A Mobile Platform for Remote Inspection Inside ESRF Tunnel

A tool for minimizing the down-time

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LabRat project

- The context and the need: how the project is born
- Experiences and preparation steps
- Design features
- Further development

Keeping high level of reliability

- 24hx7 continuous operation -> NO ACCESS
- no beam cut shorter than one hour
  - Heating time of the SR equipment
  - Thermal stabilization time on beamlines optical elements
  - Etc…

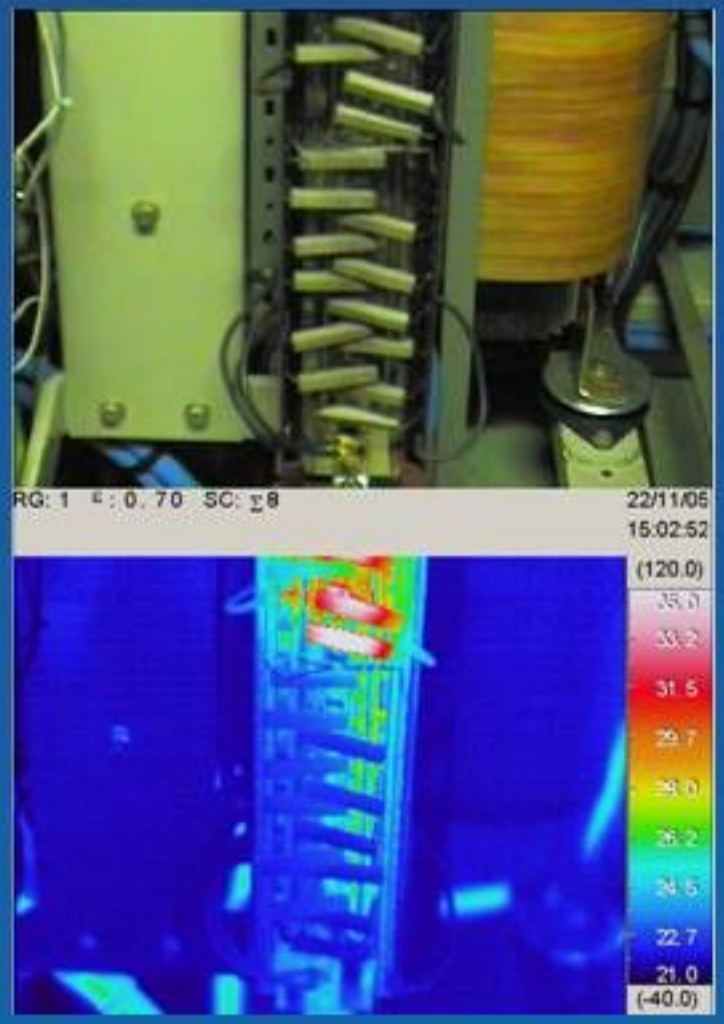
Aging hardware -> Potential problems

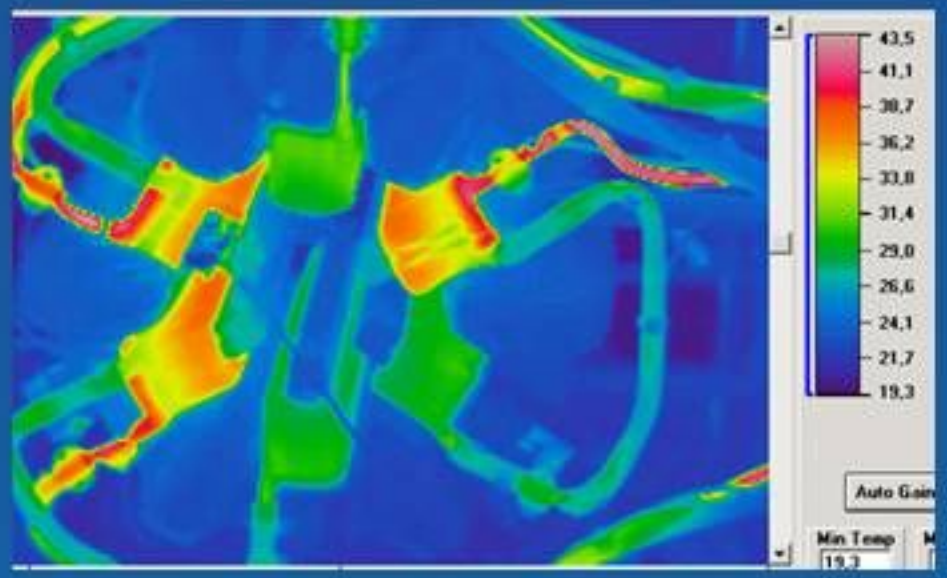
- Water alarms (pipes radiation damage)
- Fire alarms (smoke, hot points…)
- Temperature alarms (hot point due to beam)
- Motor blocking (mechanical obstacle)
- ….

