the robot can help the robot stand when move to slope surface. For the motion, we use 4 DC motors and 2 chains for move the wheels and we use stepping motors for control the motion of the hands of the robot. See also Figure 9 and Figure 10.

10. Team Training for Operation (Human Factors)

Major preparation before the competition is as describe below :

1. Setup preparation within 10 minutes is required a laborious training with the robot starting, immediate fixing in case of accidental failure and robot maintenance. The more practice, the less unexpected errors we encounter.

People in charge :

- Mr. Danucha Pasertsom
- Mr.Thongchai Photsathian
- Mr.Adisak Duangkaw

2. Robot remote operating control has been practiced several times with the simulated competition situations. Then the output data is used to correct and improve the performance of the remote control operator.

People in charge :

- Mr.Pinit Khunsuwong

11. Possibility for Practical Application to Real Disaster Site

The structure mechanic and components of InSE.V.1 team have been proved for the functioning of the robot in the simulated situation used in the Thailand Rescue Robot Championship 2004 competition. The mechanism shows the ability to overcome the uneven terrain, extremely dangerous area, highly chemical contamination area. However the limitation of this system is due to the highly electronic components with incomplete protection. So the searching in the highly damp and wet area is under consideration of a highly protective redesign phase.

12. System Cost

Since most of the parts are bought in the local market, so there are not much information or useful data available except the national standard one. At this moment the money unit is in Baht.

TOTAL SYSTEM COST (per robot): Bahts 148,000

---

1 Mechanics :	
- DC Motor, chain and gear drive system	6,000-
- Fasteners	2,000-
- Aluminum sheet	4,500-
- Labor cost	4,000-
2 Wireless sets :	
- CMOS cam	5,000-
- IP address adapter from CMOS cam	20,000-
- Access Point	
3 Sensors :	
- Infrared temp. sensor	20,000-
- CO_2 sensor	15,000-
- Ultrasonic position/distance sensors	4,000-
- Digital compass	2,600-
4 Control	
- Ethernet IO	4,200-
- Remote Control	14,000-
- Motor driving circuit board	3,000-
- Board microcontroller	1,400-
- Cords , PCB	3,000-
5 Power Supply and accessories	
- Battery	16,800-

- Battery charger	5,000-
- Transformer 110 V to 220 V	1,500-
- Power Supply circuit board	3,000-
- Robot and accessories container	3,000-
- others	6,000.-

-References

www.design-gateway.com
www.planet.co.tw

APPENDIX:

Figures and Photographs

Note : You can reach the pictures archives at http://www.kucity.com/robot

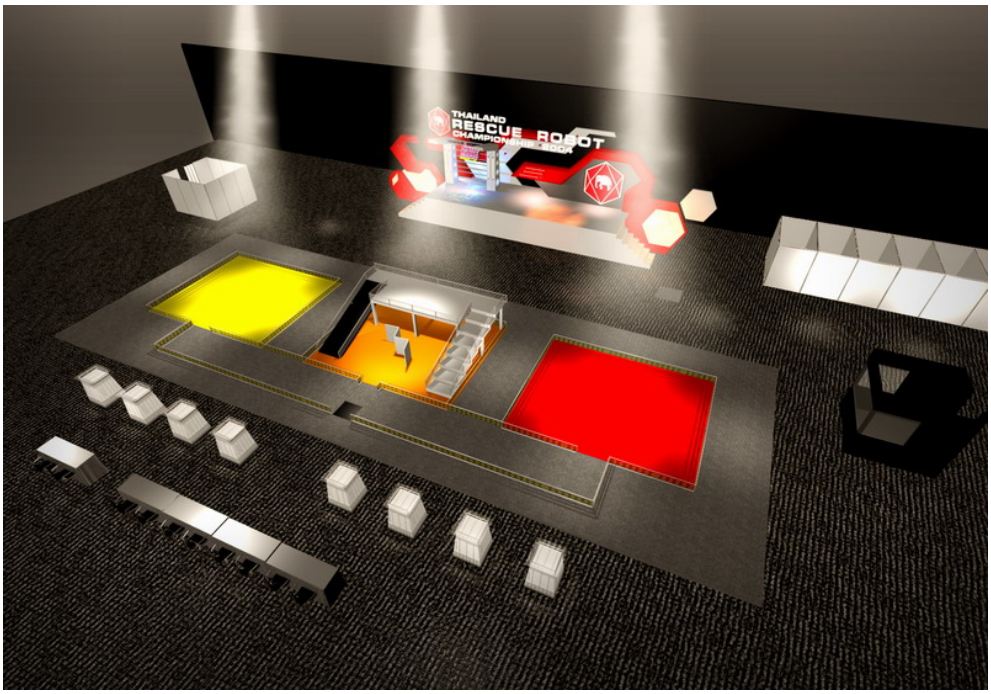

Fig. 1. Computer graphic for the final round arena of Thailand Rescue Robot Championship 2004 .

