Eurathlon 2013

Scenario Application Paper (SAP) – Review Sheet

Team/Robot ELP
Scenario Mobile manipulation for handling hazardous materials

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

Team ELP propose to use the well proven commercial iRobot PackBot platform; which we judge as suitable for this scenario.

Processing

A Pentium processor running Linux and the iRobot Aware software is appropriate.

Communication

The robot is equipped with WiFi as the default communications medium, although the SAP indicates optical cable or UNTS (cellular) network commincations as options.

Localization

Although the SAP does not state this explicitly, the implication is that the robot will be tele-operated, in which case localisation is achieved primarily by the operator, making use of the various onboard sensors, including digital compass, vision and GPS.

Sensing

The robot is comprehensively equipped with sensors, including GPS and 4 video cameras.

Vehicle Control

The SAP leads us to assume that the team intends to tele-operate the robot and its manipulator.

System Readiness

High (9), given that this is a proven commercial robot.

<u>Overall Adequacy to Scenario-Specific Challenges</u>

The SAP is clearly set out. Team ELP's proposed hardware, including arm and manipulator, is well proven and suitable to the scenario. Success in the scenario will therefore much depend on the skill of the robot's operator(s).

euRathlon 2013

Team ELP

Scenario Application Paper

Mobile Manipulation for handling hazardous material

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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.

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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”.

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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)

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Mobile Manipulation for handling hazardous material:

PackBot 510 is very capable of overcoming obstacles such as railway tracks and “switches”.

The manipulator arm enables the operator to manipulate valves and levers depending on their type and the shape of their handles. The manipulator arm can be used to inspect objects to heights of above 2 meters. The gripper is however restricted in height, given its mounting position on the second elbow of the arm.

PackBot has proven its ability to traverse even rough terrain at high speed numerous times due to its tracked base and low center of gravity.

The robot, as well its sensors are designed to withstand rough conditions. Smoke, Dust and Mud do not cause damage to the system or its sensors.

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