Team LyonTech | RoboCup@Home SSPL

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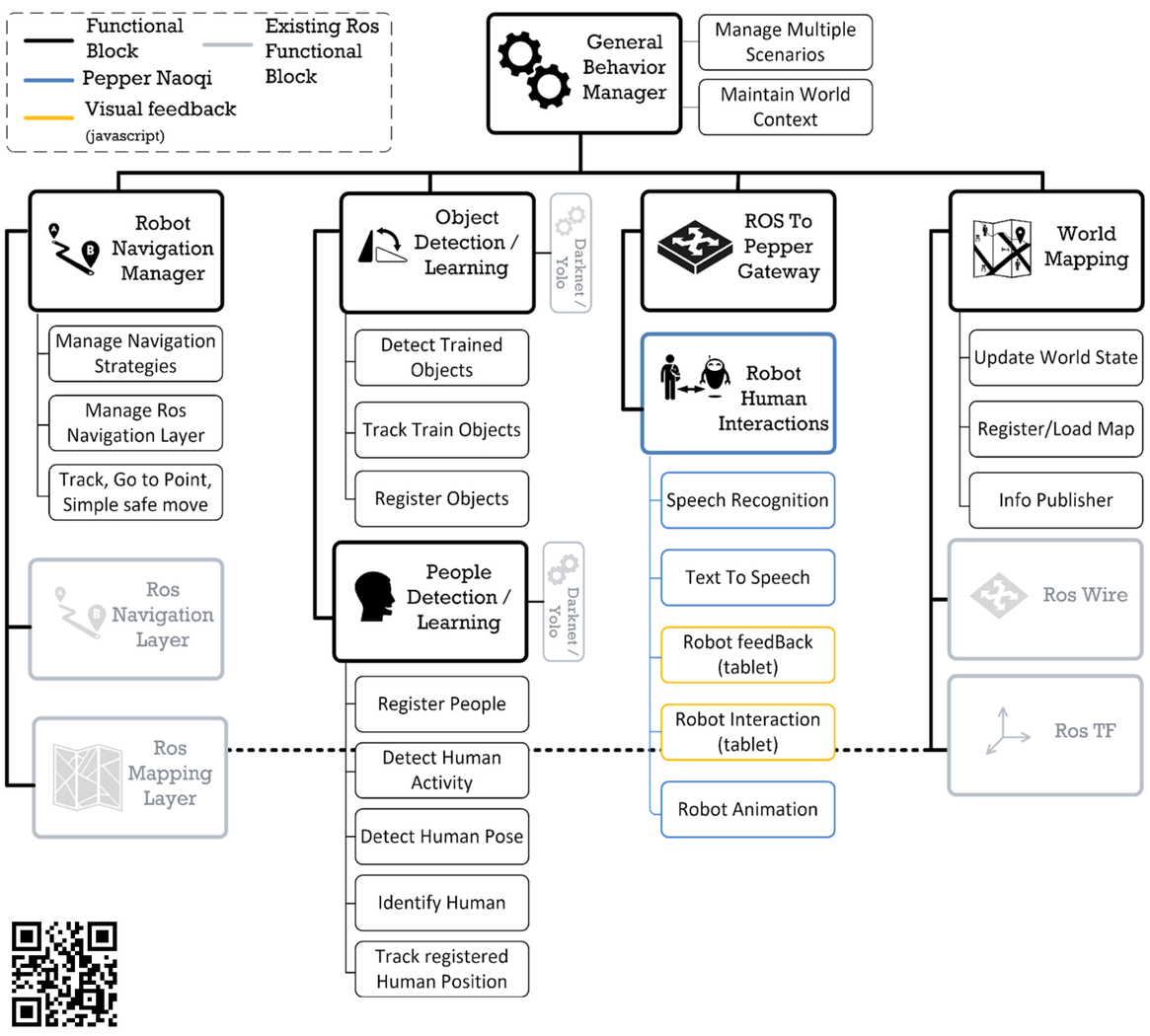
Summary

