

Exploration of a disaster scene with a SPOT robot



Arnoud Visser

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for Natural Disaster Management,
Virtual RoboCup, July 1, 2021**



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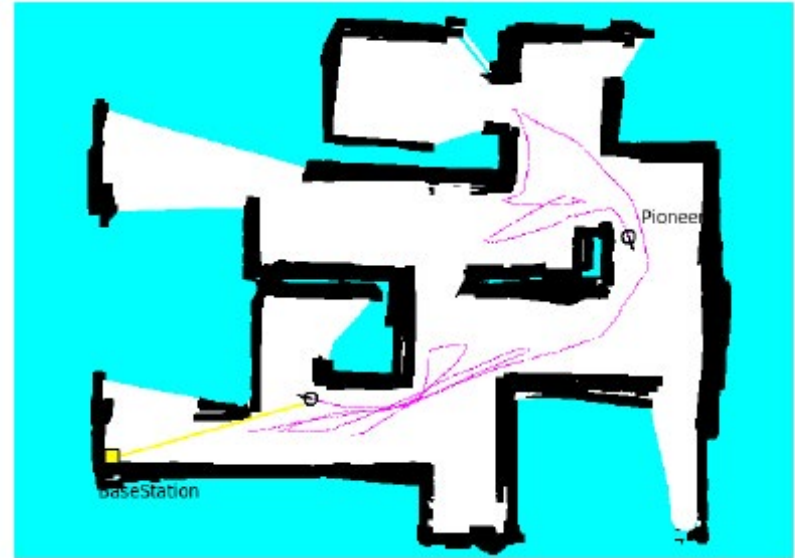
With slides and images from Joris Sijs en Emily Mes

RoboCup Rescue



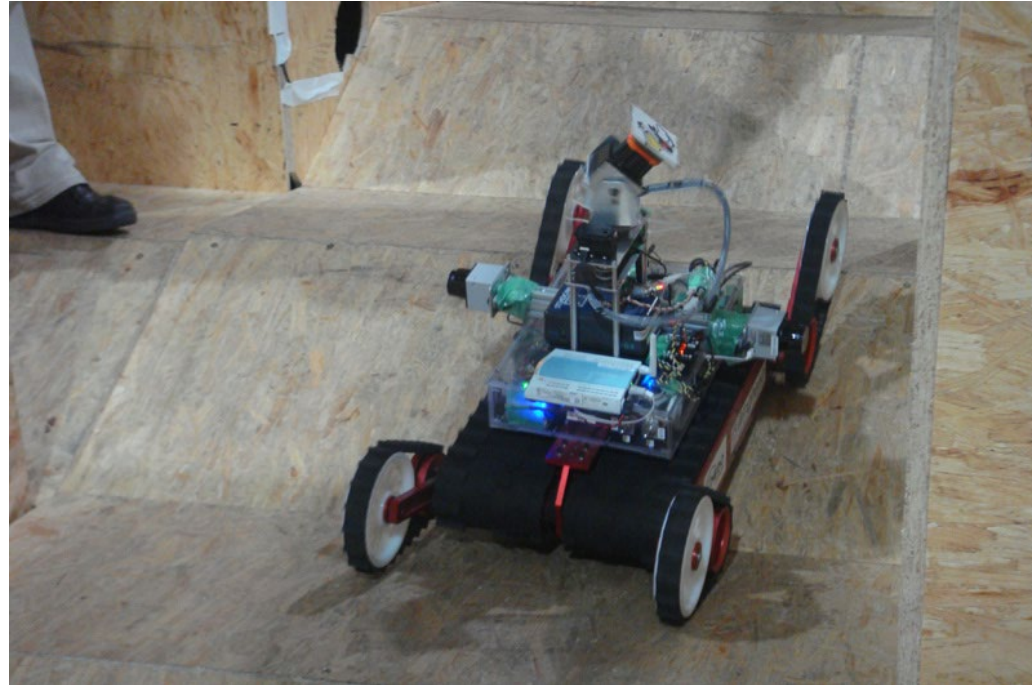
Take a robot & search for victims

Pioneer robot



See Julian de Hoog, Stephen Cameron and Arnoud Visser, "Role-Based Autonomous Multi-Robot Exploration", Proceedings of the International Conference on Advanced Cognitive Technologies and Applications, pp. 482-487, November 2009

Kenaf robot



The Kenaf robot, designed to travel rough terrain.

