Mobile Robot Place Segmentation and Categorization Using Object Semantics

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Motivation

Semantic maps can be improved by incorporating information about functional places, through place **segmentation** and **categorization**.

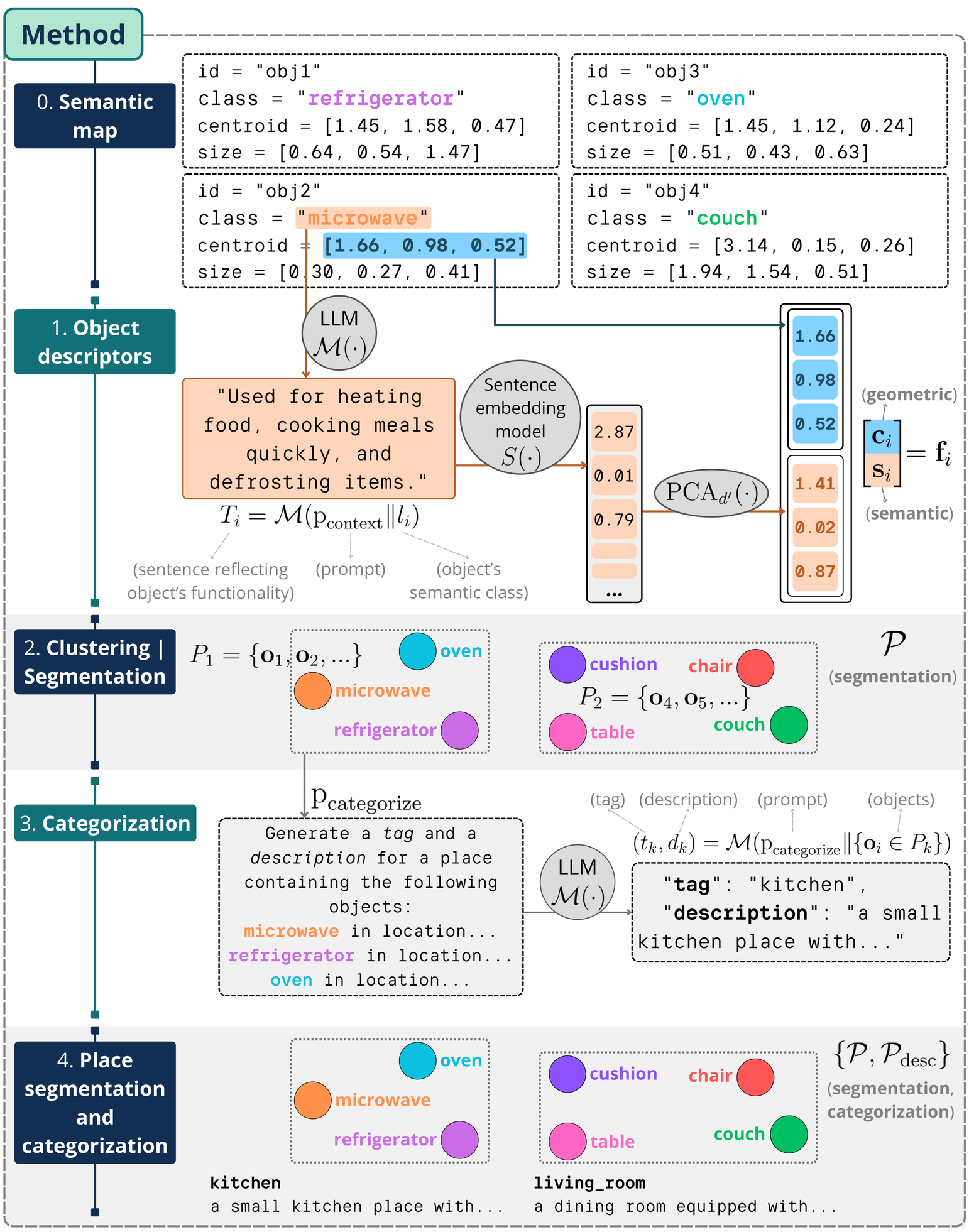
Limitations of traditional methods:

- Require **manual annotations**.
- Rely on rigid, **room-based** assumptions.
- Use **closed vocabularies** that cannot adapt to new environments.

