AlphaTablets: A Generic Plane Representation for 3D Planar Reconstruction from Monocular Videos

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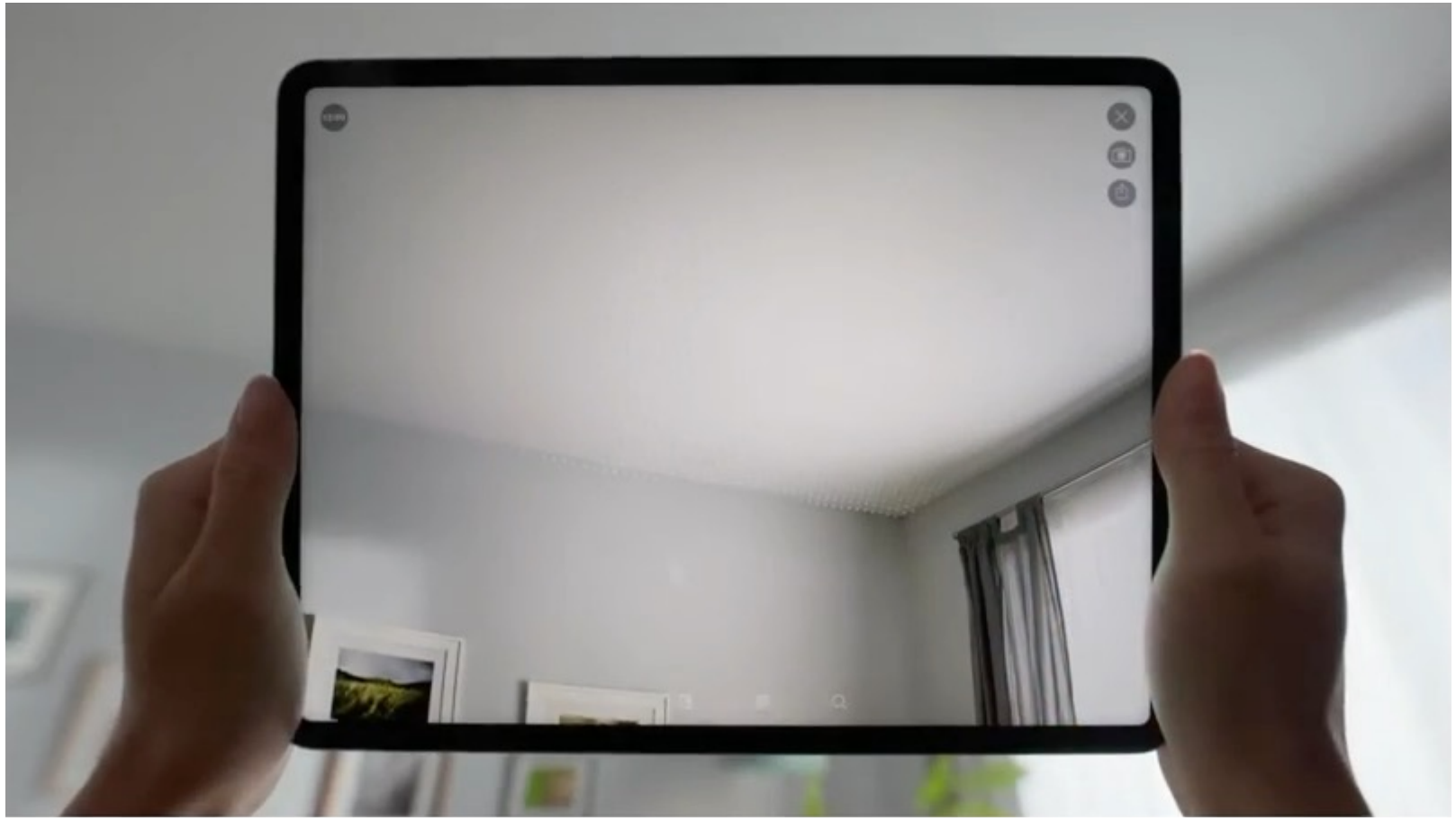
AlphaTablets