Alarm occurrence: Is it a severe problem ?

- Small leak: we can wait and prepare an intervention at an adequate time.
- Big problem: it is better to prepare the intervention before cutting the beam
- Anyway, we have to cut the beam to ch

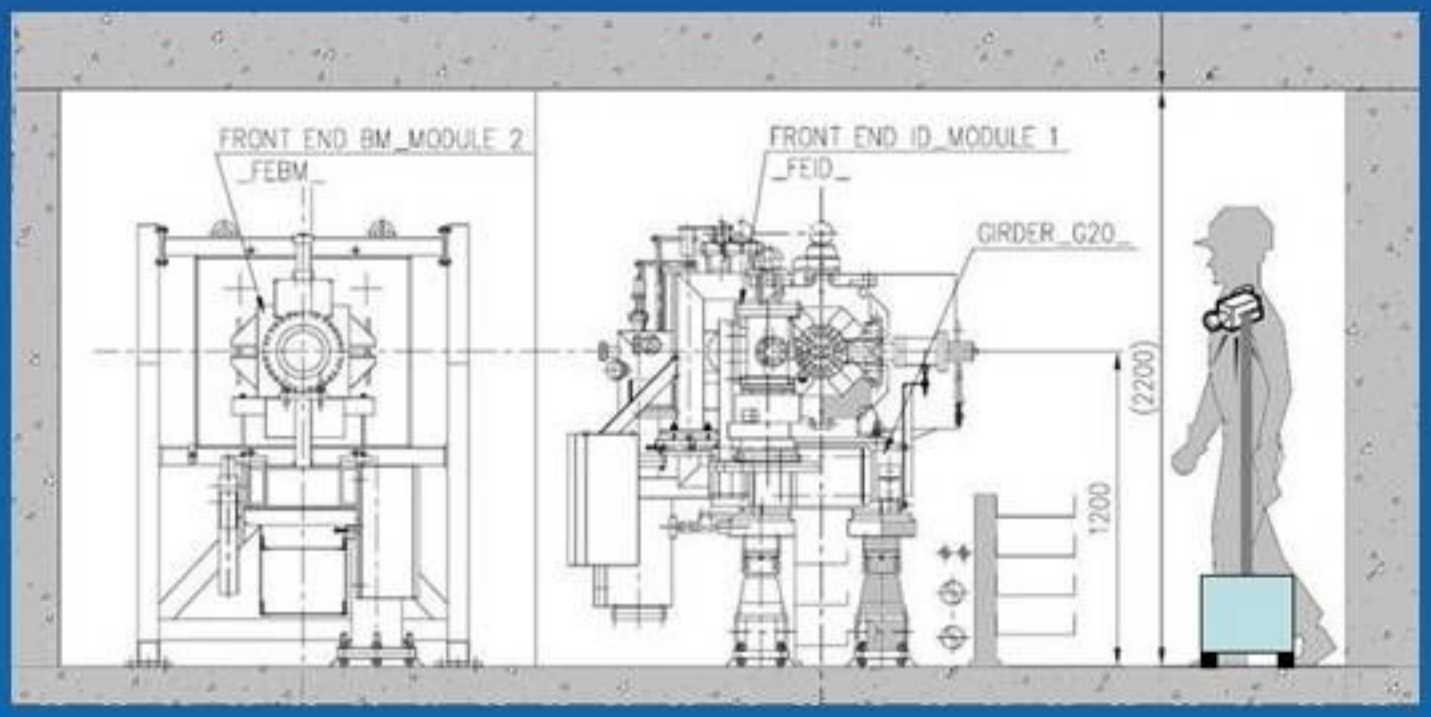
Temperature problems need beam to show-up





