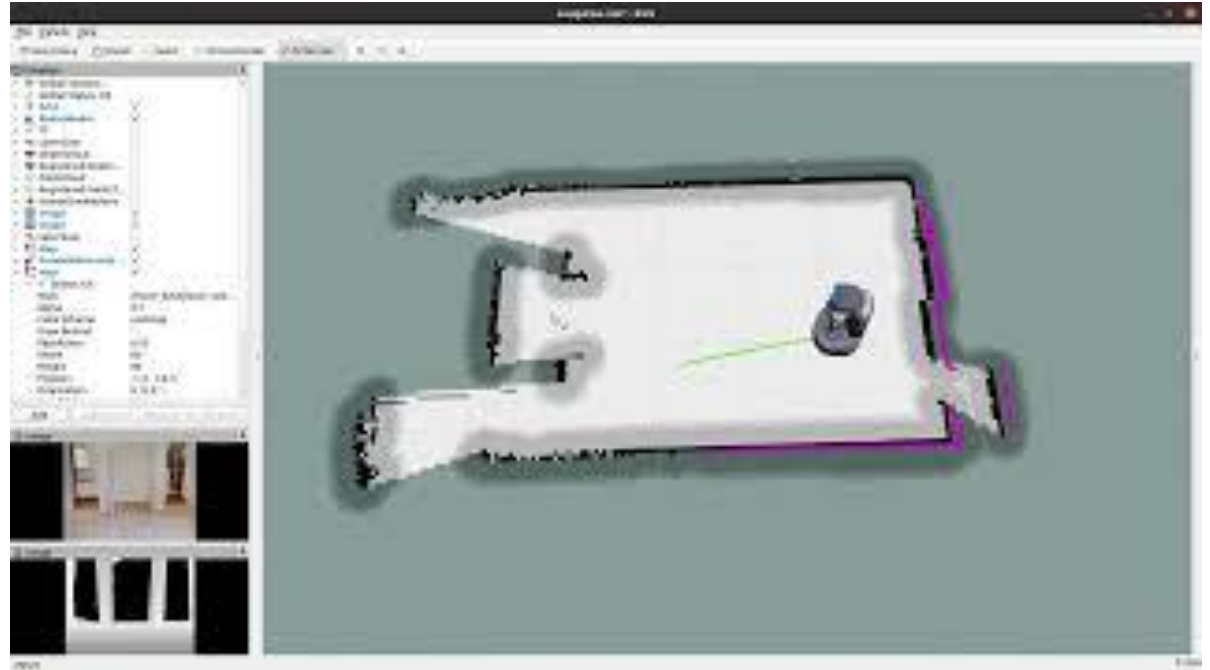


Semantic Exploration and Mapping of Unknown Environments - Mobile Robots

Presented by
SAI HANEESH ALLU

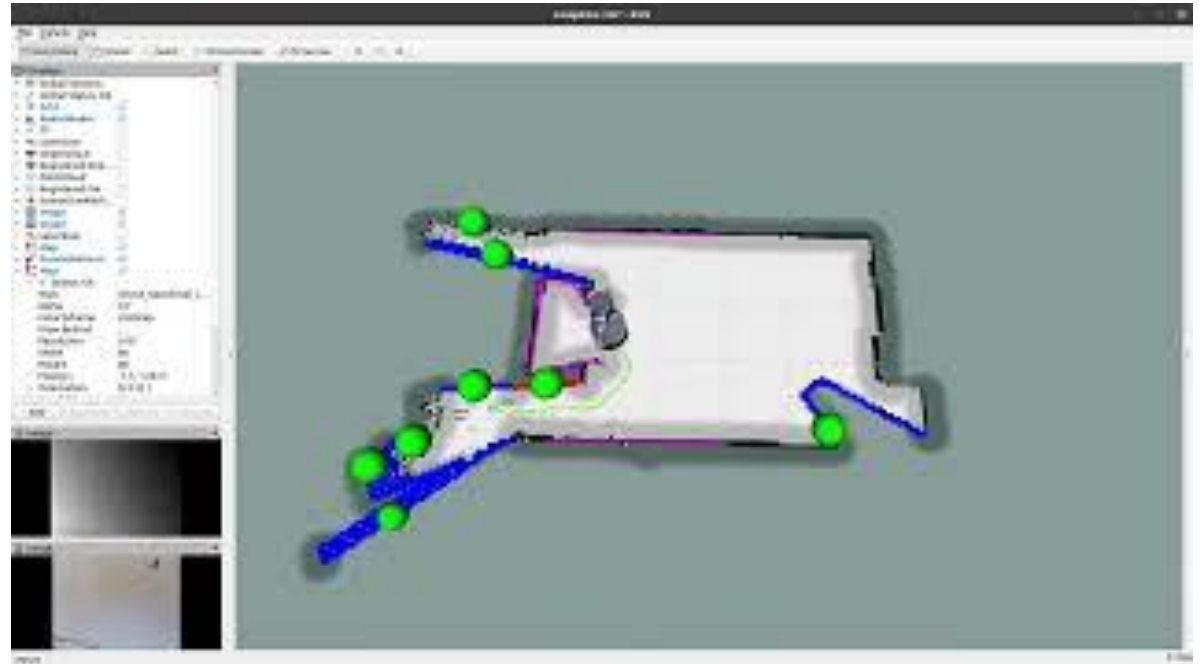
Mapping

- Build a map of occupied, free, unknown areas.
- Occupancy grid data structure
- To plan a obstacle free path to reach any location



