

## ICAPS18 Tutorial

# Integrating Classical Planning and Mobile Service Robots using ROSPlan

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# Part 4 - Introduction to robot skills



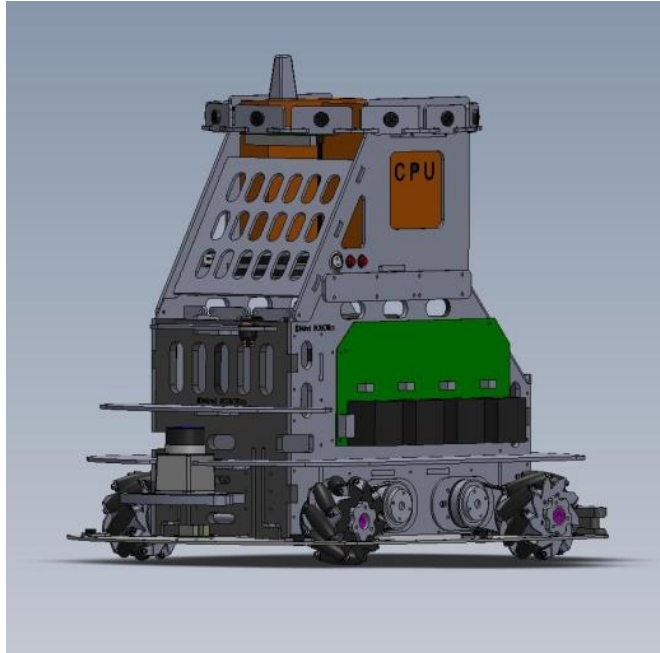
# Use case for this tutorial - Mbot robot

- [MOnarCH](#) robot or mbot
- Manufactured by [IDMind](#) (Portuguese company)
- Originally designed to interact with children in hospitals
- Omni-directional mobile base equipped with four mecanum wheels actuated by four independent motors.
- Features two 5m laser range finders installed 13.5 cm above ground level
- One on-board computer with i7 processor and GPU for real time object detection using CNN's
- Weight : 24 Kg, Max speed: 2.5 m/s, Acceleration: 1 m/s<sup>2</sup>





# Mbot omni-directional base





# Mbot Skills

- Move base (e.g. move to the hallway table)
- Find object (e.g. find a coke in the kitchen)
- Grasp (e.g. grasp the energy drink)
- Place (e.g. place the pringles on the table)
- Find\_person (e.g. find John in the kitchen)
- Guide (e.g. find a person and guide it to the exit)
- Tell (e.g. tell a joke to Jackie at the dining table)
- Follow (e.g. follow a person)
- Answer (e.g. answer a question to John at the kitchen)