Okamoto, Shogo, et al. "Validation of simulated robots with realistically modeled dimensions and mass in UsarSim." *Safety, Security and Rescue Robotics*, 2008. SSRR 2008. IEEE International Workshop on. IEEE, 2008.

Spot robot

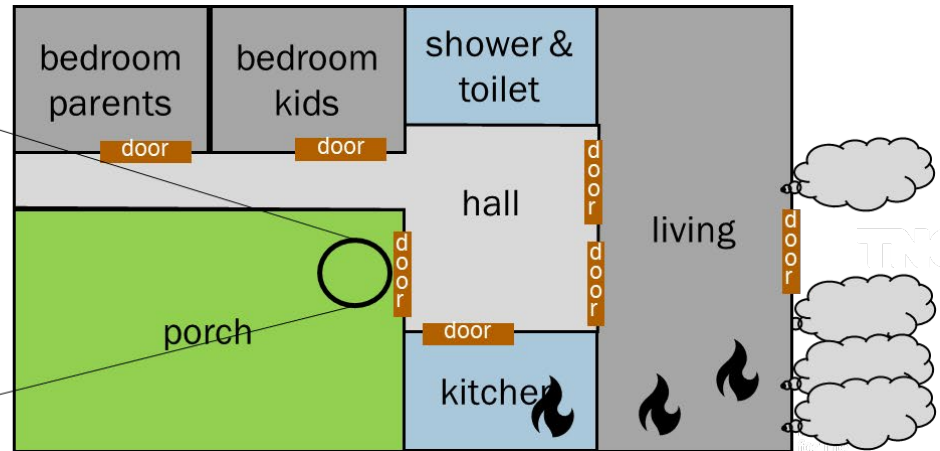


The Spot robot is very versatile, so ideal for rescue operations.

E.g. Amanda Bouman et al, 'Autonomous Spot: Long-Range Autonomous Exploration of Extreme Environments with Legged Locomotion', Nov 2020, arXiv 2010.09259

Scenario

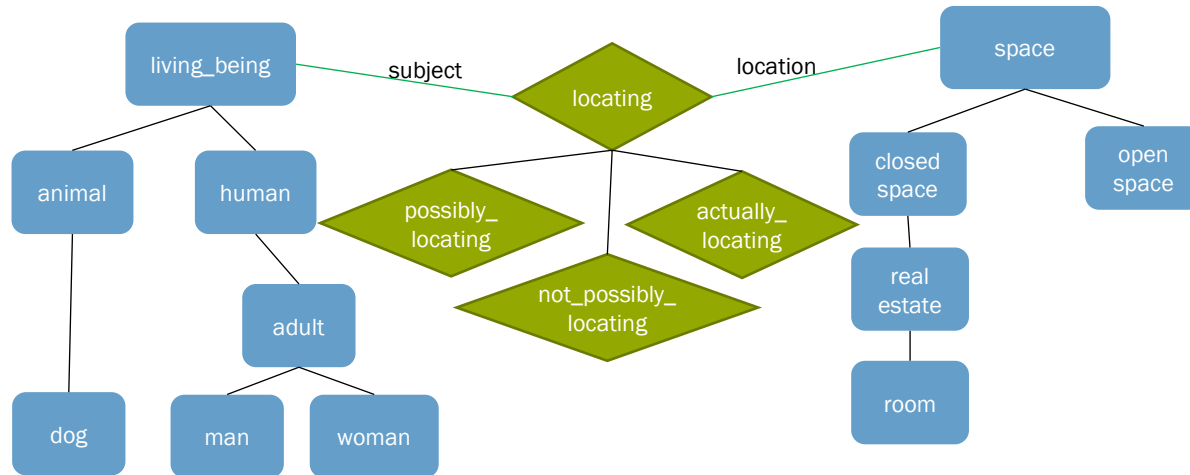
- There is a fire in a house:
find the two parents and two children



