RoboCup Rescue 2016 Team Description Paper Team Name

Robo Hero, John Doe, and Jane Doe

Info

Team Name:	The Nameless Team
Team Institution:	Moon University
Team Leader:	Robo Hero
Team URL:	https://moon.edu

RoboCup Rescue 2016 TDP collection: https://to-be-announced.org

***Abstract*—The abstract goes here. Do not describe RoboCup Rescue in detail - concentrate on your robots, their main capabilities and what sets them apart from the competitors.**

***Index Terms*—RoboCup Rescue, Team Description Paper, up to 3 others.**

I. Introduction

PLEASE use this Team Description Paper (TDP) template to answer the following questions about your team's approach to designing, fabricating, controlling, and operating your urban search and rescue robot team. We will likely have many more teams interested in participating than we can accommodate, so we will use this paper to initially qualify your team for final registration. We are looking for teams showing solid progress toward a functioning system, particularly innovative approaches, and well formulated (and well described) team strategies. Timely submittal of this and other documents is also appreciated.

It is very important that you follow this particular template regarding formatting. From 2016 on we will make the TDPs of all qualified teams publicly available via the webpage **to update** and also on arXiv.org . We understand that at this early date your system is likely not fully realized, so we expect this document to be incomplete in parts. However, we expect you to articulate at least some ideas in each area outlined below. The more comprehensive your approach appears, the more favorably it will be reviewed. If you have hardware implemented, please add lots of pictures as you describe your system, and give details regarding the parts themselves (sensors, motors, joysticks, etc). If you have drawings of your system, please include them. If you have particular team strategies, please describe them. Otherwise, please attempt to describe at least the direction you are going in any given section and what we can expect to see at the competition. Please also describe how your operator(s) plan to interact with your system.

Robo Hero is with the Department of Robotics Gurus, Moon University, Moon, e-mail: .

J. Doe and J. Doe are with Anonymous University.

Fig. 1. Photo of your robot. Should ideally be located in a corner with lines 10cm apart (at least on the ground). Take the photo from an angle such that front, side and top are visible. This photo should appear on the first page of your document exactly where it is placed in the template! If you have other robots or an unusual operator station add those in extra figures.

The TDP is not the place to describe your awesome new approach in all details with experiment that proof the performance, etc. This should go into an extra paper. Anyways be sure to cite all your relevant publications and also the according publications of other researchers, for example [1], [2], [3], [4], [5], [6], [7]... The TDP is an overview paper to show how the system performs as a whole. The introduction should give an overview of your systems and your approach to RoboCup Rescue.

A. Submission

If you are a) accepted for the RoboCup Rescue competition, b) payed the registration fees AND c) participated in the event we plan to publish your TDP on the webpage and arXiv.org . We plan to do the upload to arXiv for you. In order to do so you need to:

- submit your TDP as PDF **AND** the Latex source files including images, biliography, etc. (for publication in arXiv.org) http://arxiv.org/help/submit_tex (if you use the LaTeX template)
- We do accept TDPs created in Word if they closely follow the example layout. Be sure to submit the PDF! http://arxiv.org/help/submit_pdf
- The RoboCup Rescue OC needs you to give us the rights to publish your TDP. Additionally you need to grant us the following rights http://arxiv.org/licenses/nonexclusive-distrib/1.0/license.html. Do so by filling out and signing the following form: https://to-be-announced.org.

- If you have any supplemental material that should be uploaded to arXiv you have to submit to us in LaTeX. http://arxiv.org/help/datasets

After the competition we will give you four weeks to improve and extend your paper based on our comments and based on your lessons learned from the competition.

Obviously, do not include any of the TDP template preparation instructions in your TDP ;)

B. Improvements over Previous Contributions

If you have previously participated at RoboCup Rescue, describe how your system differs and improves from your previous entry.

II. System Description

Use this section to describe your overall system. Depending on the emphasis of your team the different subsections can be of different lengths. Nevertheless please be as detailed as possible. The advantages are:

- Get qualified for RoboCup Rescue by having a detailed system description.
- Document your teams approach.
- Allow a comparison of your team with other teams.
- Allow a comparison between different years of RoboCup and thus (hopefully) a documentation of the improvements through the years.
- Allow other and especially new teams to kick-start their research by copying your system.

A. Hardware

Document the hardware of your system. This can be very brief if you bought the robot (in this case mention the major modifications). The first image of this document (should also appear on the first page) should be a photo of your real robot - see Figure 1.

Refer to the Tables I and following as well as Table IV in the Appendix - there is no need to document part here in detail if it is sufficient to know that it is used from the tables. Please also share your CAD drawings or electronics plans with the community! Do so by adding a big picture to the appending AND by providing the files in a commonly used format as ancillary files http://arxiv.org/help/ancillary_files.

Explain your approach regarding those topics - create relevant subsubsections as needed:

- Locomotion
- Power (Batteries)
- Electronics, including micro-controllers, etc.
- Manipulation/ directed perception
- Sensors
- Computation (high performance for autonomy, etc.)
- Communication is covered in its own subsection - mention the regarding hardware and software there.
- Others...

B. Software

Refer to Table V in the Appendix.

Explain how your software works. Create relevant subsubsections as needed. You might want to explain:

- low level control
- communication protocol (video, commands, data)
- localization
- mapping
- autonomy
- victim detection
- path planning
- navigation
- arm control
- arm planning
- ...

C. Communication

Please use this section to describe your plan for communicating with your robots (passive tether, active tether, radio, etc.) Double check the rules regarding restrictions and rules!

D. Human-Robot Interface

Explain how your robot is controlled. What does the operator see? In which ways can he interact with the robot? Also describe how a potential user should be trained and how you trained the operator for your team.