Exploration

- To map the environment autonomously
- Frontiers - regions between Known and unknown space
- Nearest accessible frontier is selected



Semantic Exploration and Mapping

What we have

- Pure Geometrical map of the environment
- Primarily for Navigation

What we need

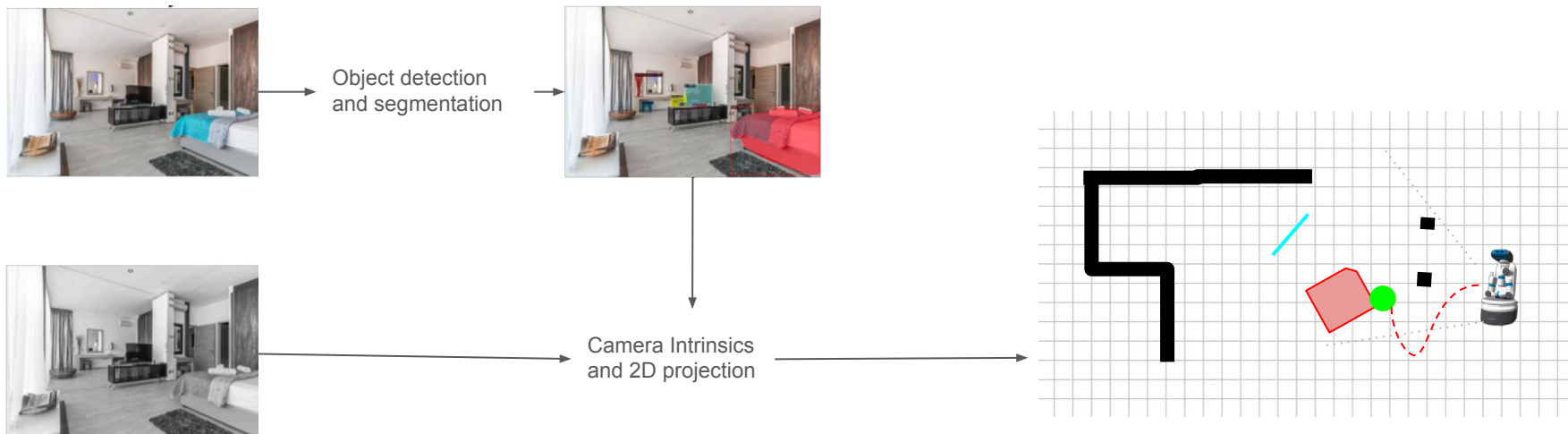
- For tasks like, **navigate to particular object**, **is this object present in the environment**, **grasp a particular object**, we need information about objects in environment too
- For this, we need to perform exploration to look at as many object as possible

How do we do it

- Build a map of the object locations along with the geometry map
- Modify the FBE, to explore locations of high semantic information gain as a priority

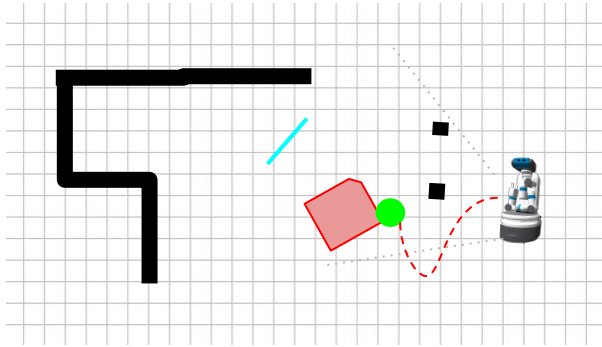
Semantic Exploration and Mapping Method

Overview:



Semantic map and exploration goal

Semantic Exploration and Mapping Method



Semantic map and exploration goal

- Each color, corresponds to each object category
- If Furniture level object $\in \{Table, Chair, Futon, etc., \}$ detected, reach to it first
- If not, select the nearest frontier

Platform

Simulation: Gazebo & ROS

World Environment: Modified version of AWS house environment (and iGibson)

