

IEEE – Robotics & Automation Society Award
Tech. Committee: Energy, Environment, and Safety Issues in
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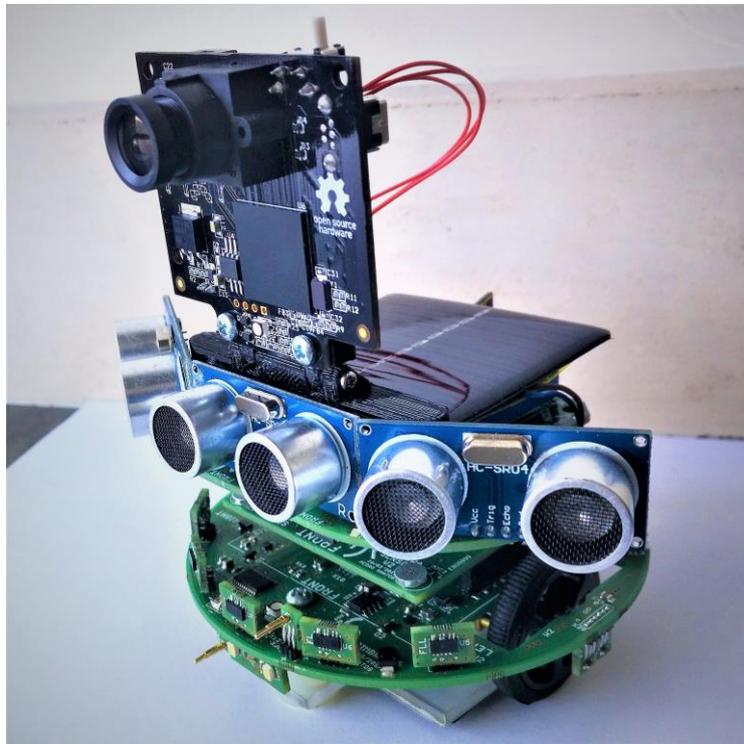
Energy harvesting systems for low energy mobile robots

Course of Robotic Systems and Mobile Robotics

MSc in Electrical Engineering and Computers at Univ. of Coimbra, Portugal

2016/2017

ENERGY AUTONOMOUS MINI PLATFORM FOR MOBILE
ROBOTICS TRAINING



OBJECTIVE

It is the objective of this laboratory component to provide students with the possibility of implementing, on mobile robotic educational platforms, some computational solutions for navigation, localization and mapping.

By conducting the proposed laboratory work it's intend to:

1. Place the student before the universe of mobile robotics in "semi-real" environments;
2. Validate the functionality of the studied algorithms through their integration into embedded robotic mobile systems;

Description

This laboratory component has 3 mini-projects aiming at the development and adaptation of functions/algorithms for navigation and mapping, ending with the realization of a 4th mini-project.

The mini-project to be developed will aim to implement in the mobile platform an algorithm of simultaneous localization and mapping (SLAM) with occupation grids, using information provided by ultrasound sensors.

Mini projects

In the first 3 mini-projects are developed functions/algorithms necessary for the implementation of the 4th mini-project and it's mandatory to achieve the objectives for each of them.

1. Modeling and control of platform movement

Objective: Develop and integrate the basic functionalities of the platform, namely its sensorial and control functions. In this first contact with the platform it's intended to integrate the algorithms necessary to maneuver the platform between different poses in an obstacle-free navigation space. It is proposed the development of open-loop and closed-loop motion control approaches using only the odometric information.

2. Mapping based on Occupation Grids

Objective: Using the distance information provided by ultrasound sensors, we intend to implement a probabilistic approach to mapping the navigation space. To this end, it is proposed the implementation of the Bayesian approach presented by Sebastian Thrun for the mapping based on occupation grids. As a validation approach to occupation grids mapping, the navigation approaches developed in the previous stage can be used and any collision avoidance process/strategy can be adopted.

3. Navigating Using Virtual Forces Field

Objective: Supported in the functions developed in stages 1 and 2, we intend to implement a navigation approach based on the virtual forces field (VFF) algorithm. It is proposed to implement navigation solutions supported in simultaneous mapping and using previous map information.

4. Simultaneous Location and Mapping Based on Occupancy Grids (Occupational Grid SLAM)

Objective: Supported in the functions developed in the previous stages, it is intended to develop a simultaneous localization and mapping approach with Occupancy Grid (SLAM). Unlike the approach to be developed in stage 3, which assumes the knowledge of the location of the platform in the navigation space, in this approach, the odometry information will only be used as a location estimate.

Development support

A support WEB platform is available, where Mini EXPLORER users can access manuals and supplementary information on how to use the platform.

(<https://docs.google.com/document/d/14RsXqrhZ6nyppBY3yfCQXD6f3uTCFzbP647Z0V72bB4/edit>)

A library of functions of the Mini Explorer for motor control and sensor reading was also developed and made available online on the MBED platform (https://developer.mbed.org/users/ISR/code/ISR_Mini-explorer/), as well as the documentation about all the functions in the library.

The analysis of these documents is essential for a correct use of the platform. As a good practice, it is recommended to read ALL the information that is available BEFORE STARTING the development.