III. Application

This section covers the practical aspects of your system...

A. Set-up and Break-Down

Please use this section to describe your plan for set-up and break-down of your the robots and the operator station.

B. Mission Strategy

If not already covered in the Introduction, explain your overall strategy to the RoboCup Rescue Challenge. Also mention what you cannot or don't want to do.

C. Experiments

Explain how you verify your system. Did you build any standard test methods for testing your robot? What kind of experiments and validations did you do with your hardware/ software/ overall systems? What did you learn?

D. Application in the Field

Discuss how your system is applicable to the field of search and rescue. Where are its strength and weaknesses? What do you think would be possible to improve in the near and medium future towards using it in real scenarios?

IV. Conclusion

The conclusion goes here. Brief summary, outlook to the competition, lessens learned from previous competitions, etc.

TABLE I
MANIPULATION SYSTEM

Attribute	Value
Name	MoonRobbi
Locomotion	tracked
System Weight	23kg
Weight including transportation case	28kg
Transportation size	0.6 x 0.6 x 0.5 m
Typical operation size	0.5 x 0.8 x 0.4 m
Unpack and assembly time	180 min
Startup time (off to full operation)	10 min
Power consumption (idle/ typical/ max)	60 / 200 / 800 W
Battery endurance (idle/ normal/ heavy load)	240 / 120 / 60 min
Maximum speed (flat/ outdoor/ rubble pile)	4 / 1 / - m/s
Payload (typical, maximum)	3/ 10 kg
Arm: maximum operation height	160 cm
Arm: payload at full extend	2kg
Support: set of bat. chargers total weight	2.5kg
Support: set of bat. chargers power	1,200W (100-240V AC)
Support: Charge time batteries (80%/ 100%)	90 / 120 min
Support: Additional set of batteries weight	2kg
Any other interesting attribute	?
Cost	5000 USD

TABLE II
AERIAL VEHICLE

Attribute	Value
Name	MoonFly
Locomotion	quadcopter
System Weight	3kg
Weight including transportation case	6kg
Transportation size	0.6 x 0.6 x 0.5 m
Typical operation size	0.6 x 0.6 x 0.2 m
Unpack and assembly time	10 min
Startup time (off to full operation)	2 min
Power consumption (idle/ typical/ max)	100 / 150 / 300 W
Battery endurance (idle/ normal/ heavy load)	30 / 20 / 15 min
Maximum speed	12 m/s
Payload	0.15 kg
Any other interesting attribute	?
Cost	2000 USD

TABLE III
OPERATOR STATION

Attribute	Value
Name	MoonOp
System Weight	3.2kg
Weight including transportation case	4.5kg
Transportation size	0.4 x 0.4 x 0.2 m
Typical operation size	0.4 x 0.4 x 0.4 m
Unpack and assembly time	1 min
Startup time (off to full operation)	1 min
Power consumption (idle/ typical/ max)	60 / 80 / 90 W
Battery endurance (idle/ normal/ heavy load)	10 / 5 / 4 h
Any other interesting attribute	?
Cost	2000 USD

APPENDIX A
TEAM MEMBERS AND THEIR CONTRIBUTIONS

Please use this section to recognize all team members and their technical contributions. Also note your advisors and sponsors, if you choose. You may want to include links to homepages.

- Adam Jacoff — Controller development
- Satoshi Tadokoro — Mechanical design
- Robo Hero — SLAM algorithm

APPENDIX B
CAD DRAWINGS

Put one or two nice views of your CAD drawings (for hardware teams - software teams can delete this section). Keep in mind that you can use *\begin{figure*}* to display an image in full width.

APPENDIX C
LISTS

A. Systems List

For every system (each robot individually robot incl. support, Operator Station) answer the following items. One table per system. Remove entries that do not make sense. If a number is unknown try to estimate it or put a question mark (do not delete the entry if it might be interesting but you don't know the answer).

B. Hardware Components List

List all interesting components of your Robots and Operator stations. Include a hyperref link to the product page if possible - see the examples.

C. Software List

List all relevant software packages you (actually) use! Include a hyperref link to the software page if possible - see the examples. Include version numbers.

If you are using some advanced algorithms be sure to cite the according papers.

When it is not very obvious explain briefly what the software is used for in usage.

TABLE IV
HARDWARE COMPONENTS LIST

Part	Brand & Model	Unit Price	Num.
Drive motors	Maxon RE 50 200 W	CHF 870	2
Drive gears	Planetary Gearhead GP 52		2
Drive encoder	Encoder HEDS 5540		2
Motor drivers		?	2
DC/DC		?	1
Battery Management		?	1
Batteries		?	1
Micro controller		?	1
Computing Unit		?	1
WiFi Adapter		?	1
IMU		?	4
Cameras		?	4
PTZ Camera		?	1
Infrared Camera		?	1
LRF		?	2
CO_2 Sensor		?	1
Battery Chargers		?	4
6-axis Robot Arm		?	1
Aerial Vehicle		?	1
Rugged Operator Laptop		?	1

TABLE V
SOFTWARE LIST

Name	Version	License	Usage
Ubuntu	14.04	open	
ROS	jade	BSD	
PCL [8]	1.7	BSD	ICP
OpenCV [9], [10]	2.4.8	BSD	Haar: Victim detection
OpenCV [11]	2.4.8	BSD	LBP: Hazmat detection
Hector SLAM [12]	0.3.4	BSD	2D SLAM
Moon 3D Mapping	0.8	GPL	3D Mapping
Proprietary GUI from Moon U.	0.7	closed source	Operator Station

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