Fig. 2. First round contest for the orange level arena.

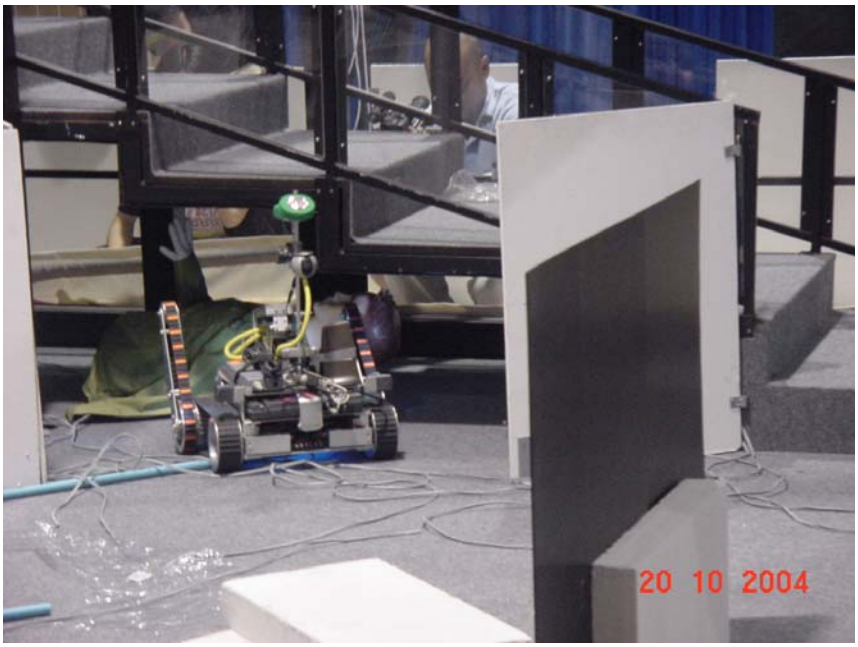

Fig. 3. First round contest.

Fig. 4. Opening ceremony for the final round.

Fig. 5. Opening ceremony for the first round competition (Staff and committee).

Fig. 6. InSE.V.1 Robot on the uneven muddy terrain.

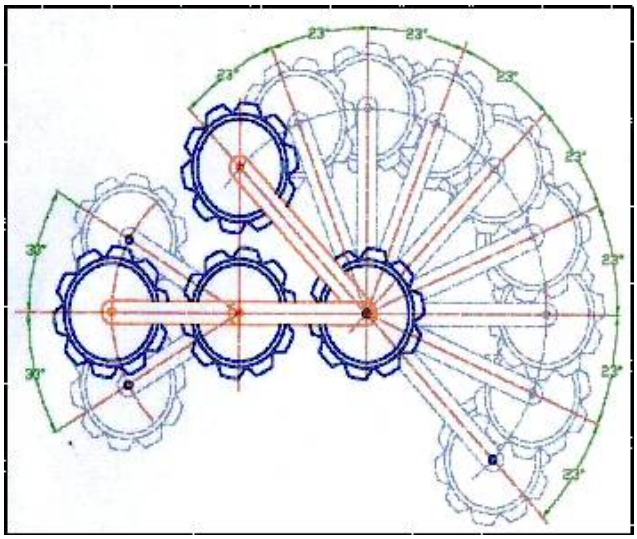

Fig. 7. Drawing sketch shows the link travel ranges.

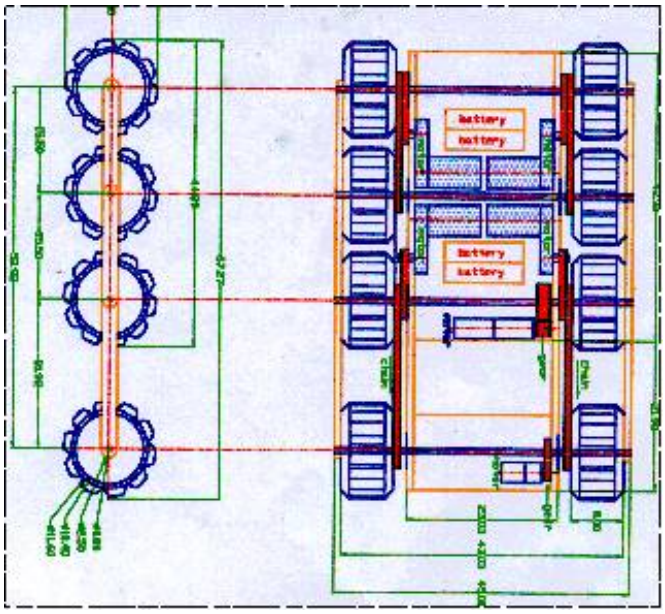

Fig. 8. CAD shows dimension and position of each mechanic component.