Mapping: Gmapping

Navigation: move_base

Exploration: explore_lite

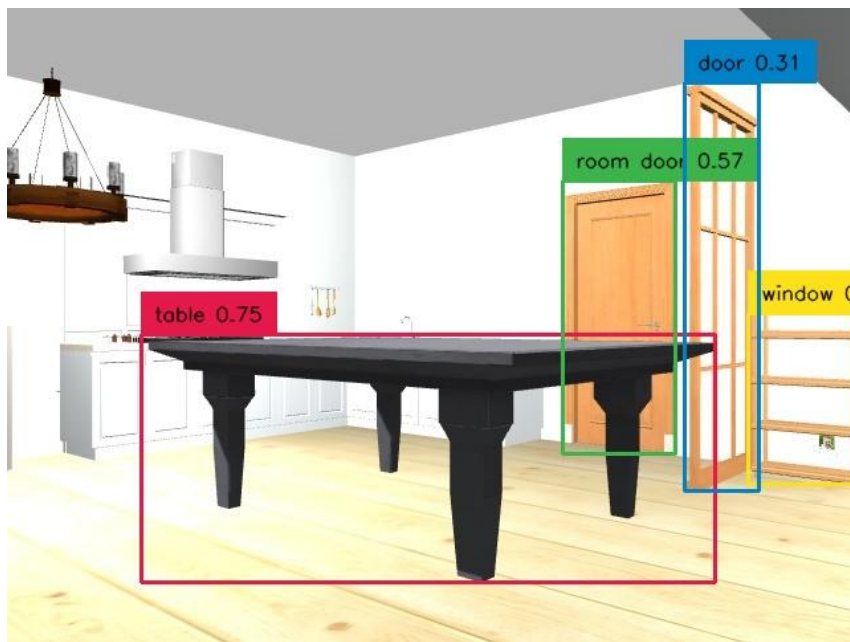
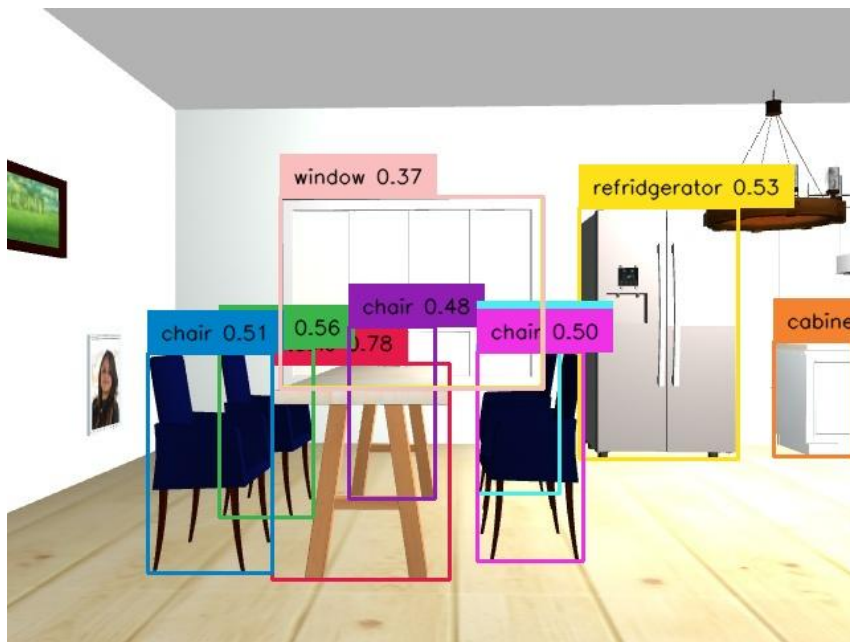
Object detection: Grounding DINO, Proto-CLIP

Object Segmentation: SAM

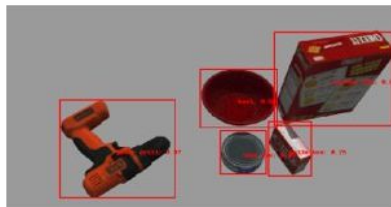
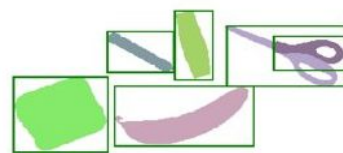
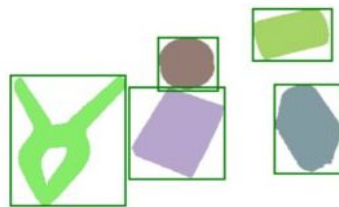
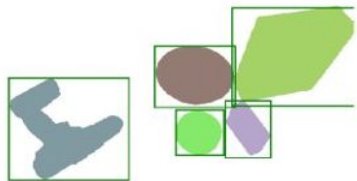
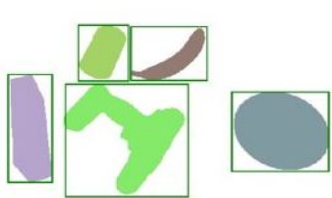
System - Environment



Furniture level detection (Grounding DINO)



System - Manipulable object detection and segmentation (Grounding DINO + SAM + PROTOCLIP)



Sem Exploration