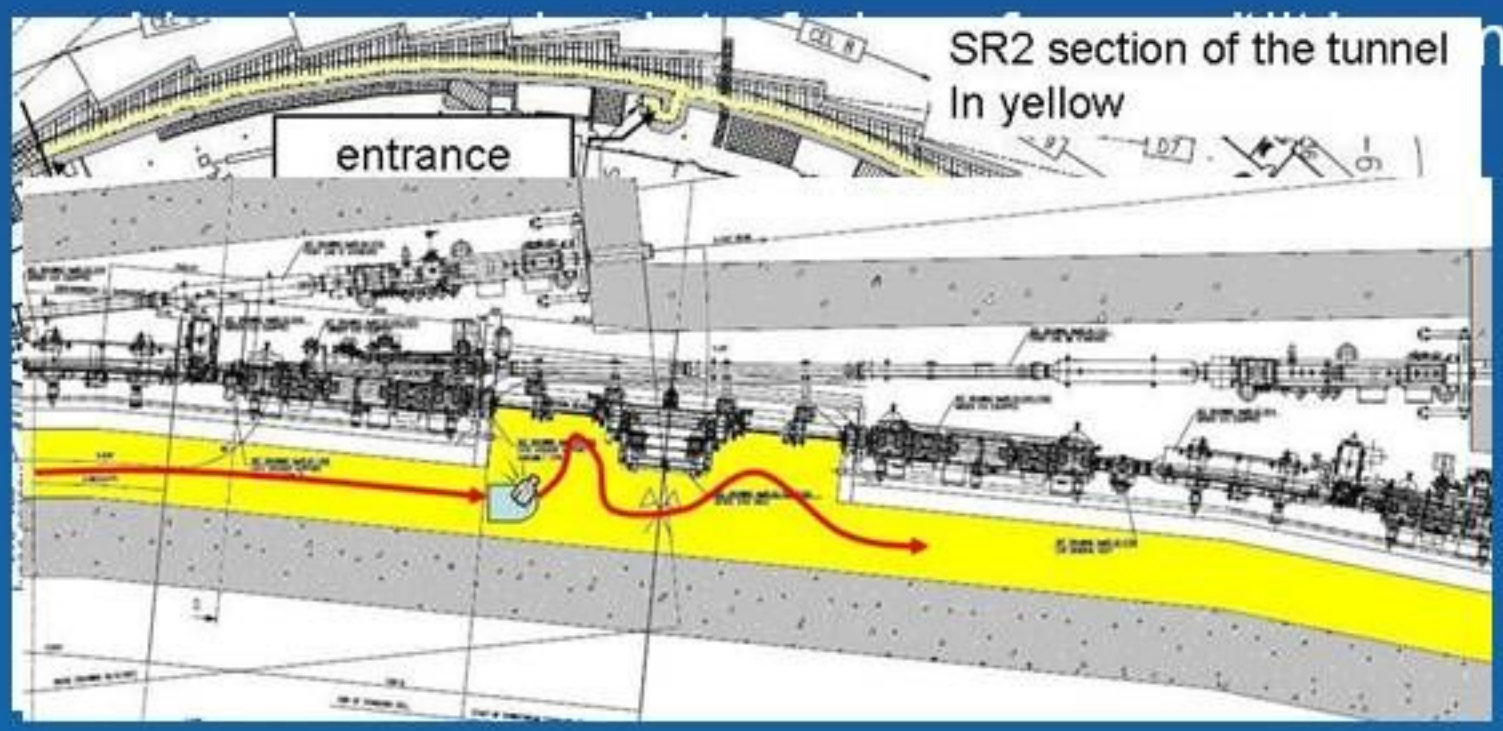
An autonomous robot could help us to avoid false alarms

- Wifi remote operation
- Color image transmission to CTRM
- Pan tilt zoom high quality video
  - Movable arm for different point of view



ESRF major constraints

- Should stay alive without human intervention for one week
  - automatic recharging system
- Long travelling path (200m)
  - Should be fast enough
- Narrow path (90 cm)



camera

Do not reinvent the wheel…

- Try to find a commercial product
- "Robot"is a very active keyword on
- Google search on "autonomous rob results…

Commercial products

- Many tools, market growing rapidly

We bought one!







Learn from experience

- Manual joystick remote operation is not sufficient
  - WiFi coverage sometimes weak
  - Video transmission freezing -> unsecure situation
  - Very long travel become tedious.

- re than a remote operated car,
  ould be able to go to destination autonomously
  ted-> Continue until target position reached
  e best decision in case of unforeseen situation

- eal issue…
  at least one week.
- g, ->, +20Kg payload -> not possible on many devices
- Limited facilities for localization
  - No GPS, No active transponders, should learn form environment.