Fig. 9. A real assembly of the mechanic system.

Fig. 10**.** Mechanism shows the climbing step.

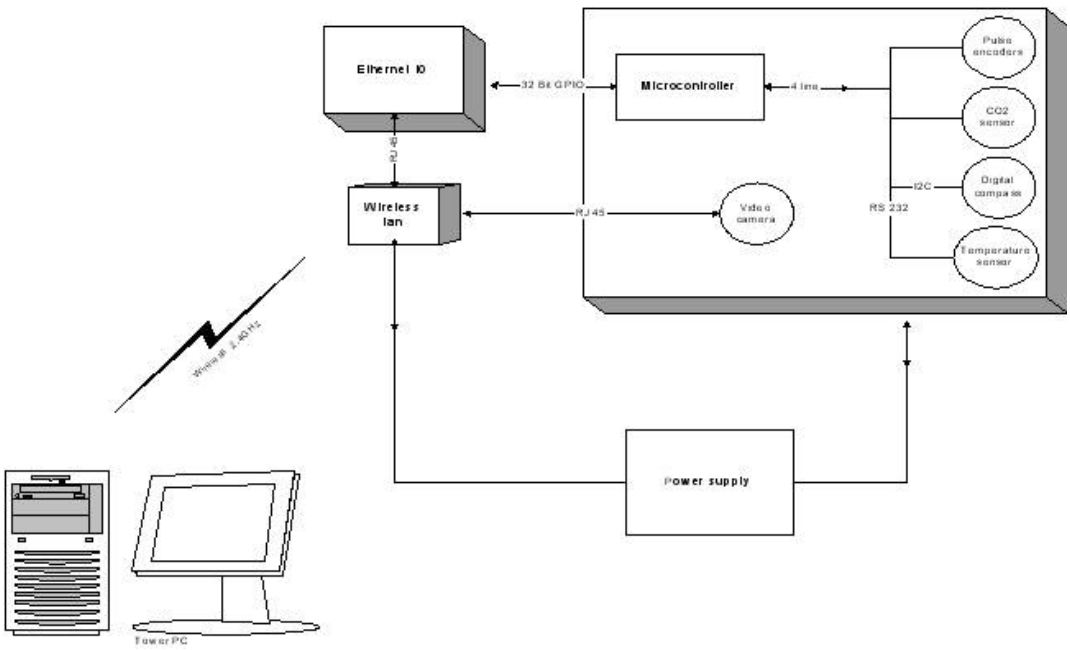

Fig. 11. Electronic communication architecture.

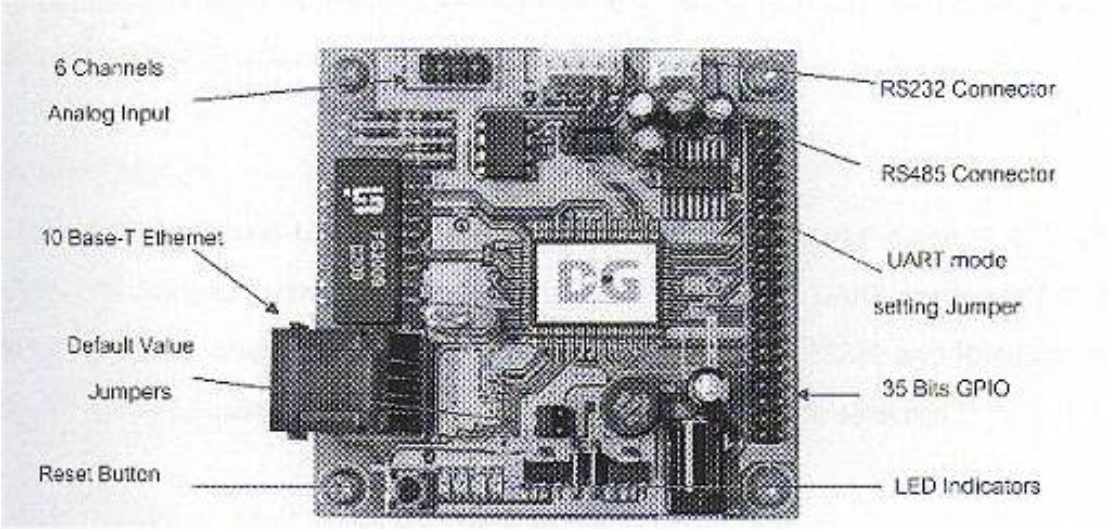

Fig. 12**.** Sample of the market available electronic board.

