Domestic Robotics – Extending the Functionality of Smart Home Devices

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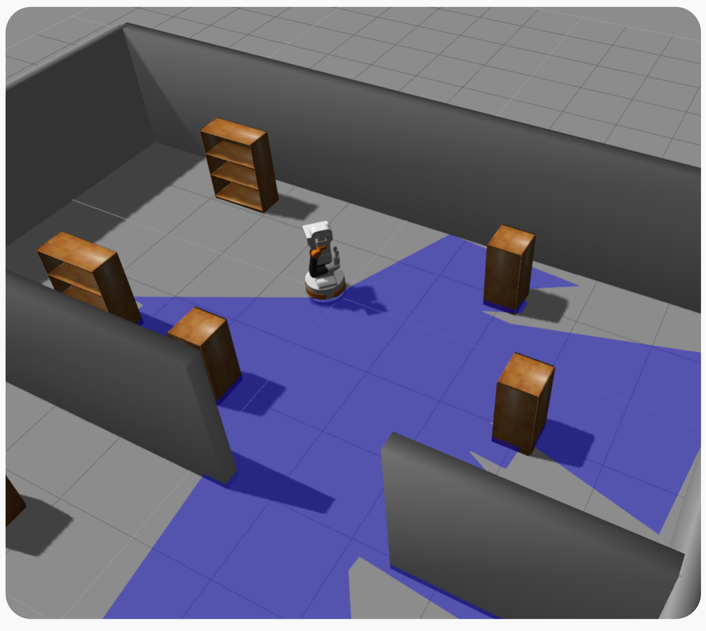
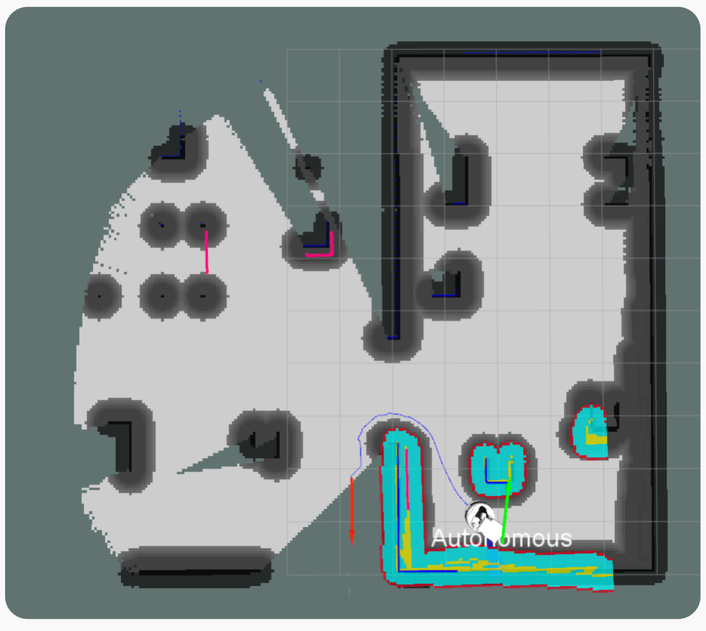
Existing smart home devices lack knowledge of their home's characteristics such as size, layout, or their own location within the building. This project aims to demonstrate how a domestic robot could be utilized to provide smart devices with maps and details of their environment.

SLAM & Exploration

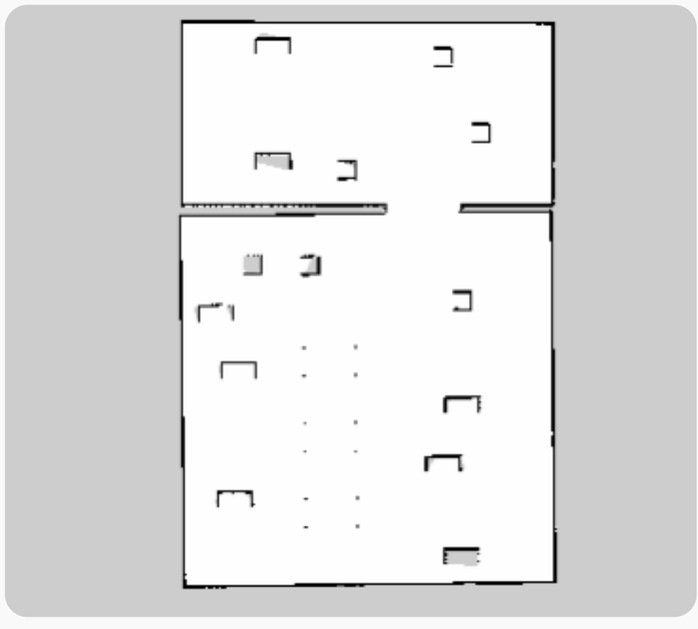
ROS 'gmapping' package [1] used to implement particle filter SLAM



