OVIR-3D: Open-Vocabulary 3D Instance Retrieval Without Training on 3D Data

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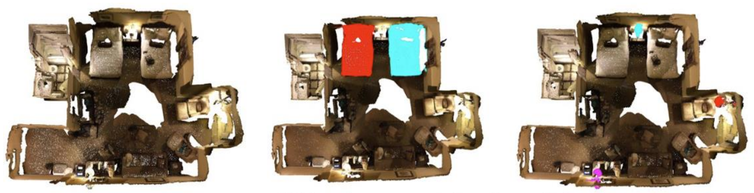
Introduction

Recent progress on open-vocabulary (language-driven, without a predefined set of categories) 3D segmentation addresses the problem mainly at the semantic level. Nevertheless, robotic applications, such as manipulation and navigation, often require 3D object geometries at the instance level. This work provides a solution for open-vocabulary 3D instance retrieval, which returns a ranked set of 3D instance segments given a 3D point cloud reconstructed from an RGB-D video and a language query.

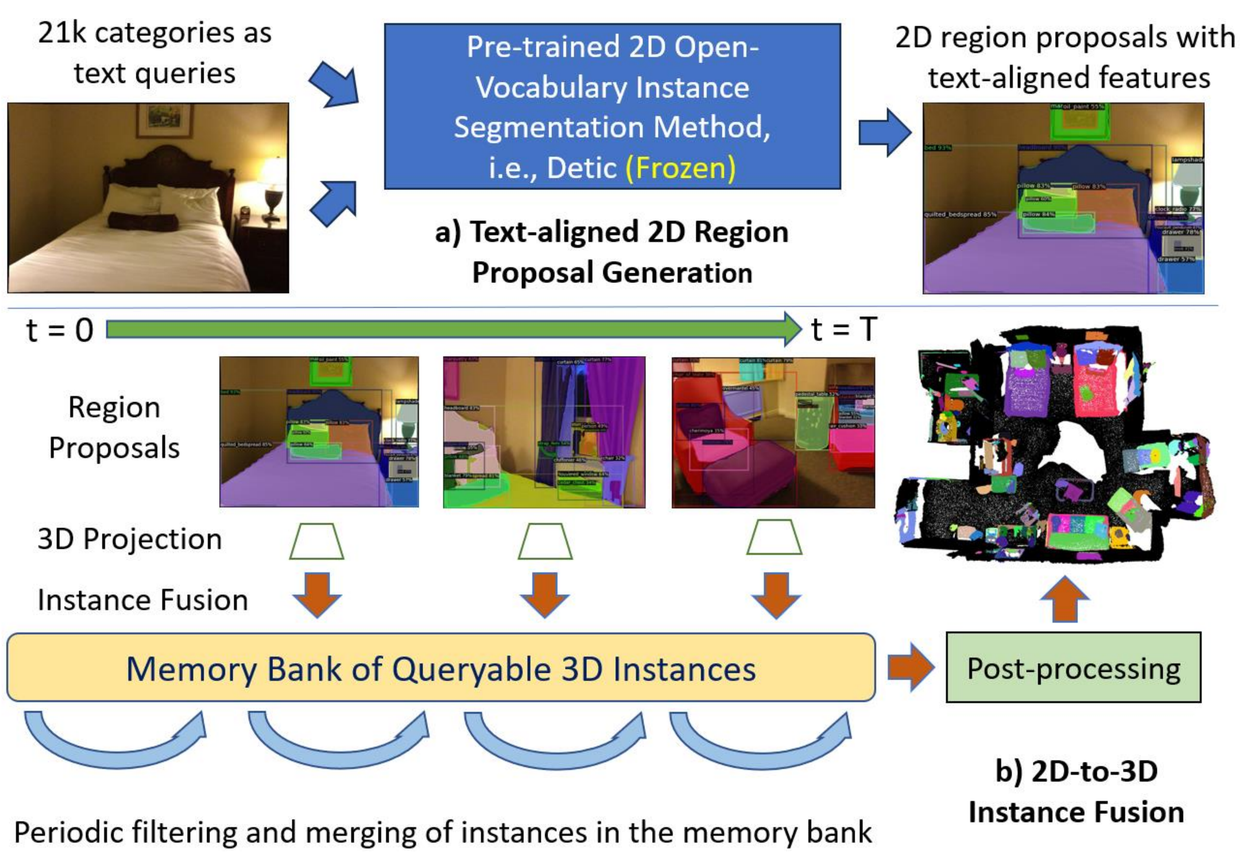


a) Original scan

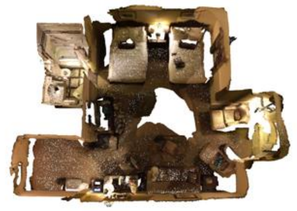
b) Top 2 instances retrieved given the query: "*bed*"

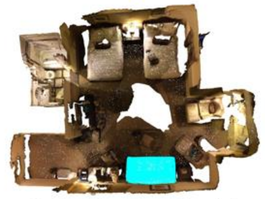
c) Top 3 instances retrieved given the query: "*lamp*"

Overall Pipeline



Inference





Top 1 is shown in blue.

Key Takeaways

Directly training an open-vocabulary 3D segmentation model is hard due to the lack of annotated 3D data with enough category varieties. Instead, this work views this problem as a 3D fusion problem from language-guided 2D region proposals, which could be trained with extensive 2D datasets, and provides a straightforward yet effective method to project and fused 2D instance information in the 3D space for fast retrieval.

Quantitative Results

The proposed method outperforms existing methods on both ScanNet200 (200 classes) and YCB-Video (21 classes) using mAP metric.

	ScanNet200 [25]		YCB-Video [29]	
Method	mAP_{50}	mAP	mAP_{50}	mAP
OpenScene [23]	0.190	0.089	0.333	0.116
Fusion++ [19]	0.253	0.094	0.464	0.120
PanopticFusion [21]	0.370	0.150	0.803	0.393
Ours	**0.443**	**0.211**	**0.848**	**0.465**

Table 1: Results on ScanNet200 [25] and YCB-Video [29]

Ablation Studies

	COCO	ScanNet200	LVIS	ImageNet21k
mAP_{50}	0.228	0.419	0.429	**0.443**
	ImageNet21k - ScanNet200			
mAP_{50}	0.410			

Table 2: Results on ScanNet200 [25] with different input queries to the region proposal network.

	Average	KMeans(16)	KMeans(64)
mAP_{50}	0.428	0.429	**0.443**
	Feature from largest 2D detection		
mAP_{50}	0.380		

Table 3: Results on ScanNet200 [25] with different feature ensemble strategies