Eurathlon 2013

Scenario Application Paper (SAP) – Review Sheet

Team/Robot ELP/Packbot
Scenario Reconnaissance and surveillance in urban structures (USAR)

For each of the following aspects, especially concerning the team's approach to scenario-specific challenges, please give a short comment whether they are covered adequately in the SAP.

Keep in mind that this evaluation, albeit anonymized, will be published online; private comments to the organizers should be sent separately.

Robot Hardware

Packbot 510 commercial product from Irobot. IP67, can climb slopes over 50% as well as stairs. 30Kg. Options include arm and cameras. Description looks like a copy-paste from commercial brochure.

Processing

On-Board Pentium 4 ETX with flash running linux. Software is standard linux and Irobot aware framework.

Communication

2.4GhZ wireless Lan and wireless Radio. Comms range from 1200m LOS and can be extended using repeaters. Fibre Optic cable optional (up to 250m). No discussion on 'realistic' reliable range in indoor environment.

Localization

Based on IMU and GPS. No sensor based navigation apart from odometry.

Sensing

Various on-board diagnostics sensors, audio and 4 video cameras with IR and visible LED-illumination. Mention the possibility of using a LIDAR for mapping but not clear if it will be integrated.

Vehicle Control

Not specified. Some autonomous behaviour to try to regain comms in case of failure.

System Readiness

Product with no adaptation for competition. Might do well or struggle in complex situation. Fully teleoperated. Comparable to armadillo from Allen Vanguard in terms of approach. Large experience in disaster scenarios (World trade centre, Fukushima).

Eurathlon 2013

Overall Adequacy to Scenario-Specific Challenges

Very simple reliable product with no autonomy. Provides a good basis for state of the art benchmark for small class (<30Kg) UGV. SAP is a copy paste from brochure and therefore very limited.

euRathlon 2013

Team ELP

Scenario Application Paper

Reconnaissance and surveillance in urban structures

Author: Colin Weiss

Technical Director
ELP GmbH
European Logistic Partners
e-mail: cweiss@elp-gmbh.de

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Vehicle:

The PackBot 510 EOD is a field-proven, commercially available platform that is deployed throughout the world. It is a modular, ruggedized, lightweight (approx. weight: 30 kg depending on configuration) and highly maneuverable platform capable of carrying numerous different payloads.

The vehicle is IP-67-rated and can be submerged in 1.2m depth for over 1 hour. PackBot can climb hills in excess of 50° depending on surface conditions and is capable of climbing various different kinds of stairs.
Two Flippers mounted in the front of the robot assist in climbing stairs and overcoming obstacles.

Available payloads include manipulator- and camera-arms and communications- as well as sensory and computational payloads. By utilizing standardized hardware-Interfaces (Power, USB, Ethernet, Video) and a powerful, embedded Linux platform, it is very easy to add additional sensors and extend the system with further capabilities.

The operational runtime with 4 Li-Ion Batteries averages 15 hrs., depending on driving activity and power consumption of external sensors.

Processing:

On-board Pentium 4 ETX-Computer with integrated flash memory. The System is based upon the “Common OS” Linux-Platform and the iRobot Aware 2 Software Framework.
The software is field-proven, with thousands of units deployed across the world.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Communication:

The system supports any IP-based communications medium. The chassis features a built-in 2.4 GHz Wireless LAN radio (802.11g). Optionally, a 4.9 GHz (802.11a-derivative) radio-module can be mounted for improved performance in environments where the 2.4 GHz-Band cannot be used. Typical effective communication ranges go up to 1.2km line of sight and beyond, depending on conditions.

The system is capable of extending its operational range by use of MESH-networking.

An optional Fiber optical spooler system carrying up to 250m of optical cable.

If necessary, communication may also be established using UMTS or LTE cellular Networks, as well as satellite links.

Localization:

The PackBot features a built-in digital compass and pitch/roll sensors. Furthermore, 3-axis accelerometers are utilized to detect hard impacts that might damage the robot.

The User Assistance Payload (UAP) features built-in position-sensors and accelerometers as well as a high-precision GPS.

Positional data acquired by the Robot is displayed on the Operator Control Unit (OCU) and is displayed as an overlay of a digital map or Aerial Photo. The route traveled by the robot is also displayed, along with any locations identified as “Points of Interest”.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Sensing:

PackBot carries built-in absolute and relative sensors to monitor the positions and movements of its joints. The system maintains a 3D-model of itself for purposes of collision avoidance.

Furthermore, all motor voltages, currents and temperatures are constantly monitored as part of a built-in health-monitoring, failure recognition and diagnostics system.

In addition, the robot carries 2-way audio and 4 Video-Cameras with both visible and non-visible (IR) LED-illumination.

The system features interfaces for additional sensors, such as RADAR, LIDAR, Hazardous material and Radiation detectors, temperature and humidity monitors, as well as additional cameras (Thermal or wide-angle)

System Readiness

PackBot 510 EOD is a matured, field-proven, fully functional and ruggedized platform.

TRL: 9 for both hardware and software. (some additional sensors may however be a lower TRL)

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Reconnaissance and surveillance in urban structures (USAR):

PackBot 510 is very capable of climbing stairs due to its strong drive motors and low center of gravity. An experienced operator can even traverse certain types of spiral staircases

It has already proven its capabilities to operate in collapsed structures by searching for buried victims in the debris of the World Trade Center in New York following 9/11/2001, as well investigating and monitoring contaminated areas inside the Fukushima Nuclear Power Station in Japan in the aftermath of the 2011 Tsunami.

In areas without GPS reception, the Aware 2 Framework permits the robot to track its route and heading using internal odometry as well as built-in compass, which are also utilized to compensate for skidding and ground-slippage.

