RoboCup2005
Rescue Robot League Competition
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RoboCupRescue - Robot League Team NuTech-R (Japan)

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Abstract. At 23rd October 2004, in CHU-ETSU area in Japan, we had great earthquake, in which over 100,000 people evaluated. Our university is in the CHU-ETSU area in Japan so that we had a lot of lessons in rescue activities. Through this Robocup, we would like to evaluate not only our ideas for the robot features but also the Human-Robot interaction, e.g., safety joy-stick.

1. Team Members and Their Contributions

- Team Leader: Tetsuya KIMURA(Nagaoka University of Technology(NuTech))
- Operator: Wong Choon Vui(NuTech), Kazuya MORI(NuTech)
- Mechanical design: Kazuya MIYAGAMI(NuTech), Manabu YAMAMOTO(NuTech), Nagaoka Ironsmith Organization
- Controller development: Daichi KUDO(NuTech)

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

Our operating system aims to use in rescue site, so it is small, mobile, and independent. See the photos below. Therefore, the set-up and break-down needs a few minutes.

Figure 1. Operating board

3. Communications

The communication system for our main robots is passive tethered, so there is no problem related wireless communication. We are planning to use an additional simple robot like “Red Tank” of SINOBI team in Japan. This simple robot will use wireless communication with 802.11a and RC(Radio Communication) frequency for hobby.

Rescue Robot League		
NuTech-R (Japan)		
MODIFY TABLE TO NOTE ALL FREQENCIES THAT APPLY TO YOUR TEAM		
Frequency	**Channel/Band**	**Power (mW)**
5.0 GHz - 802.11a	Following Japanese regulation	Following Japanese regulation
2.4 GHz - 802.11b/g	none	
2.4 GHz - Bluetooth	none	
2.4 GHz - Other	none	
1.2 GHz	none	
900 MHz	none	
40 MHz	Following Japanese regulation	Following Japanese regulation
27 MHz	none	
72 MHz	Following Japanese regulation	Following Japanese regulation
<FILL IN OTHER>		

4. Control Method and Human-Robot Interface

4.1 Control Method

Our robots are controlled by remote teleoperation. Movement of robot is controlled through controlling the motor power by the operator directly. Movement of camera on the robot is controlled by the operator in order to controlling the position of the camera and zoom level. The camera is a commercially available IP-camera.

4.2 Human-Robot Interface

"On site use" is our main purpose of Human-Robot Interface, which is small and mobile as shown in Fig. 1. The CRT is a general notebook PC. The own-made joy-stick controller has special feature, that is, it produces OFF-ON-OFF signals according to input force(See Fig.2), so that it produces OFF signal for larger input. Such large input could be happened when the joy-stick hits something or the operator falls to floor.

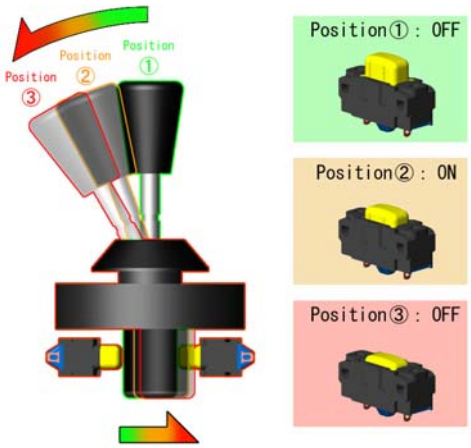

Figure 2. Joy-stick with OFF-ON-OFF states

5. Map generation/printing

The operator inputs the measured data to a CAD system manually. The result is printed out by a mobile printer.

We have been using a Laser Range Finger to generate map more precisely. This is a Level 2 class laser so we stop to use in the contest for the safety of the audience, but we would like to use it when we can try a practice without the audience.

6. Sensors for Navigation and Localization

Our team is composed of two robots. Each robot's cameras see each others.

7. Sensors for Victim Identification

Color network camera with remote control of pan(plus-minus 100degree), tilt(-30 to +90 degree) and zoom(x16) or equilibrant is used.

8. Robot Locomotion

The robot has two crawlers, where the sub-crawler is located in INSIDE of rear side, which has better stiffness than OUTSIDE one (Our former one is OUTSIDE). By using the rear sub-crawler it can climb the stair in a stable condition. See Fig.3

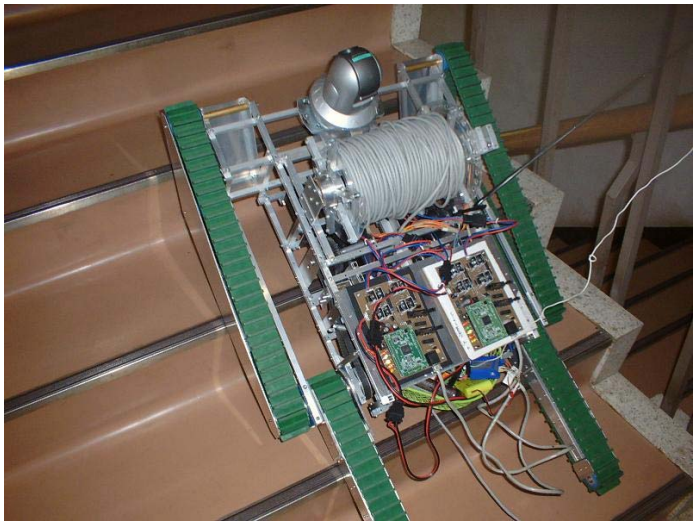

Figure 3. Robot climbing stair

9. Other Mechanisms

Two robots make a team, where both robots have equilibrant mobility and have cameras which can watch each other. Such cooperation is common for human rescue operation. Both robots are tethered so that the operation in order to avoid the wire confliction is a difficult issue, but this would be overcome by the training of the operators.

10. Team Training for Operation (Human Factors)

We have participated Robocup2003 Japan Open, Robocup 2004 Japan Open, Robocup 2005 World Competition. Theses experiences gives us a lot of lessons for human factors.

In addition, we are planning to use a rescue training site in NPO International Rescue System Institute in Japan to train our staffs. Furthermore, we have seen a lot of disaster area at CHU-ETSU great earthquake area in Japan, which happened in 23rd, October 2004. Our university in the CHU-ETSU area, so we had a lot of experience of rescue activities.

11. Possibility for Practical Application to Real Disaster Site

The operation board with a safety joy-stick composed of three position switches, which avoid the robot reaction due to unintended command input, will be applicable to a real disaster site with minor modification because the main parts of the board is used in tough environment in many heavy industry factories, e.g, with oil, water and dust. According to our study so far, this joy stick reduces the error to 13% and has 80% controllability comparing to a normal joy-stick.

12. System Cost

- Main and sub crawlers: 200,000 yen, a standard product of Gates Unitta Asia Co. http://www.unitta.co.jp/
- Visual sensor: 230,000 yen, Network camera VB-C10 of canon, http://www.canon.co.jp, http://cweb.canon.jp/Product/vsl-com/vbc10.html
- Laser distance meter:110,000 yen, LEM30 of JENOPTIK Co.
- Three position switch: some thousand yen. IZUMI ELECTRIC Co. http://www.idec.com

TOTAL SYSTEM COST (per robot): 1,000,000yen

KEY PART NAME:	three position switches for safety joy-stick
PART NUMBER:	4
MANUFACTURER:	IDEC Corporation.
COST:	50$/switch
WEBSITE:	http://www.idec.com/japan/
DESCRIPTION/TIPS:	