NEURAL INFORMATION PROCESSING SYSTEMS

Motivation

3D Planar Reconstruction



Credit: ArKit

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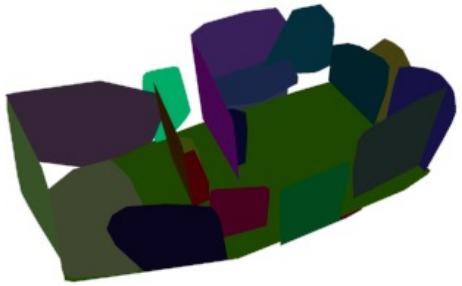
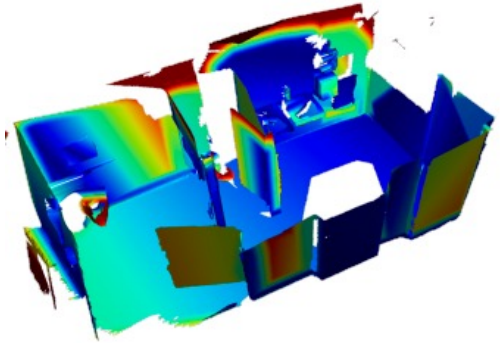
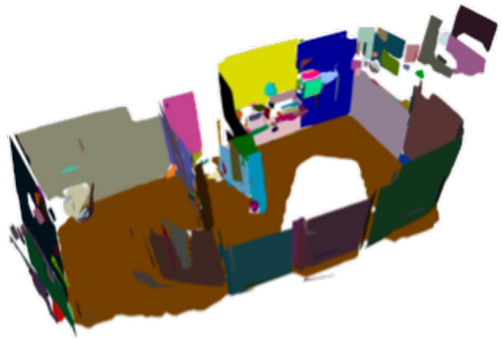
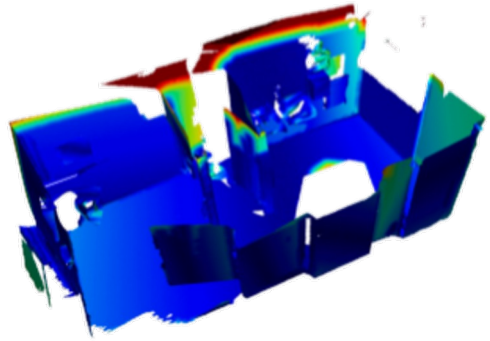
PlanarRecon





AlphaTablets (Ours)





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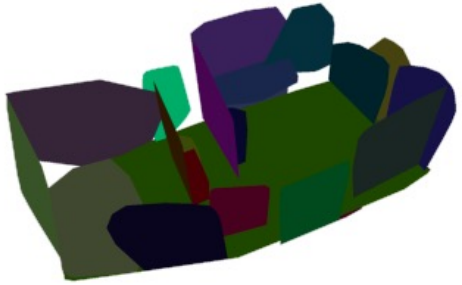
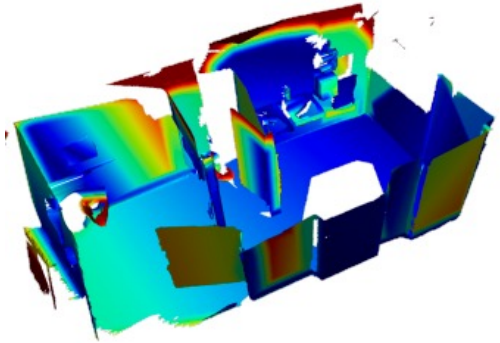


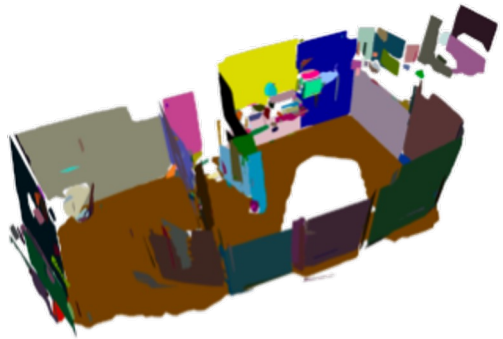


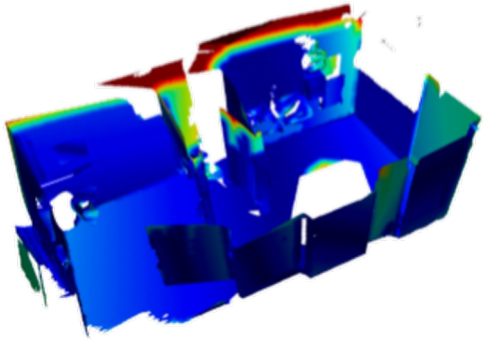
PlanarRecon

- Detects only large planes
- Limited in adaptability to various shapes
- Falls short of achieving complete reconstruction
- Requires pretraining and may encounter generalization issues