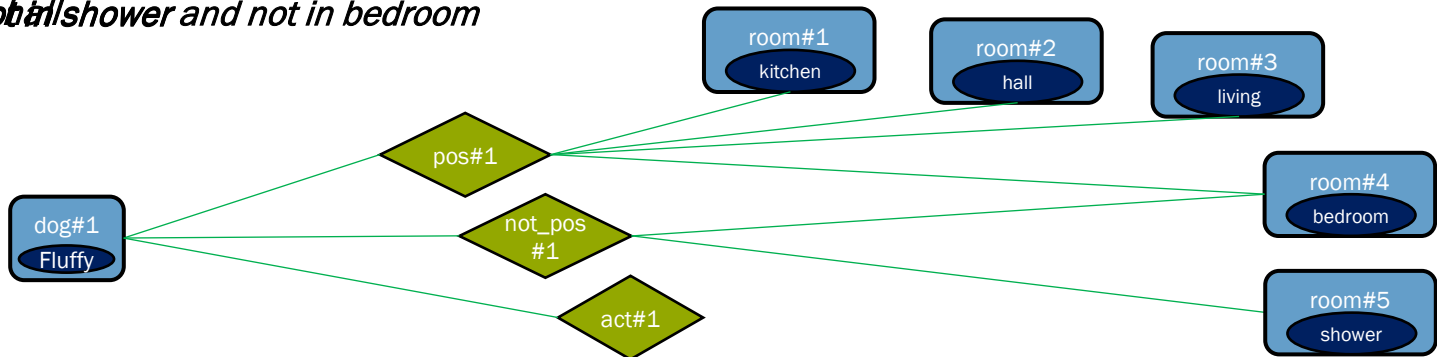
REASONING IS BASED ON A KNOWLEDGE BASE



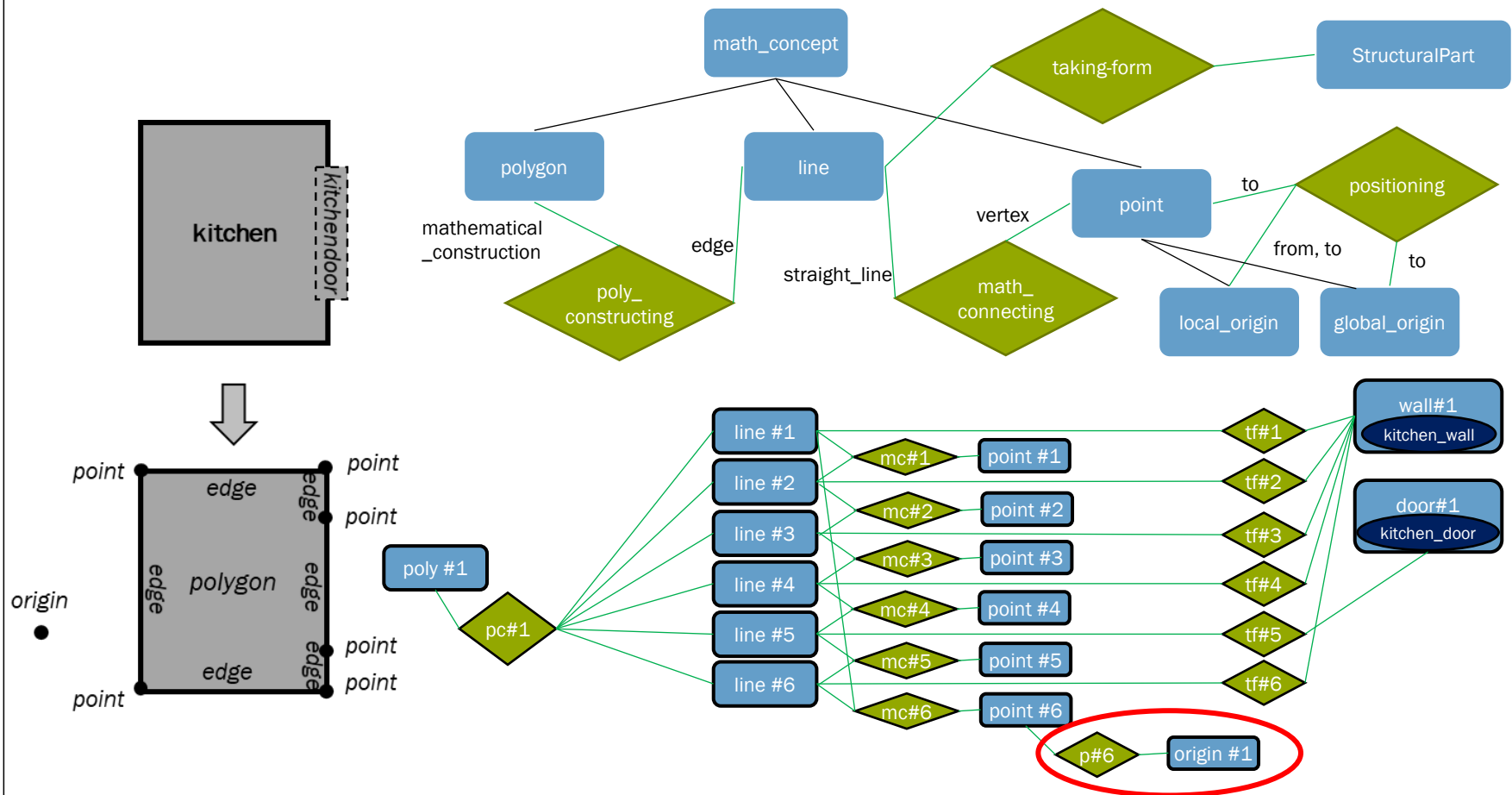
The location of living beings is not known