We do not have the necessary competences ->Collaborative project

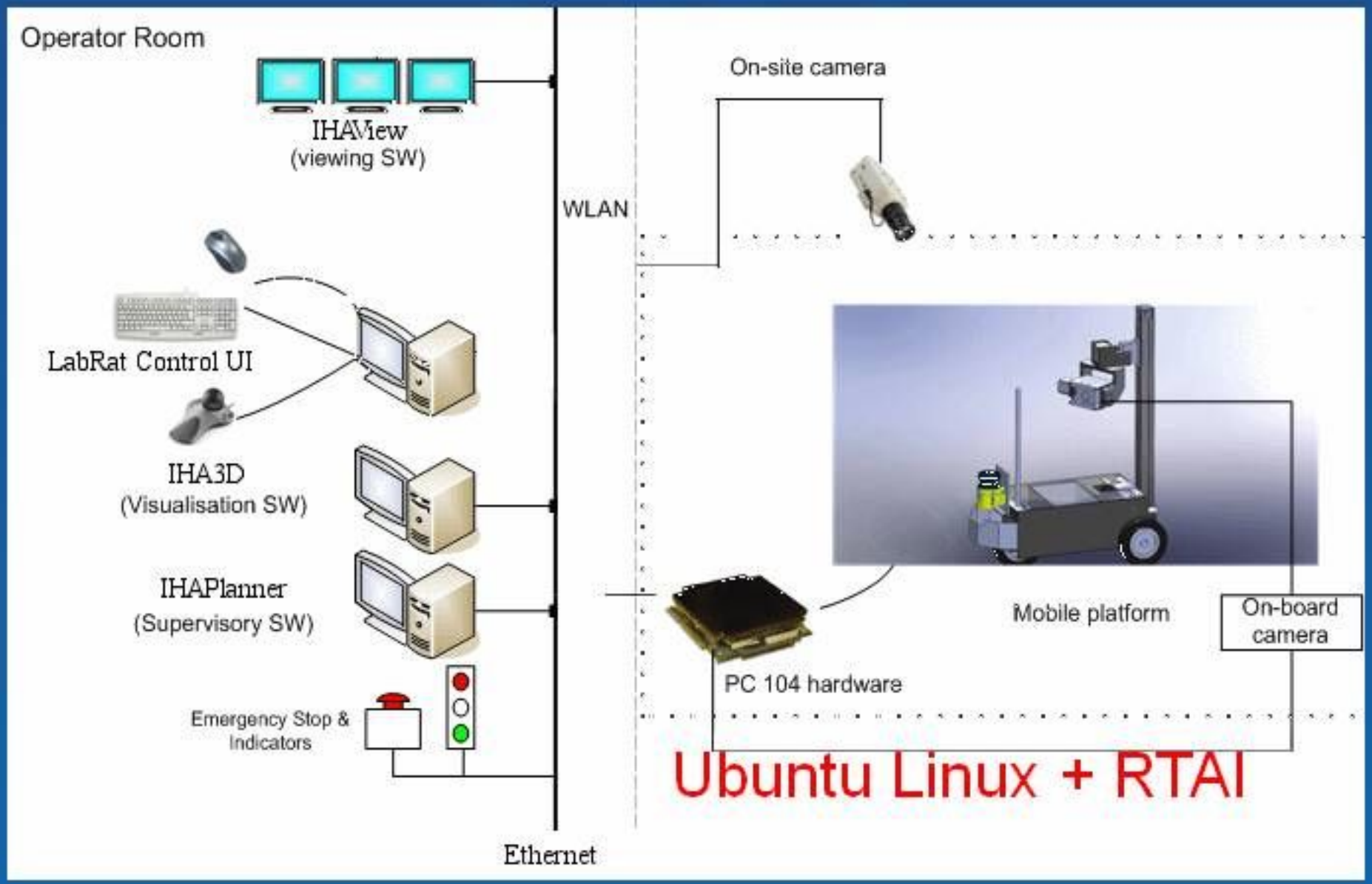
- Found a partner with high level of expertise in robotics

TAMPERE UNIVERSITY OF TECHNOLOGY
IHA - Department of Intelligent Hydraulics and Automation