AlphaTablets (Ours)

- Detects planes of any size
- Supports arbitrary plane shapes
- Achieves complete reconstruction
- Requires no pretraining and generalizes effectively across different cases





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2D vs 3D plane representations

2D Planes

3D Planes

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✅ Precisely illustrate plane contours

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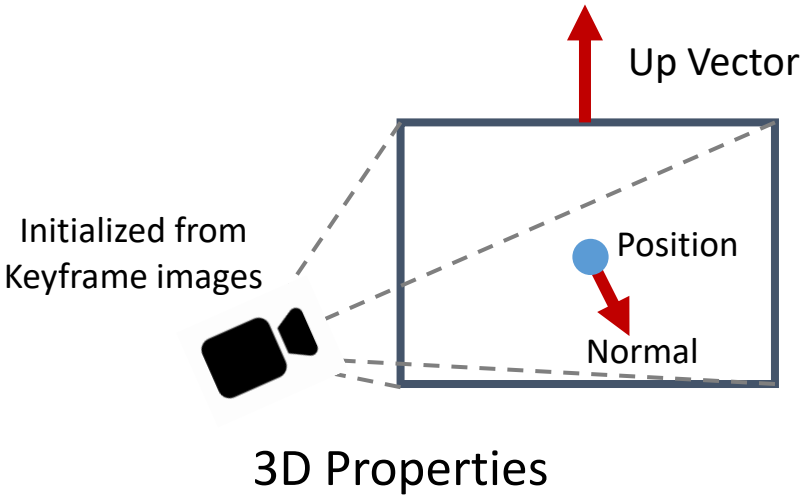

3D Properties

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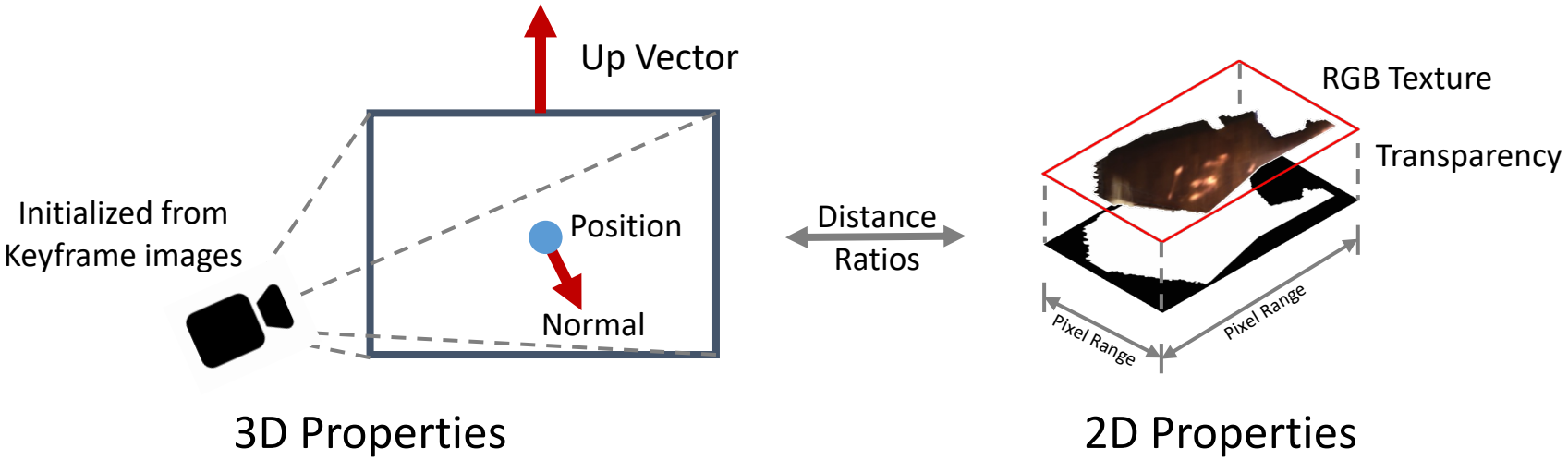