The LyonTech Team was founded in 2017 to address the scientific challenges of the RoboCup@Home. The team is composed of students, engineers and researchers from the University of Lyon, France (CPE Lyon, INSA Lyon, Inria, Lyon 1). We work on both Pepper and PALbator robot platform, on navigation, perception and mapping of complex environments, as well as human-robot interaction. Our approach is built on recent methodologies linked to social navigation and deep learning. We developed an architecture [1] dedicated to the orchestration of high level abilities of a humanoid robot, which rely on several abilities such as those required in the RoboCup@Home competition. The validation of our approach is based on many experiments performed in an apartment-like environment and in presence of several humans.

Architecture [1]



Contribution to the Community

People Feature extraction and tracking

The People management framework has been published in [2]. The source code is available here:

- People-Management: People similarity evaluation and tracking
  https://github.com/Robocup-Lyontech/People-Management-Framework

Socially-aware Navigation Among Movable Obstacles

The proposition of Socially-aware NAMO has been published in [3], the source code is available here:

https://gitlab.inria.fr/brenault/s-namo-sim

Software Architecture

The Lyon-Tech architecture has been published in [1] and is illustrated below. The source code is available here:

https://github.com/Robocup-Lyontech/robocup-main

Software World Management

The Lyon-tech world and objects management

https://github.com/jacques-saraydaryan/ros_world_mng/tree/dev_palbator_postgis_js

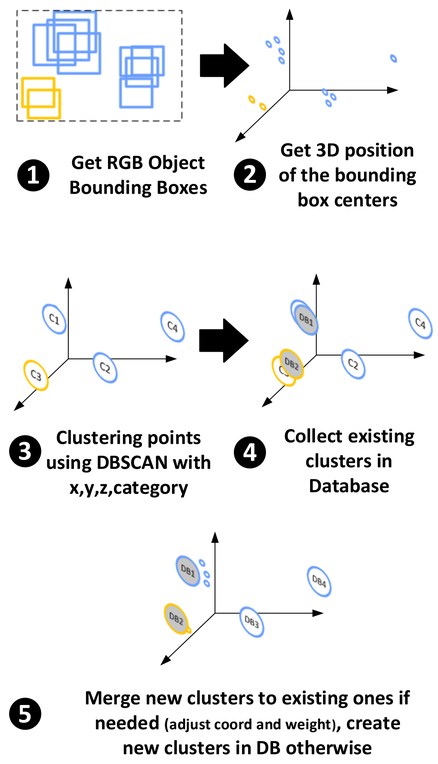
References

[1] F. Jumel, J. Saraydaryan, R. Leber, L. Matignon, E. Lombardi, C. Wolf, and O. Simonin, Context Aware Robot Architecture, Application to the RoboCup@Home Challenge, RoboCup symposium 2018.
[2] J.Saraydaryan, R. Leber, and F. Jumel, People management framework using a 2D camera for human-robot social interactions, RoboCup symposium 2019 (best paper award).
[3] B. Renault, J. Saraydaryan, O. Simonin,“Modeling a Social Placement Cost to Extend Navigation Among Movable Obstacles (NAMO) Algorithms”, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020.
[4] Z. Cao, G. Hidalgo, T. Simon, S. Wei, and Y. Sheikh. Open-pose: Realtime multi-person 2d pose estimation using part affinity fields, CoRR, 2018.

Scientific Contributions [2,3]