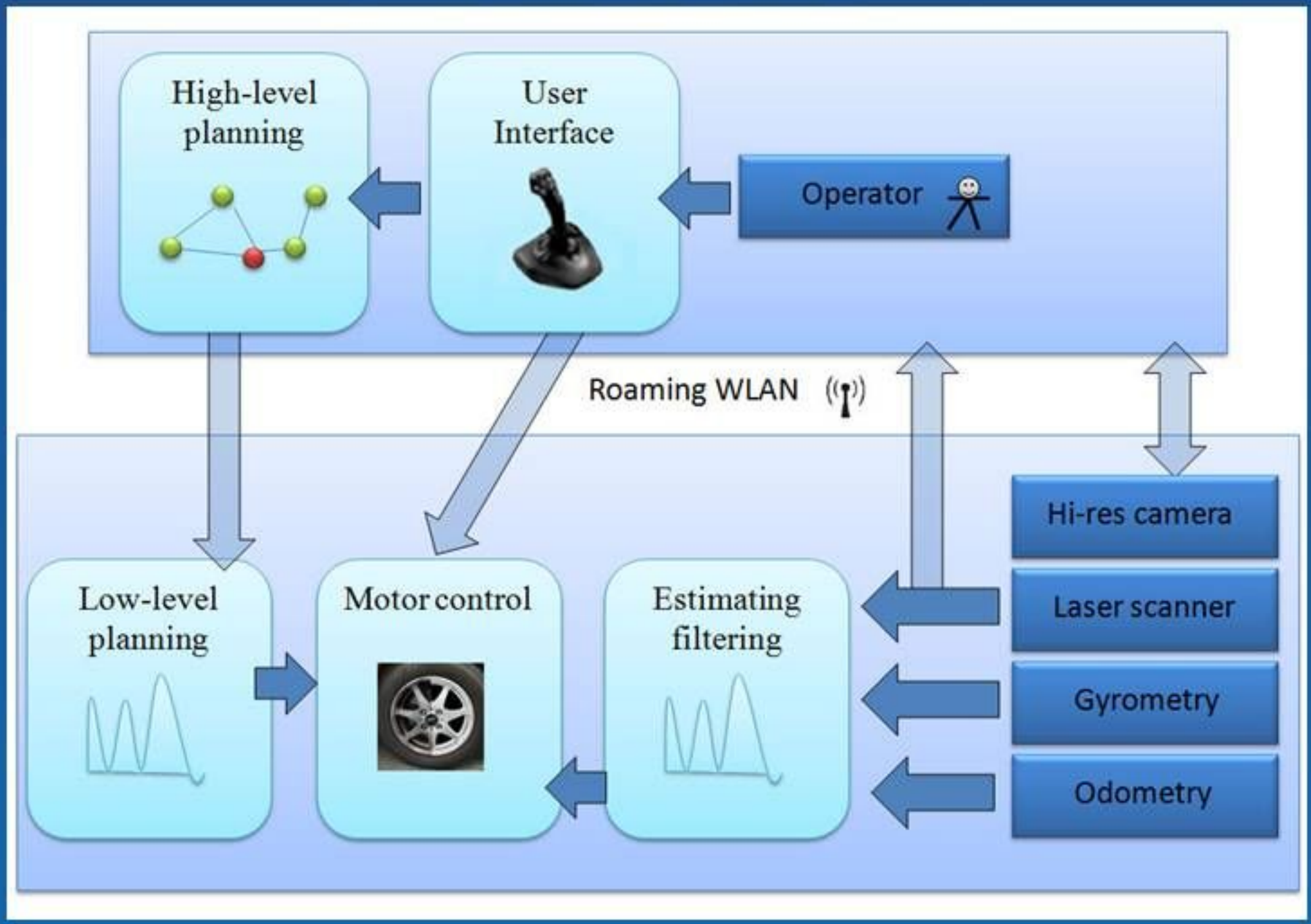
- Artificial intelligence, Virtual reality
- Remote handling
- Intelligency of mobile machine
- Mechanical design
- Is building a robot for ITER

- Interdiciplinarity, cooperation industry,
- technology transfer
- The Target: Building a tool that can be reproduced and used in other institutes.