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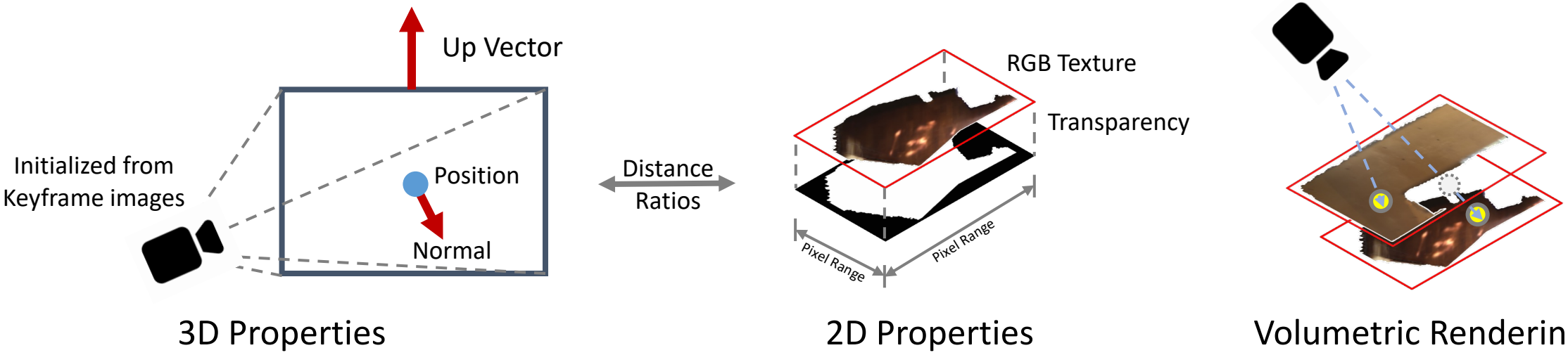

3D Properties

2D Properties

Volumetric Rendering

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Framework Overview

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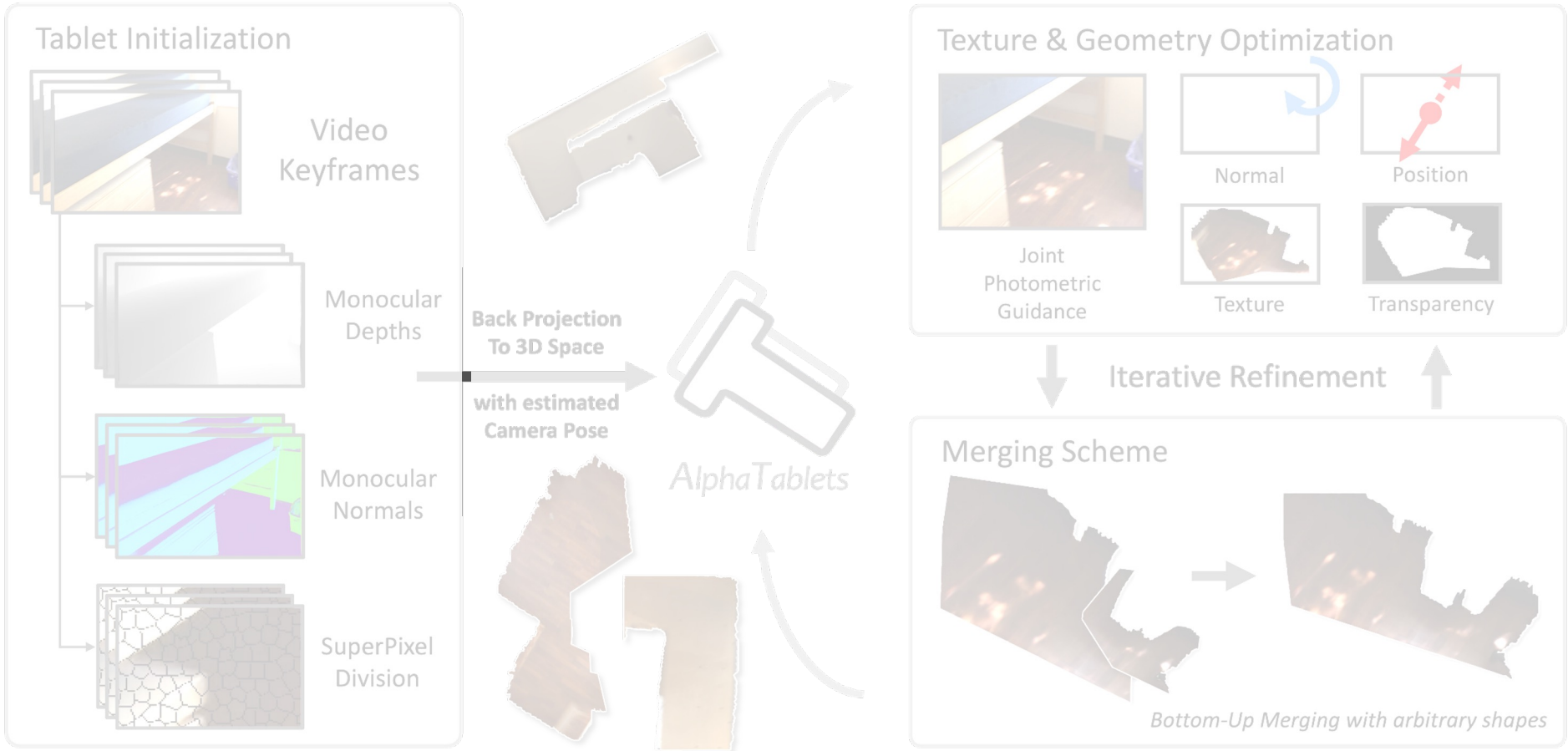