'Explorer' package [2] modified to enable frontier-based exploration

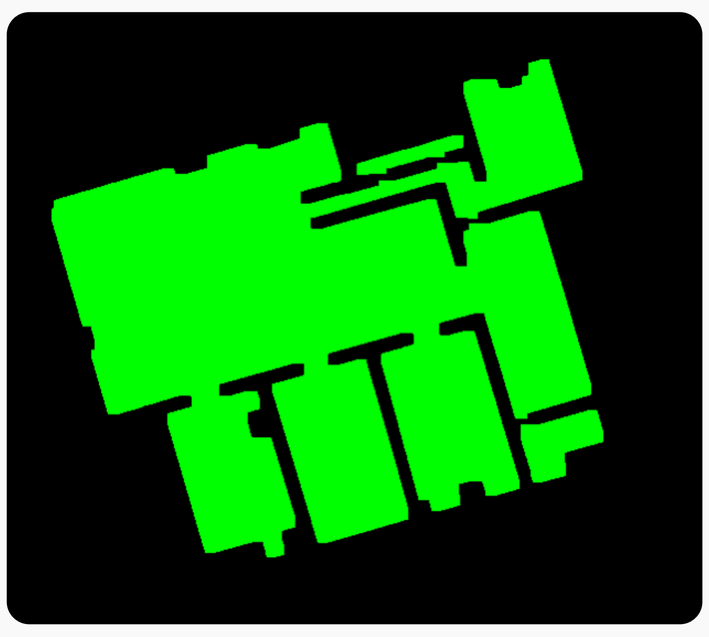


Robot autonomously maps environment & produces 2D occupancy grid map

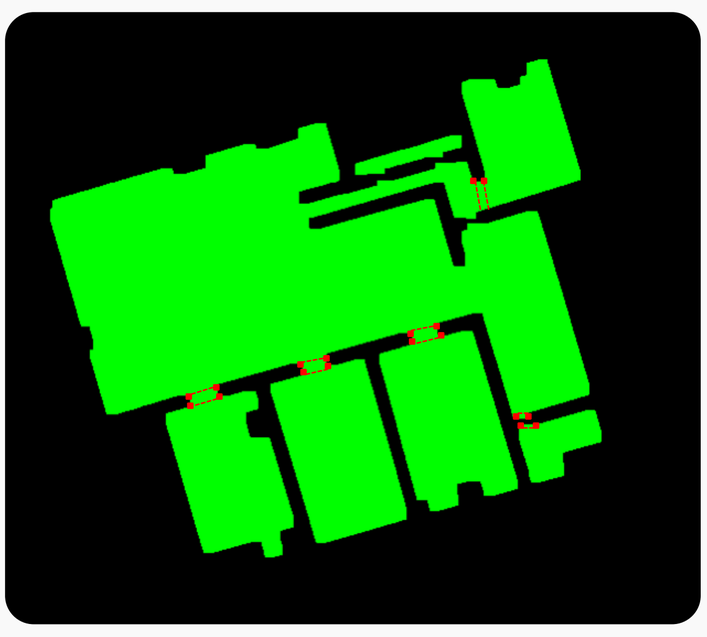


Map Analysis – ROS Package Created

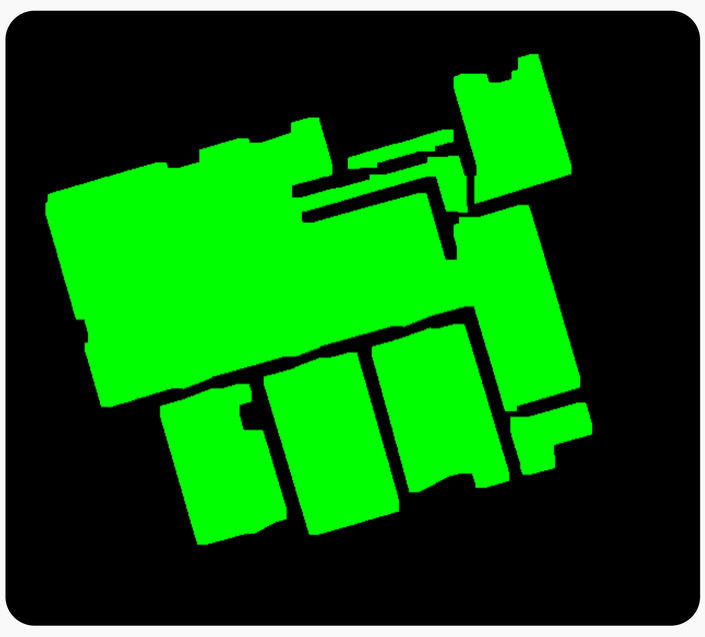
Morphological transformations & contour feature analysis in OpenCV used to clean map



Virtual door detection method devised to locate likely door positions on map



Contour feature analysis employed to calculate room dimensions



Communication with smart devices

IFTTT applet [3] created which enables the robotic application to share maps and room dimensions with other smart devices and web services.

Robots

PAL Robotics TIAGo Robot

Willow Garage PR2 Robot

Evaluation

Initial findings indicate the application computes accurate building area (4% difference) and room area (6% difference) values when compared with the actual measurements.

Future work could focus on identifying smart devices and labelling their location on the map & incorporating HRI into the application.

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References:
[1] G. Grisetti et al. (2007) *Gmapping*. Available from: http://wiki.ros.org/gmapping
[2] T. Andre et al. (2014) *Explorer*. Available from: http://wiki.ros.org/explorer
[3] L. Tibbets et al. (2011) *About IFTTT*. Available from: https://ifttt.com/about