ELEC-E8111 Course Robot Projects

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General information

- Done in teams of four students.
  - Erasmus students may take the full course, with projects too.
- You may form your own teams. Select a team leader.
  - You may use the MyCourses forum to discuss and form teams.
- The team leaders reserve the lab times in MyCourses.
- The whole project and its success depends on the team.
- It is hard to reorganize the teams after the course has started.
- Start early, preferably now.

Two subtasks:
1) Design of a case robot system

In design tasks, four application cases given, each team selects one, extra functionality can be freely added:

1. Indoor: Rescue robot for saving humans in a burning house.
2. Indoor: Food delivery robot to a certain stand in an exhibition.
3. Outdoor: Trash picking robot for Kaivopuisto-park
4. Outdoor: Autonomous drone system for wide range ice field
5. mapping.

2) Testing algorithms under ROS on Pioneer robot platform

Implementation with ROS/Pioneer, introduced in a separate slide set.

Indoor: Rescue Robot for saving humans in a burning house.

- Two operating modes for a priori map information and mission:
  1. In newer buildings, there is a CAD 3D building model available for the Robot. The operator defines the likely locations of the victim(s).
  2. In older buildings, any kind CAD model is not available. The operator describes the feature based path having rough distance estimates to the likely victim(s).
- The Robot can open the doors and move using the stairs.
- If fire situation allows, the Robot is returning using the same path with the rescued victim.
- If fire situation has made the default return path impossible, the Robot plans and operator accepts a new return path or the operator describes the return paths with HRI.
- Locomotion mechanism, localization, perception proper for fire situation. Interactive Human Robot Interface very essential.

Indoor: Food delivery robot to a certain stand in an exhibition hall.

- Safety is absolutely important, the Robot should not collide with humans or equipment.
- Sufficient positioning inside a large halls should be solved and presented, the Robot has the map of the exhibition hall, which contains kitchen and delivery points, and dishes and waste points.
- Multi-robot system, flexibility in scheduling and task allocation. How to coordinate the system, control architecture.
- For battery management there should be reliable system.
- You should also plan and design the web-based user interface for ordering the meals.
- The standard logistic units, trays, for food delivery should be defined. The dishes and waste management with trays, too.

Outdoor: Trash picking robot for Kaivopuisto-park.

- Operation must be safe for human park-users and pets.
- The locomotion of the platform and picking mechanism must be solved so that all common type trash can be picked. For each type of trash a different solution (not too detailed).
- Sufficient machine perception to detect and recognize all essential objects.
- The operation can be based on full coverage path planning and/or perception based picking. (Also drones can be used for surveying)
- The real map of Kaivopuisto, loaded from e.g. Google Maps, should be used. Maybe different areas require different type of operation
- How to cope with the weather conditions, particularly wind and rain?

Outdoor: Autonomous drone system for wide range ice field mapping.

- A priori information: daily low resolution satellite map, weather forecast
- Implementation of safe autonomous departing, cruising and docking in possibly windy condition on the dock of the ship.
- The principles of path planning; different phases…
- Energy management for the drone; the drone system is flying continuously when needed
- Machine perception, what instruments, sensor fusion
- The mission goal: 3D information about ice ridges, motion patterns of the ice field
- Operation must be safe, especially in the busy harbor and corridor area.

In the design task

You can freely select, but the design should be realistic and feasible:

- The robot platform
- The perception and measurement devices
- Way of operation
- Algorithms, described at schematic level
- Human Robot Interface
- Required contents defined in a separate document.
- The design report can be at most 10 pages.

Timetable

- Testing algorithms under ROS/Pioneer starts on Wednesday, March 18
- The 1st exam will likely be on Tuesday, April 7; The 2nd exam two weeks after that i.e. April 21
- Design of a case robot system, DL for reports Sunday April 19, 21:00
- Testing algorithms under ROS on Pioneer robot platform, DL for reports Sunday April 19, 21:00