With its manipulator-arm, PackBot is able to open doors and clear light-weight pieces of debris from its path.

While limiting effective visible range, smoke, dust and mud do not damage the sensors deployed.

Depening on the situation, PackBot can be fitted with a LIDAR-system to create a map of the area it is searching. The map is then displayed on the OCU.

Furthermore, either a wide-angle camera or a thermal camera are attached to the robot in order to help search the structure.

If PackBot loses communication with its control station, it will try to re-establish communications. If unsuccessful, it will retro-traverse up to 20 meters in intervals of 5 meters to try and return into range of the OCU.
Furthermore, MESH-Networking Technology may be utilized using either stationary nodes dropped off by the robot or a smaller, mobile repeater node to increase effective communications range.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

euRathlon 2013

Team ELP

Scenario Application Paper

Reconnaissance and surveillance in urban structures

Author: Colin Weiss

Technical Director
ELP GmbH
European Logistic Partners
e-mail: cweiss@elp-gmbh.de

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Vehicle:

The PackBot 510 EOD is a field-proven, commercially available platform that is deployed throughout the world. It is a modular, ruggedized, lightweight (approx. weight: 30 kg depending on configuration) and highly maneuverable platform capable of carrying numerous different payloads.

The vehicle is IP-67-rated and can be submerged in 1.2m depth for over 1 hour. PackBot can climb hills in excess of 50° depending on surface conditions and is capable of climbing various different kinds of stairs.
Two Flippers mounted in the front of the robot assist in climbing stairs and overcoming obstacles.

Available payloads include manipulator- and camera-arms and communications- as well as sensory and computational payloads. By utilizing standardized hardware-Interfaces (Power, USB, Ethernet, Video) and a powerful, embedded Linux platform, it is very easy to add additional sensors and extend the system with further capabilities.

The operational runtime with 4 Li-Ion Batteries averages 15 hrs., depending on driving activity and power consumption of external sensors.

Processing:

On-board Pentium 4 ETX-Computer with integrated flash memory. The System is based upon the “Common OS” Linux-Platform and the iRobot Aware 2 Software Framework.
The software is field-proven, with thousands of units deployed across the world.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Communication:

The system supports any IP-based communications medium. The chassis features a built-in 2.4 GHz Wireless LAN radio (802.11g). Optionally, a 4.9 GHz (802.11a-derivative) radio-module can be mounted for improved performance in environments where the 2.4 GHz-Band cannot be used. Typical effective communication ranges go up to 1.2km line of sight and beyond, depending on conditions.

The system is capable of extending its operational range by use of MESH-networking.

An optional Fiber optical spooler system carrying up to 250m of optical cable.

If necessary, communication may also be established using UMTS or LTE cellular Networks, as well as satellite links.

Localization:

The PackBot features a built-in digital compass and pitch/roll sensors. Furthermore, 3-axis accelerometers are utilized to detect hard impacts that might damage the robot.

The User Assistance Payload (UAP) features built-in position-sensors and accelerometers as well as a high-precision GPS.

Positional data acquired by the Robot is displayed on the Operator Control Unit (OCU) and is displayed as an overlay of a digital map or Aerial Photo. The route traveled by the robot is also displayed, along with any locations identified as “Points of Interest”.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Sensing:

PackBot carries built-in absolute and relative sensors to monitor the positions and movements of its joints. The system maintains a 3D-model of itself for purposes of collision avoidance.

Furthermore, all motor voltages, currents and temperatures are constantly monitored as part of a built-in health-monitoring, failure recognition and diagnostics system.

In addition, the robot carries 2-way audio and 4 Video-Cameras with both visible and non-visible (IR) LED-illumination.

The system features interfaces for additional sensors, such as RADAR, LIDAR, Hazardous material and Radiation detectors, temperature and humidity monitors, as well as additional cameras (Thermal or wide-angle)

System Readiness

PackBot 510 EOD is a matured, field-proven, fully functional and ruggedized platform.

TRL: 9 for both hardware and software. (some additional sensors may however be a lower TRL)

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de

Reconnaissance and surveillance in urban structures (USAR):

PackBot 510 is very capable of climbing stairs due to its strong drive motors and low center of gravity. An experienced operator can even traverse certain types of spiral staircases

It has already proven its capabilities to operate in collapsed structures by searching for buried victims in the debris of the World Trade Center in New York following 9/11/2001, as well investigating and monitoring contaminated areas inside the Fukushima Nuclear Power Station in Japan in the aftermath of the 2011 Tsunami.

In areas without GPS reception, the Aware 2 Framework permits the robot to track its route and heading using internal odometry as well as built-in compass, which are also utilized to compensate for skidding and ground-slippage.

With its manipulator-arm, PackBot is able to open doors and clear light-weight pieces of debris from its path.

While limiting effective visible range, smoke, dust and mud do not damage the sensors deployed.

Depening on the situation, PackBot can be fitted with a LIDAR-system to create a map of the area it is searching. The map is then displayed on the OCU.

Furthermore, either a wide-angle camera or a thermal camera are attached to the robot in order to help search the structure.

If PackBot loses communication with its control station, it will try to re-establish communications. If unsuccessful, it will retro-traverse up to 20 meters in intervals of 5 meters to try and return into range of the OCU.
Furthermore, MESH-Networking Technology may be utilized using either stationary nodes dropped off by the robot or a smaller, mobile repeater node to increase effective communications range.

ELP GmbH **Tel.: 0049 (0)202 69894 0**
European Logistic Partners **FAX : 0049 (0)202 69894 10**
Nützenberger Str. 359
D 42115 Wuppertal
GERMANY
e-mail: elp @elp-gmbh.de / http://www.elp-gmbh.de