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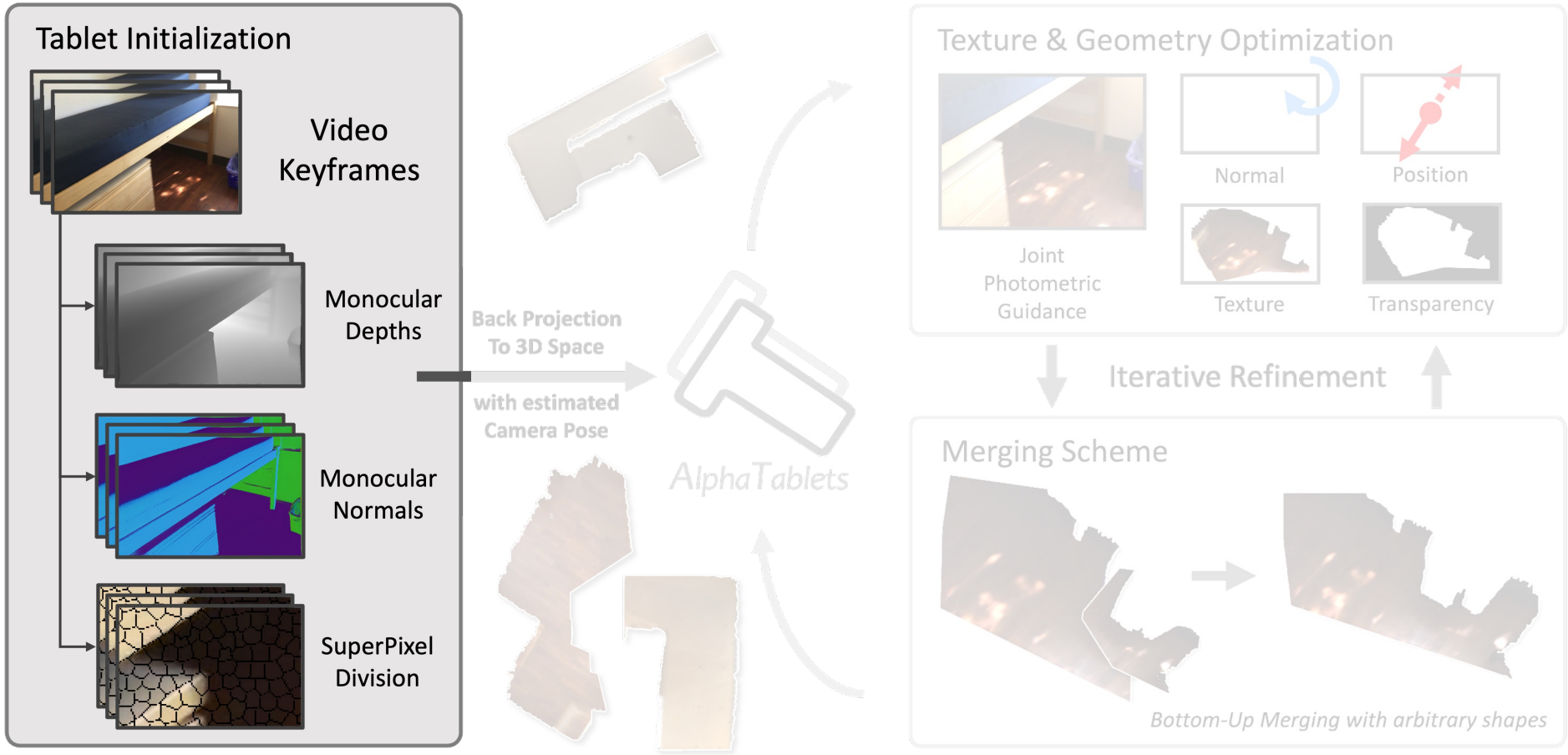