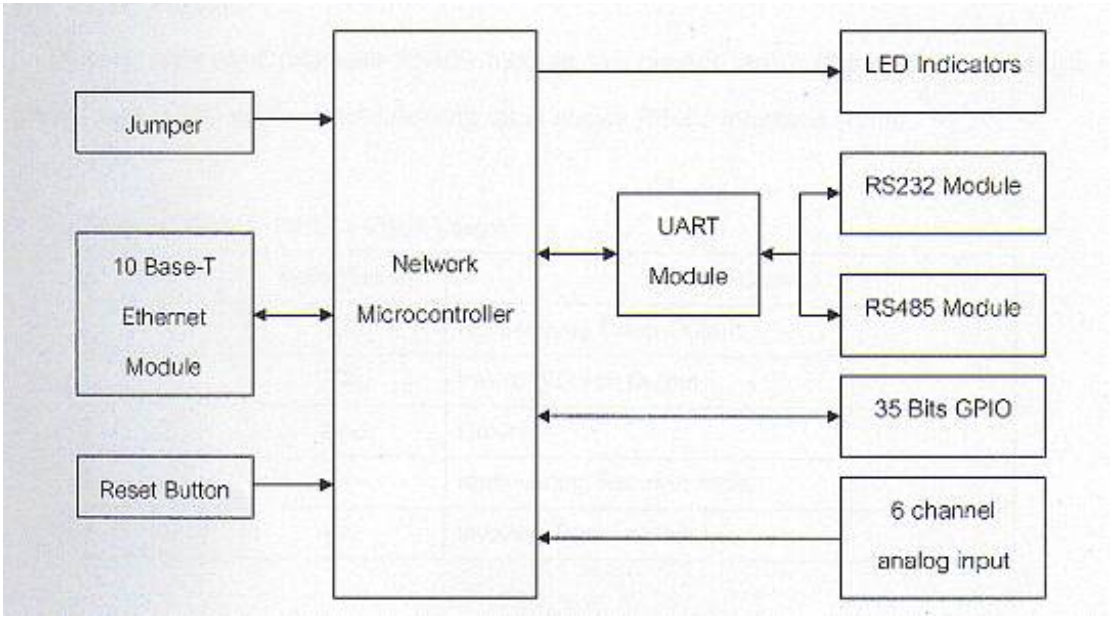

Fig. 13. structure diagram of the electronic board.

Fig. 14. Orange arena in the final round competition.

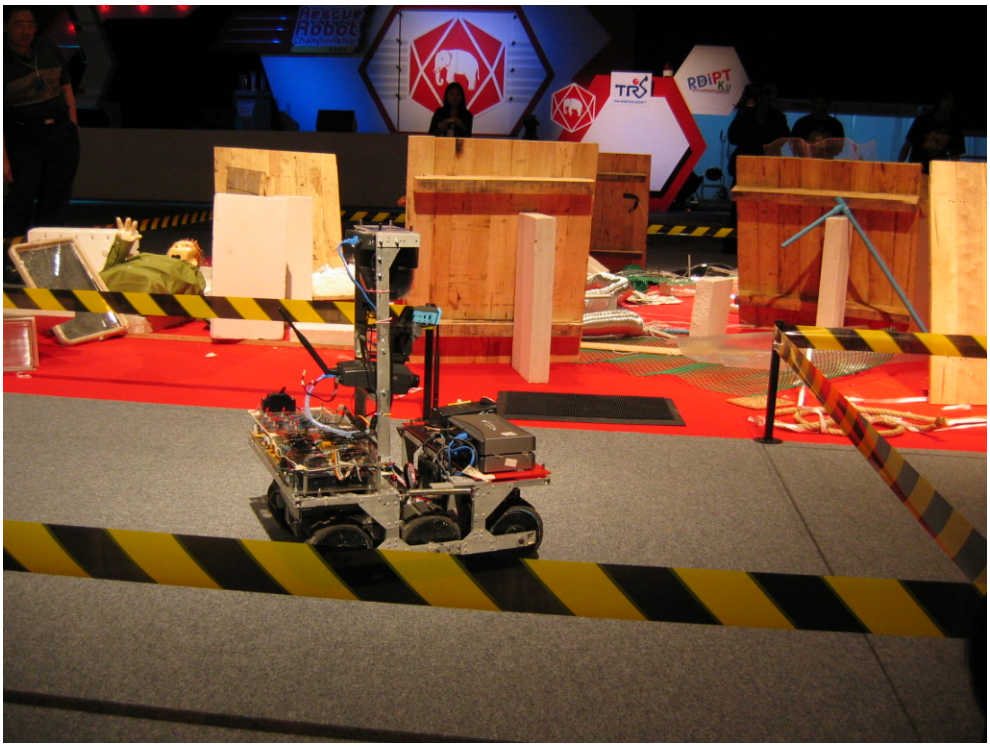

Fig. 15. Red arena in the final round competition.

Fig. 16. Setting up the arena (Visitors on the background).

Fig. 17. Closing ceremony.

Fig. 18. Organizing Staff.