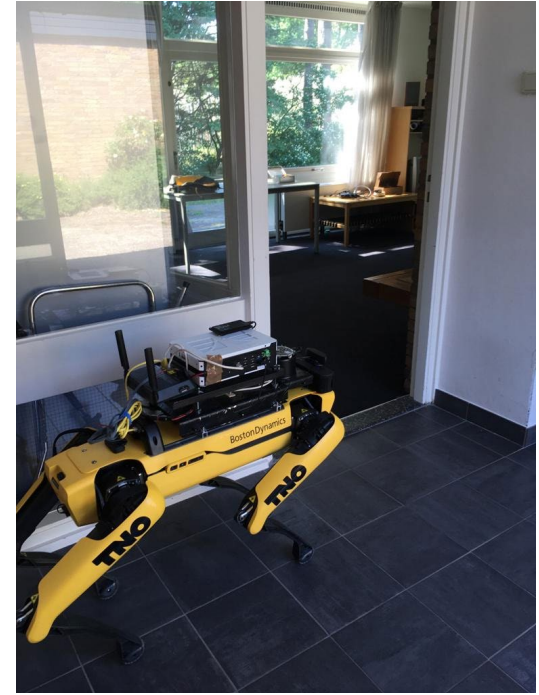
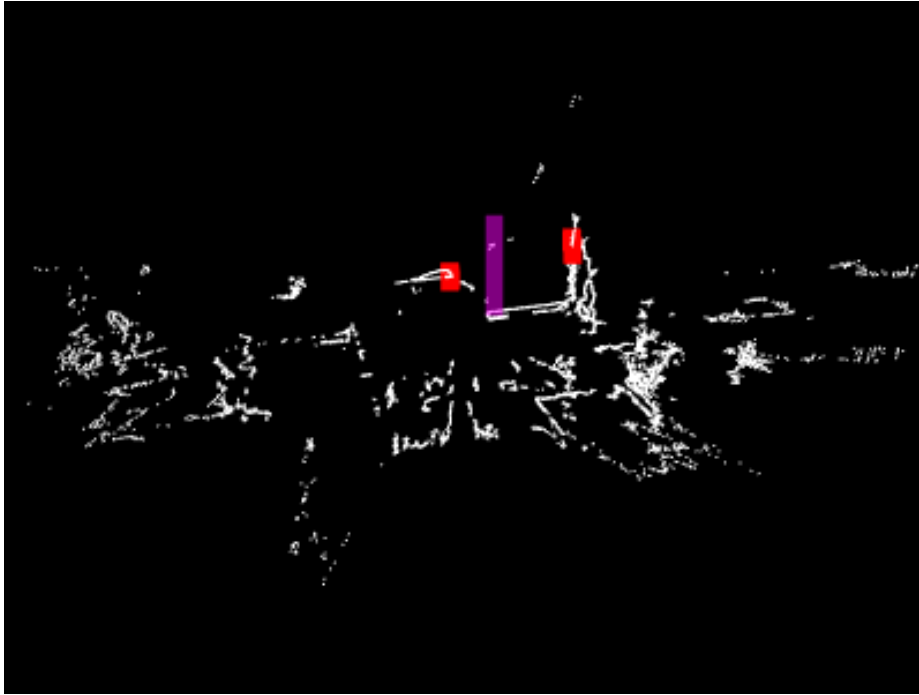
Fluffy is not in shower and not in bedroom