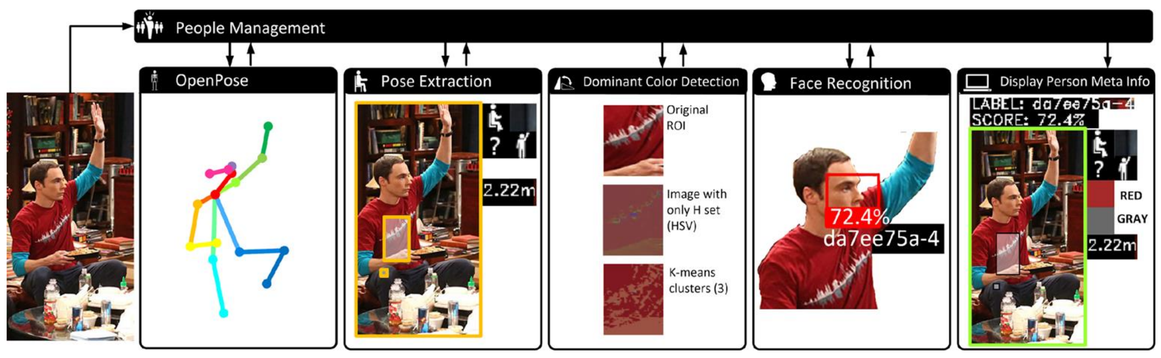
World objects management

During robot navigation operation, we scan the environment to add semantic information and object references.
To do so, Darknet’s bounding boxes are combined with point clouds (camera RGBD), bringing 3D information.
A clustering (DBscan) operation using the time, distance and object type drastically reduces the number of irrelevant entities. Finally, the resulting 3D entities are stored into a geographic information database (PostGIS).
Overall, this allows us to easily interact with the environment (object detection and grasping).



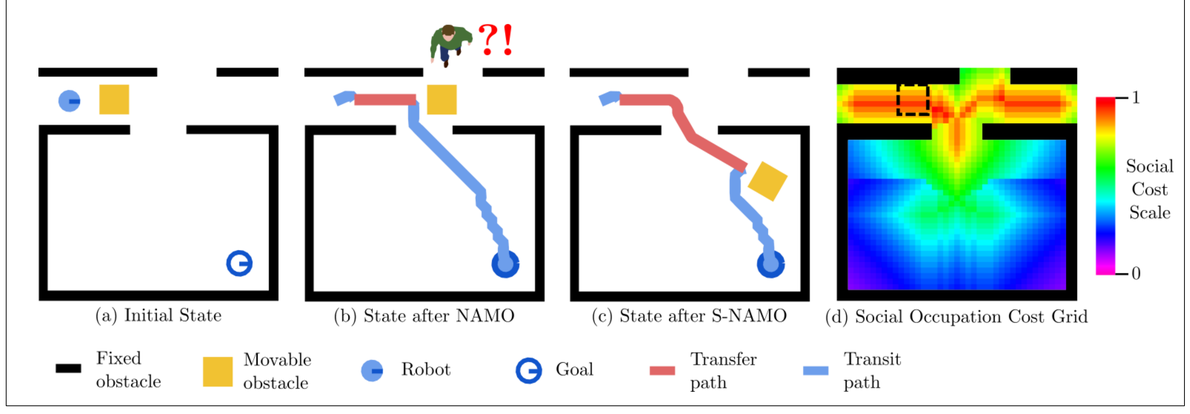
People features extraction and tracking [2]

We proposed a people management framework aggregating body and person features, including an original pose estimation using only a 2D camera. At this time, people pose and posture, clothing colors, face recognition are combined with tracking and re-identification abilities.
The figure below presents the different framework blocks. First of all, the robot gets the scene information through the camera (**2D picture**). This image is then processed in order to extract each person in the scene (**OpenPose [4]**). Semantic informations are added concerning people posture, hand posture and estimated position (**Pose Extraction**) like sitting, lying, standing or pointing.
Cues such as face and clothes are used to identify a person (face detection, color detection and naming). Finally, all the semantic information is gathered and sent to the robot decision process. The robot can identify people, understand intentions (e.g. hand call) and has an overview of the scene.



Socially-aware Navigation Among Movable Obstacles (NAMO) [3]

Since Robocup 2019, we improved our Socially-Aware NAMO approach for the problem of Obstacle Social Placement Choice.
With only the static occupation grid, our Social Occupation Cost Grid characterizes the disturbance caused to human accessibility in all free space. Using this model in NAMO algorithms guides the search to placements that improve the overall space accessibility and organization over time.
We implemented this new model in our open source ROS compatible simulator. We are now working towards bringing (S-)NAMO to Multi-Robot settings.



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