Autonomous Construction by a Mobile Robot in Unknown Environments with Scarce Resources

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LSRO - http://mobots.epfl.ch

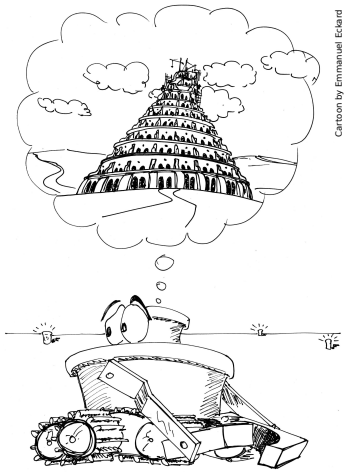
Context

Autonomous construction by mobile robots would be useful in various situations, such as in outer space, in hazardous environments, but also for the building industry.

Related work

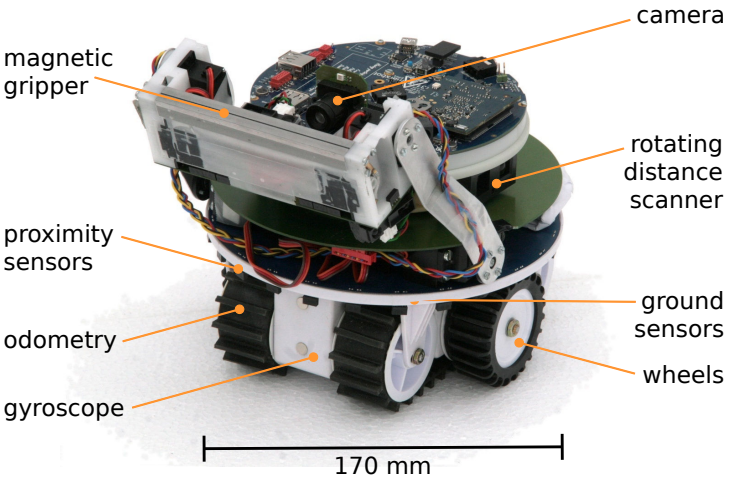
- flat environments
- readily available resources
- simples structures
- single structure type

Applications demand

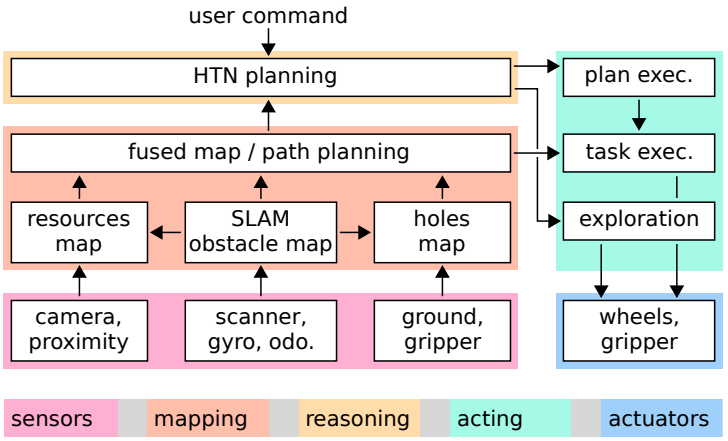


- complex, 3D environments
- remote resources
- multi-layers structures
- various structures types

Hardware



Software architecture



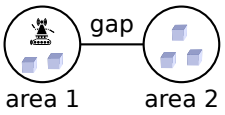
Symbol grounding

- probabilistic maps
- morphological operations
- fusion using by-pixel op.
- map regions labelization

Execution

- plan using symbols only
- ref. to geometrical data
- state machine for actions
- low-level through ASEBA

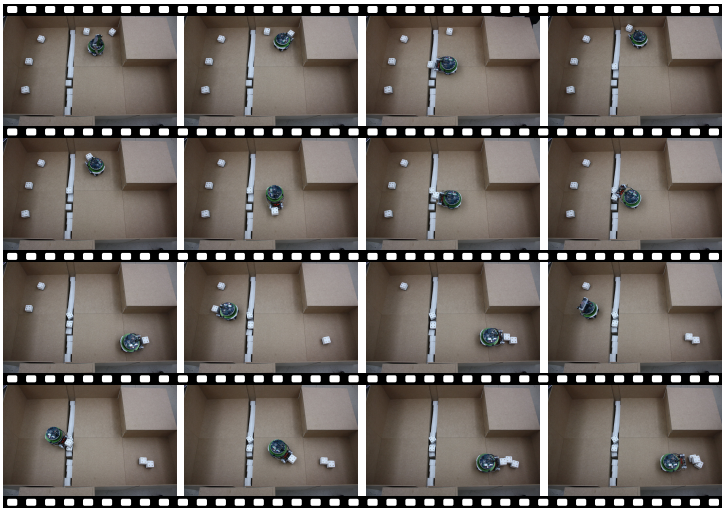
Experimental setup



Experiment goal

- build a structure in area 1
- not enough res. at area 1
- must harvest from area 2
- must fill the gap first

Preliminary results



Analysis

Estimated reliability:
- gap passing: ~80%
- structure building: ~30%
- full experiment: ~20%

imprecisions in positionning, res. detection, res. grasping

Lessons Learnt

- exploration is important, but trivial heuristics suffice
- HTN planning fast enough
- SLAM robust at 40% CPU
- real-time visualisation through Wifi critical

Conclusion

Our current results show that autonomous construction is accessible to miniature mobile robots with smartphone-level CPU.

Future Work

- movable block as obstacle
- learning of success rate
- HTN A* heuristic: most probably successful plan
- provides live adaptation

Contact and probe further

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Affordable SLAM through the Co-Design of Hardware, Software, and Methodology. Stéphane Magnenat, Valentin Longchamp, Michael Bonani, Philippe Rétornaz, Paolo Germano, and Francesco Mondada. Accepted in ICRA 2010.

Planner9, a HTN planner distributed on groups of miniature mobile robots. Stéphane Magnenat, Martin Voelkle, Francesco Mondada. In *Proceedings of the Second International Conference on Intelligent Robotics and Applications (ICIRA)*, 2009.

ASEBA, an event-based middleware for distributed robot control. Stéphane Magnenat, Valentin Longchamp, Francesco Mondada. In *Workshops DVD of International Conference on Intelligent Robots and Systems (IROS)*, 2007.