REASONING ON LOCATION IS PARTLY METRIC, PARTLY TOPOLOGICALLY

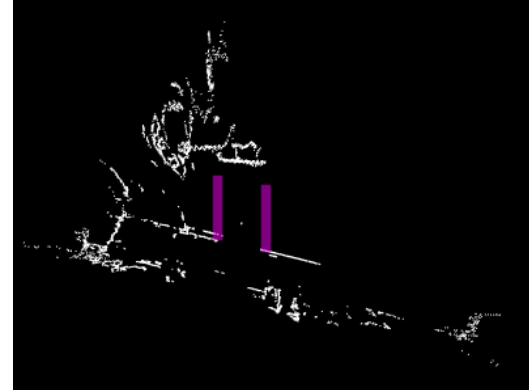
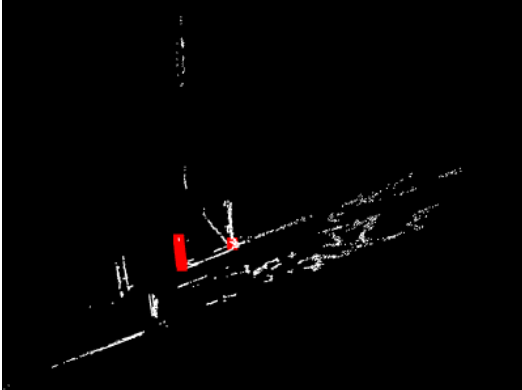
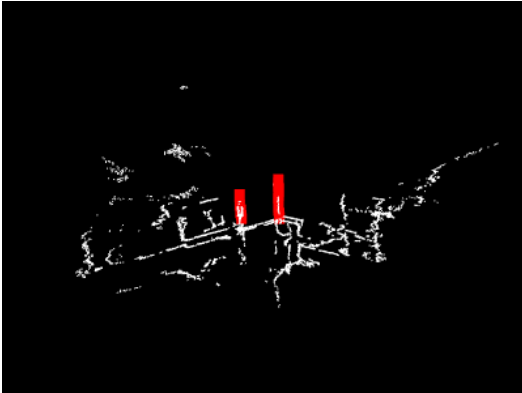


Acquiring metric information



The Spot robot has 5 stereo cameras, which provide depth images, which can be converted to point clouds.

Detecting doorways



With the downlooking stereocameras, door jambs can be detected in 70.8% of the cases.

360° camera



Equip the Spot robot with a DreamVU PAL camera, which gives panoramic depth images.

360° camera



Gives a complete overview of the surroundings.

Recognize objects in the room



2 persons, 2 backpacks, chair, clock



? room

Recognize objects in the room



3 persons, 3 chairs, 1 couch, 2 tvs



living room

Recognize objects in the room



1 person, 1 bed, 1 tv, 1 laptop



bedroom parents

Recognize objects in the room



1 person, 1 bed, 1 chair



Bedroom kids

Recognize objects in the room



1 person, 4 chairs



? room

Discussion


- Currently using YoloV5» for object recognition
- Detector is not optimized for panoramic images
- DreamVU mozaïcs segments, so not really sharp
- Detector is not optimized for blurred images