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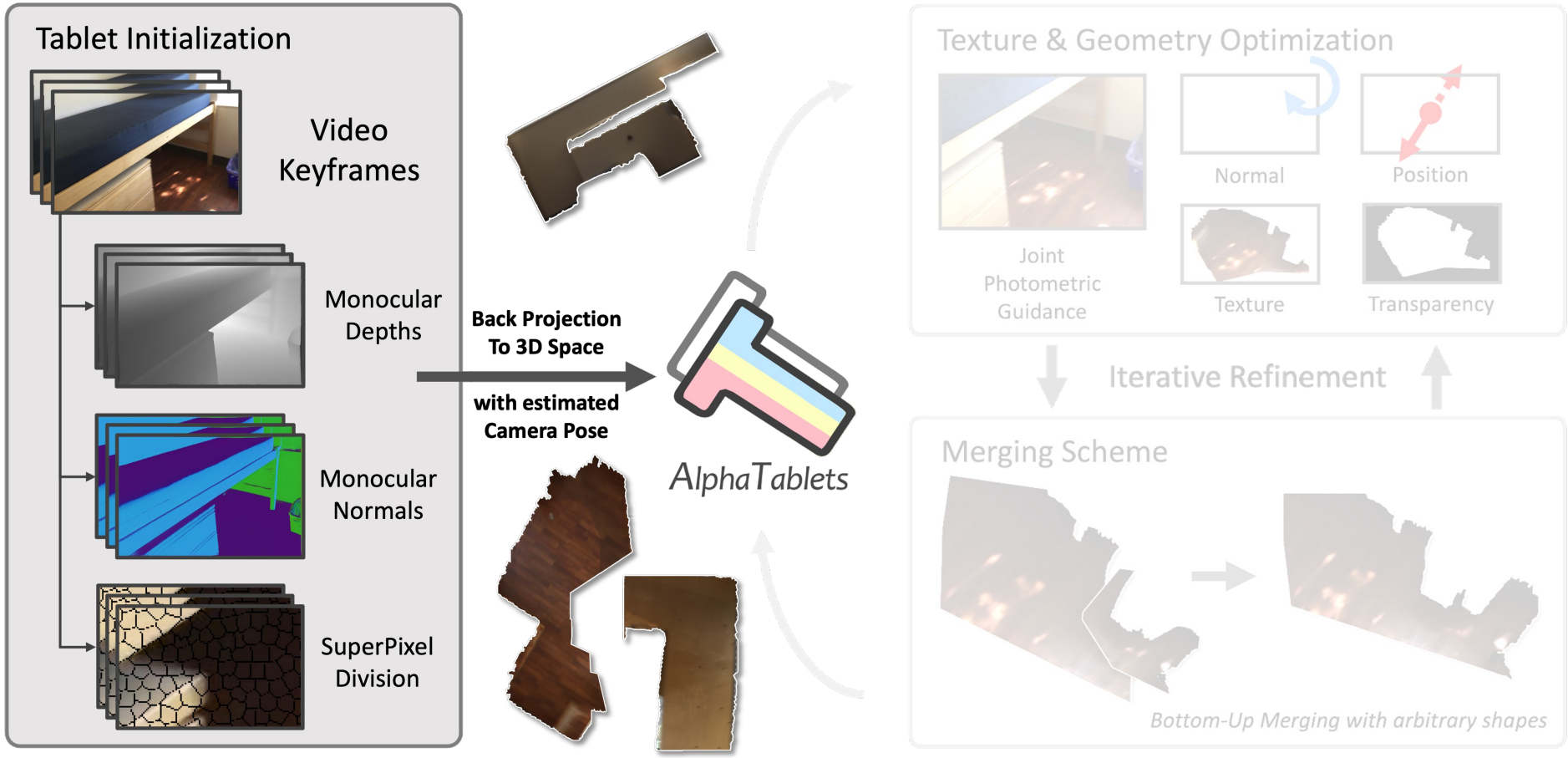

