Integrating New Functionality into a Turtlebot2

Project proposal

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1 Goals

Robotics is currently one of the areas with greater growth potential inside Artificial Intelligence, given its many applications and the current state-of-the-art that allows for many tasks that were recently seen as possible to be completed by humans only, to be done by robots.

The robocup@home competition aims to develop robots to assist in personal domestic situations. It requires the robots to have many capabilities, such as, human-robot-interaction and cooperation, navigation and mapping in dynamic environments, computer vision and object recognition, object manipulation, among others [1].

At SOCIA-lab we have been working on some of the code to allow a robot to solve several of the problems that arise in this competition (mapping, grasping, navigation, among others) [2, 3, 4, 5, 7].

With this project we want to continue to integrate all the developed code into a single framework such that it is able to work together as a whole, and also to develop and/or install code to solve other tasks, such as voice recognition.

The code will be done on the Robot Operating System (ROS) [6] in Python and will run on a Turtlebot 2 robot.

2 Work plan

The project has the following tasks:

T1 Introduction to robotics and ROS (3 weeks).

T2 Study the requirements for the robocup@home competition and integrate already existing code (2 weeks).

T3 Implement new code to solve some of the remaining necessary requirements (9 weeks).

T4 Write the project's report (3 weeks).

3 Technical and Academic Requirements

Be able to program using Python on Linux, use a source code repository and produce documentation (using doxygen, sphinx or other similar tool).

It is desirable that the student has grades above 13 on the following courses: Estruturas de Dados, Probabilidades e Estatística, Inteligência Artificial.

4 Expected Results

- robot prepared to solve most of the robocup@home tasks
- source code and documentation of all code developed
- project report

5 References

[1] Robocup@home web page. `http://www.robocupathome.org/`.

[2] M. Fernandes and L.A. Alexandre. Dynamic recognition of obstacles for optimal robot navigation. In *22nd Portuguese Conference on Pattern Recognition, RECPAD 2016*, October 2016.

[3] M. Fernandes and L.A. Alexandre. SLAMfusion: Fusing SLAM methods for improved robustness. In *IEEE International Conference on Autonomous Robot Systems and Competitions, ICARSC 2016*, May 2016.

[4] V. Lopes, L.A. Alexandre, and M. Fernandes. Less is more: Simplifying point clouds to improve grasping performance. In *2018 IEEE International Conference on Autonomous Robot Systems and Competitions (ICARSC)*, pages 256–260, April 2018.

[5] C. Pereira, G. Falcao, and L.A. Alexandre. Pragma-oriented parallelization of the direct sparse odometry SLAM algorithm. In *27th Euromicro International Conference on Parallel, Distributed and Network-Based Processing*, Pavia, Italy, February 2019.

[6] Morgan Quigley, Ken Conley, Brian Gerkey, Josh Faust, Tully B. Foote, Jeremy Leibs, Rob Wheeler, and Andrew Y. Ng. ROS: an open-source robot operating system. In *ICRA Workshop on Open Source Software*, 2009.

[7] Abel Zacarias and L.A. Alexandre. Application of lifelong learning with CNNs to visual robotic classification tasks. In *24th Portuguese Conference on Pattern Recognition, RECPAD 2018*, Coimbra, Portugal, October 2018.