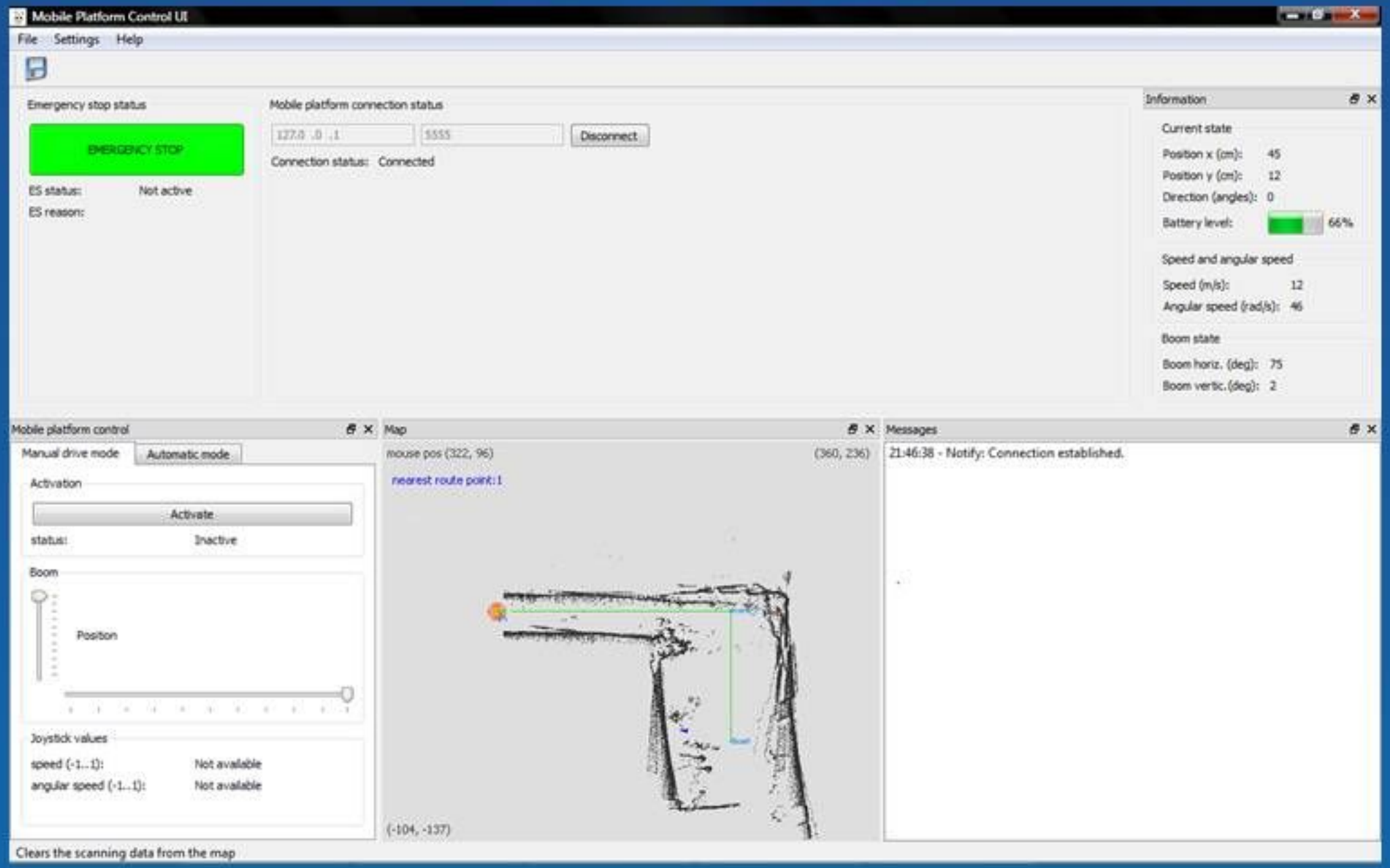
LabRat project: general architecture



Software architecture



Graphical User Interface



Current status

- Mechanical platform working
  - few improvement are necessary
- Path planner software OK
- On board camera OK
- Automatic charging procedure in development
- Commissioning of first prototype in November
  - For remote observation.
  - Need intensive tests before entering in the real tunnel…

Further developments

- Integration of various detectors
  - X /Gamma radiation mapping
  - Pyrometer
- Automatic scanning
  - Scan the tunnel volume with detectors
  - Do periodical patrol planning
- Improve the navigation system
  - A navigation system based on stereovision
  - Self learning…
- A Tango device server to integrate it in the Control System
  - Status, alarm, position etc…

Conclusions

- We are close to the first operational prototype.
- Our aim is to have LabRat as a standard industrial product
- Some R&D efforts still needed
  - Possibility to obtain some public R&D funding from Finland
  - For adjusting LabRat to synchtrotrons' needs, R&D project

Looking for synchrotrons willing to test the product and partner in the development

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