Proposal:

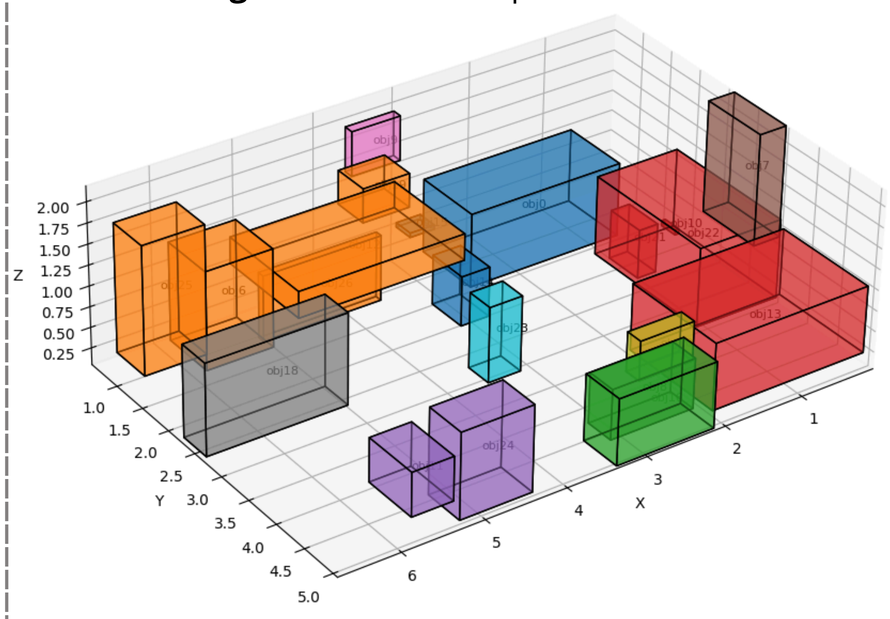
- We build geometric-semantic **descriptors** for objects and **cluster** them to **segment** places.
- We then use Large Language Models (**LLMs**) to **categorize** the places.

Method

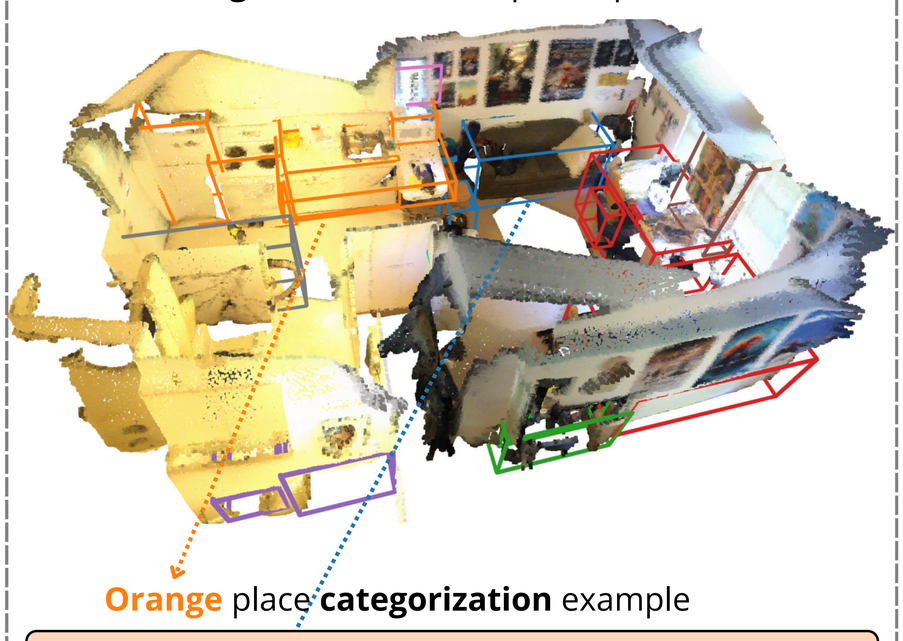


Results

Generated **segmentation** example with 3D AABBs



Generated **segmentation** example on point cloud



Orange place **categorization** example

kitchen_zone

A food preparation and storage area featuring essential kitchen appliances and surfaces, supporting activities such as cooking, reheating meals, and organizing ingredients

Blue place **categorization** example

lounging_area

A casual seating zone designed for relaxation or informal interaction, centered around a couch and complemented by stools that serve as footrests or additional seats.

Conclusions

- We propose a **clustering-based** method to segment places and an **LLM-based** approach to categorize them, assuming a pre-built semantic map.
- We focus on **functional relationships** among objects, rather than rigid **room-based** assumptions or **closed vocabularies**.
- This results in more flexible maps that enhance robot understanding and navigation.

Repository

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