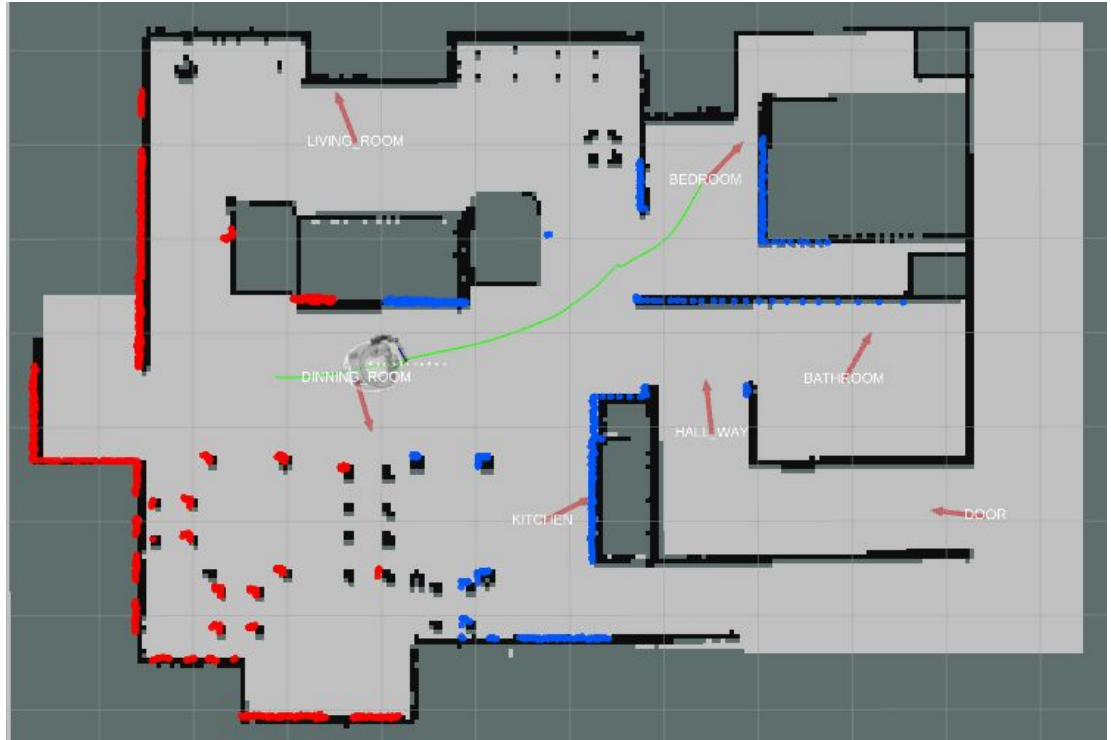
# Environment





# Navigation

- Move base
- Autonomous navigation
- Move the robot between locations





# Perception

- 3D object detection, recognition and pose estimation

## **Assumptions:**

- Robot is at the location where objects need to be perceived
- Robot neck and head cam have the objects in the FOV
- Objects are supported by a horizontal surface





# Grasp

Robot uses its arm to fetch an object from a location

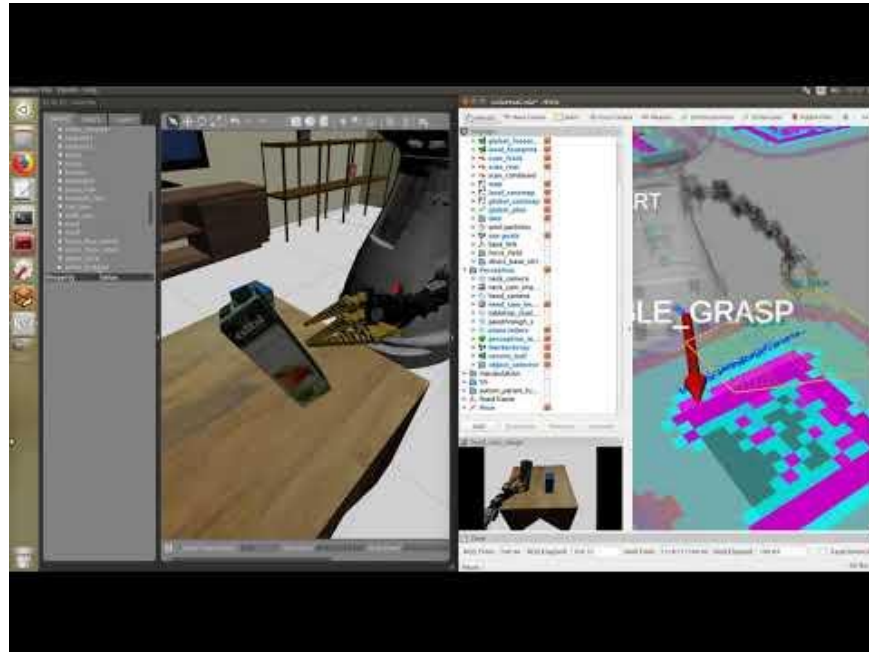
## **Assumptions:**

- Robot is at the grasp location
- Robot gripper is empty
- Object is reachable by robot manipulator
- Objects have been previously perceived



# Navigation, Perception and Grasping

YouTube video made for RoboCup 2018 test: Storing groceries





# Robot Simulator

Gazebo simulator environment available under:

[https://github.com/socrob/mbot\\_simulation\\_environments](https://github.com/socrob/mbot_simulation_environments)

Gazebo simulator for robot will be made available shortly under:

[https://github.com/socrob/mbot\\_simulation](https://github.com/socrob/mbot_simulation)



# Place

Move arm to a pre-recorded pose

Open gripper

Retract arm

## **Assumptions:**

- Robot is at the location where the object needs to be placed
- Arm configuration is known
- Path from initial arm config to final is obstacle free



# Find person

Not available at the moment in simulation

Robot detects if there is a person in front of him or not

Rotates base for a small angle, finds again

## **Assumptions:**

Robot is in same room as the person to be found

While rotating base, robot is free of collision

Head cam angle has the person in FOV



# Guide

Currently: Robot moves to a location (navigation) scoring a person

Ideally: Check from time to time that the person is still there

## **Assumptions:**

- Person has been previously found
- The robot and the person are in the same location
- Person has the will to follow the robot when is asked



# Tell

Use speech synthesizer (espeak) for the robot to convert scripted text into audio (robotic voice)

## **Assumptions:**

- Person and robot are in the same location
- Location is small enough of the human to hear the robot anywhere



# Follow

Perception:

- People detection and tracking

Control:

- Keep the person in the center of the camera by moving robot neck and head camera (tilt)

Navigation:

- Local obstacle avoidance
- Recreate person trajectory
- Follow trajectory with custom laser based navigation





# Answer

Say : I am ready to answer your question

Listen to question

Scripted reply or chatbot/wolfram alpha solution

Use speech synthesizer to answer

## **Assumptions:**

- Robot and person are in the same location



Questions?

Next: Hands on session (1 hour)