- Higher viewpoint



- Combine with depth information

Conclusion

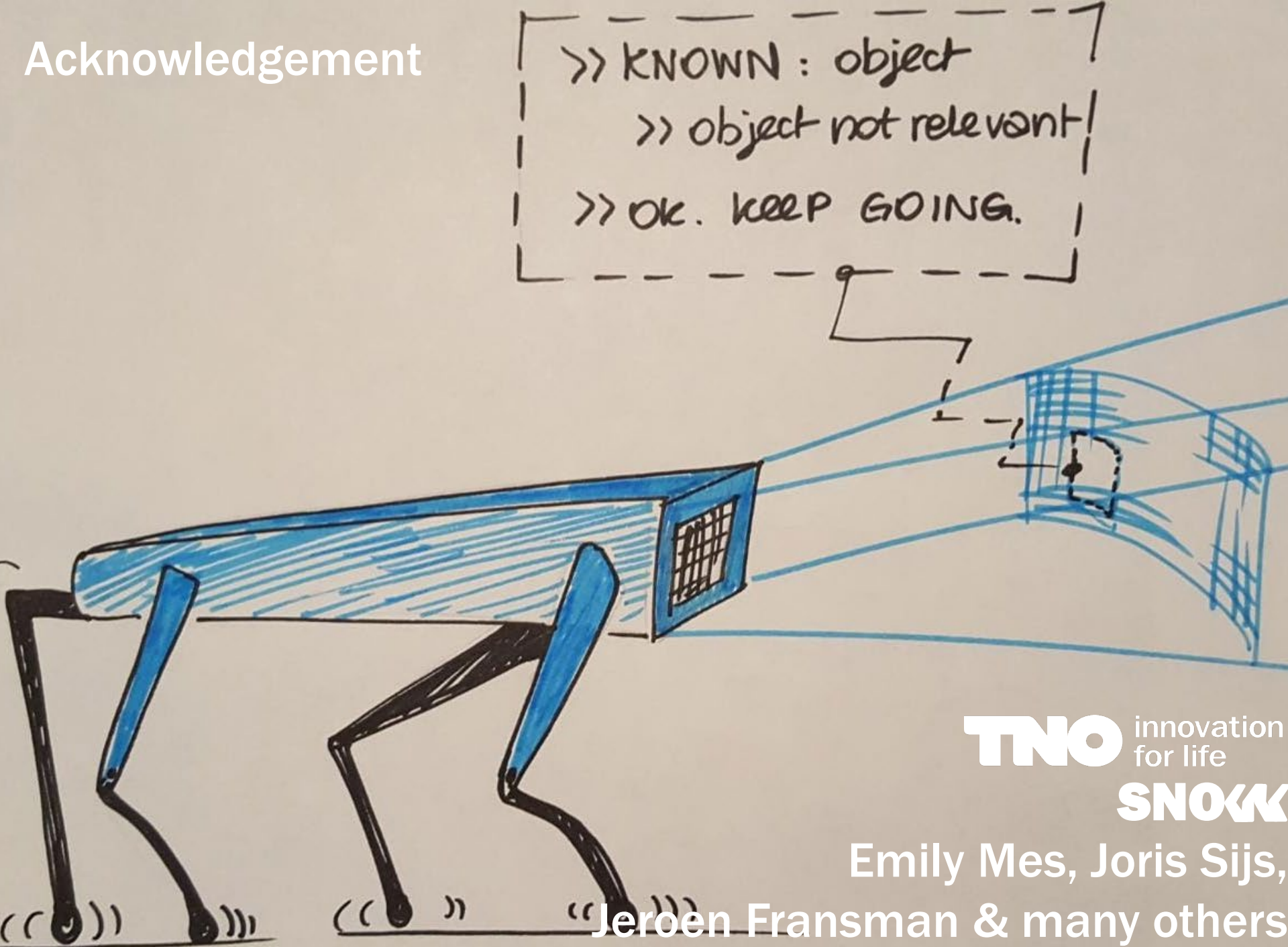
- Room classification can help in exploration
- Provides information to go from metric to topological map
- Interface to knowledge base  GRANK.AI
- Knowledge can be used in the tactical planner TAC-PLAN, which plans next action based by formulating a Markov Decision Problem

Acknowledgement

>> KNOWN : object

>> object not relevant!

>> OK. KEEP GOING.



TNO innovation
for life

SNOW

Emily Mes, Joris Sijs,

Jeroen Fransman & many others