Research Project no. 6 on Generic Mobile Platforms

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PURESAFE Kick-off Week – TUT Tampere, Finland
20th September 2011
Generic mobile platforms development for remote radiation survey and inspection
Talk Outline

• RP6 Description

• Research Approach

• Needs gathering
  • Present situation
  • Findings or Interpretations
  • Constraints

• Concepts/Ideas

• Next steps
RP6 Description

Developing modules:
• for remote radiation survey and inspection
• with long range capability over long distances
• with autonomous navigation and localization
• Based on wireless communication

Featuring good Systems Engineering practices
Research approach, in practice

1. Gather needs and constraints from RP
2. Model the functions of a RMV
3. Write reqts.; Generate concepts
4. Select concepts; Perform R&D on critical issues
5. Test concepts; Demonstrate feasibility

Get familiar with CERN and with PURESAFE

Time:
- Feb. 2012
- Aug. 2013
- Aug. 2014
Formal Needs Gathering
Gathering needs

• Interviews with 6 RP personnel!
• Questionnaire
  • Present situation
  • “Problems”
  • Potential benefits of RMV
  • Detailed needs

Requirements for Remote Mobile Platform

<table>
<thead>
<tr>
<th>Purpose?</th>
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<tbody>
<tr>
<td>Where?</td>
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<tr>
<td>How?</td>
</tr>
<tr>
<td>Present situation/convention?</td>
</tr>
<tr>
<td>Advantage of Present convention?</td>
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<tr>
<td>Problems with present convention? (Why?)</td>
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<tr>
<td>Benefits/Advantages?</td>
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<tr>
<td>Problems possible with proposed platform?</td>
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<tr>
<td>Autonomous/Manual?</td>
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<tr>
<td>Dimensions? (cm)</td>
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<td>Terrain – Flat/rough?</td>
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<td>Door passage – space restrictions?</td>
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<tr>
<td>Typical usage scenario?</td>
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<tr>
<td>Features needed? (With Importance)</td>
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Present situation
Present situation

**Human intervention** is required

- for repairing/maintenance
- when there is a
  - planned technical stop or shutdown
  - failure of equipments
Present situation - Intervention stages

ALARA principle

- Each access to radioactive area
  - started by a RP(Radiation Protection) survey
  - measure dose rates
  - visual inspection
  - plan of the intervention to optimize exposure
    - Avg. dose limit for a person ~ 5 mSv per year
Present Situation – Radiation measurement
Present Situation — Fixed Monitoring

- **RA**diation **M**onitoring **S**ystem for **E**nvironment and **S**afety
Present situation – “Problems”

- **Doses** to RP people (which can be quite high)

- **Time**
  - need to wait before RP access (long cool down)
    - Losing accelerator operation time
  - need to do the RP survey quickly (minimize exposure)

- **Limited availability of RP personnel**
Findings
Potential solutions

1. A fixed-installed monitoring system (eg. RAMSES)
   • coverage is limited unless we install high numbers
     • too expensive to install active monitoring systems
     • only passive dosimeters can be installed
     • detailed survey not possible
   • Fixed Cameras can NOT be installed – not tolerant to high radiation

2. Remote Mobile Vehicle
   • Remotely controlled device, performing simple RP measurements and visual checks
   • RP preferred solution
Needs – RP’s priorities

• Visual Inspection

• Radiation measurement/Survey

• Quick Radiation Map (Eg: LHC)

• Finding Beam Loss/Hot Spot

• Air sampling

• Contamination measurement
Needs – RP’s priorities

• Measure the radiation on the other side of the beam line
Needs – RP’s priorities

- Device Readout ★★★
Needs – RP’s priorities

• Anti-Collision system
  
• Automated Localization
  
• Automated Navigation
Constraints
Constraints

• Installation/Setup: Should not take more time than human RP survey

• Radiation levels: 1 µSv to 100’s of mSv/hour
  • Radiation level in hotspots ~ 10’s of mSv/hr

• Size limitations: Width ~ 50 cm, Height ~ 100 cm

• Communication:
  • GPRS – Everywhere – Low bandwidth
  • WiFi – Very limited availability
  • Problem with shielding walls
Constraints

• Proper protection for contamination

• EMI and EMC

• No physical damage to surroundings

• Fail-safe operation
Constraints

Cables on surfaces (sometimes also on floor)

Water on surface
Constraints

Obstacles on surface (No Dynamic Obstacles)
Constraints

Low Light Conditions
Constraints

Surface variations
Concepts/Ideas
Concepts

• Flying or floor running mobile robot

EPFL - LIS

SmartNav - India

Micro Inspection

Honeywel - T-Hawk

Magnetic crawler

Wall Contamination measurement

IIS - HighRad

Recon Scout Robot
What’s next?
Next Steps

• Some more interviews for requirements

• **Formal approval** of the needs and requirements for the system

• **Investigate** various platforms/concepts including the current TUT RMV platform

• **Define** modules to be worked on, perform **R & D**
Next Steps - Possible Research Focus

- SLAM (Simultaneous Localization And Mapping)
  - Computer vision based
  - LASER based
  - Multi modal inputs

Still defining the requirements!
Next Steps

Trainings
Systems Engineering
RMV technologies
Accelerator and Detector technologies
Radiation safety
Project management

Secondments
TUT – 4 months
UPM – 2 months

Get familiar with CERN and with PURESAFE

Gather needs and constraints from RP

Write reqts.; Generate concepts

Select concepts; Perform R&D on critical issues

Test concepts; Demonstrate feasibility

Model the functions of a RMV

Feb. 2012

Aug. 2013

Aug. 2014
Thank You!

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