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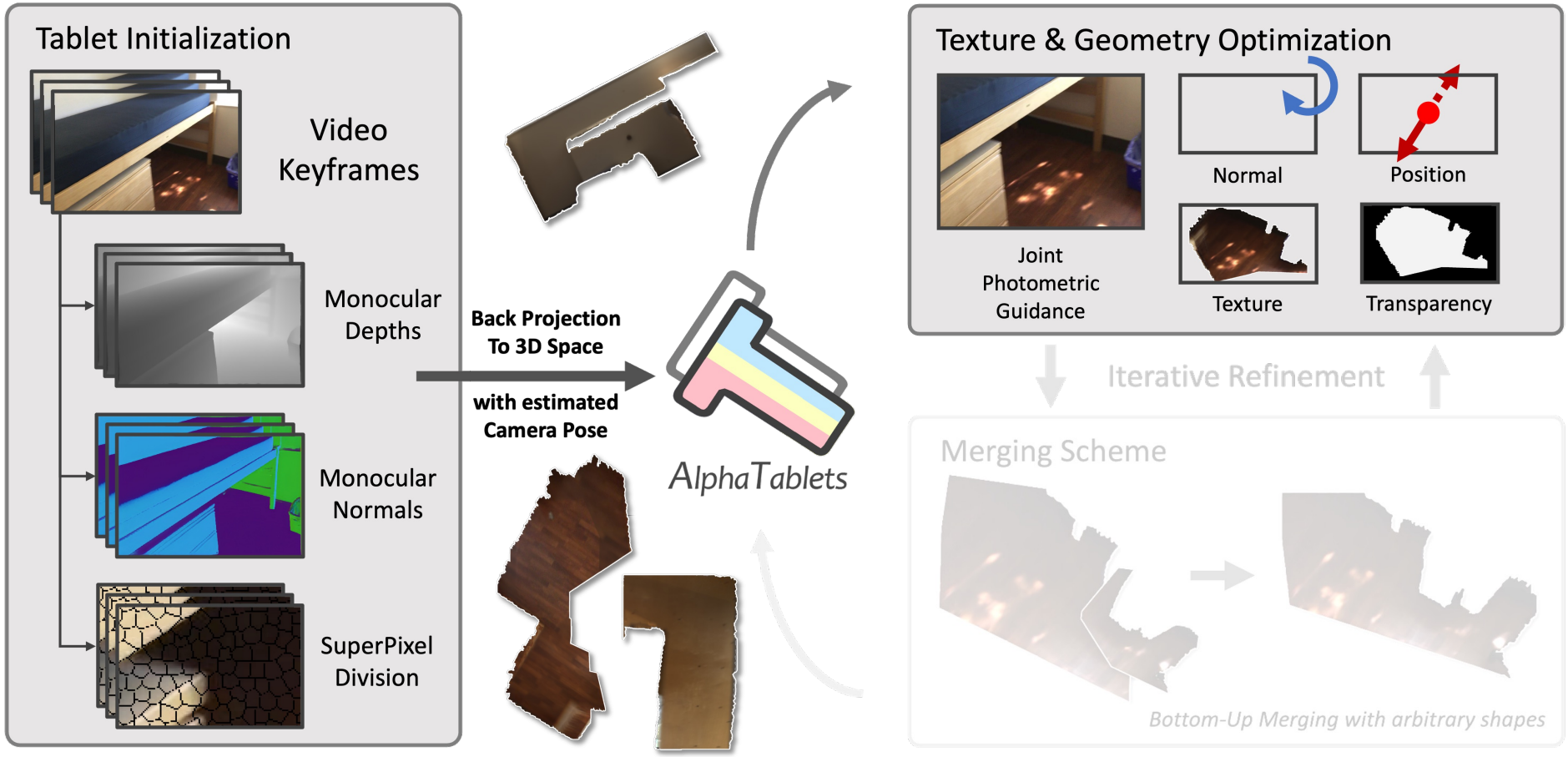

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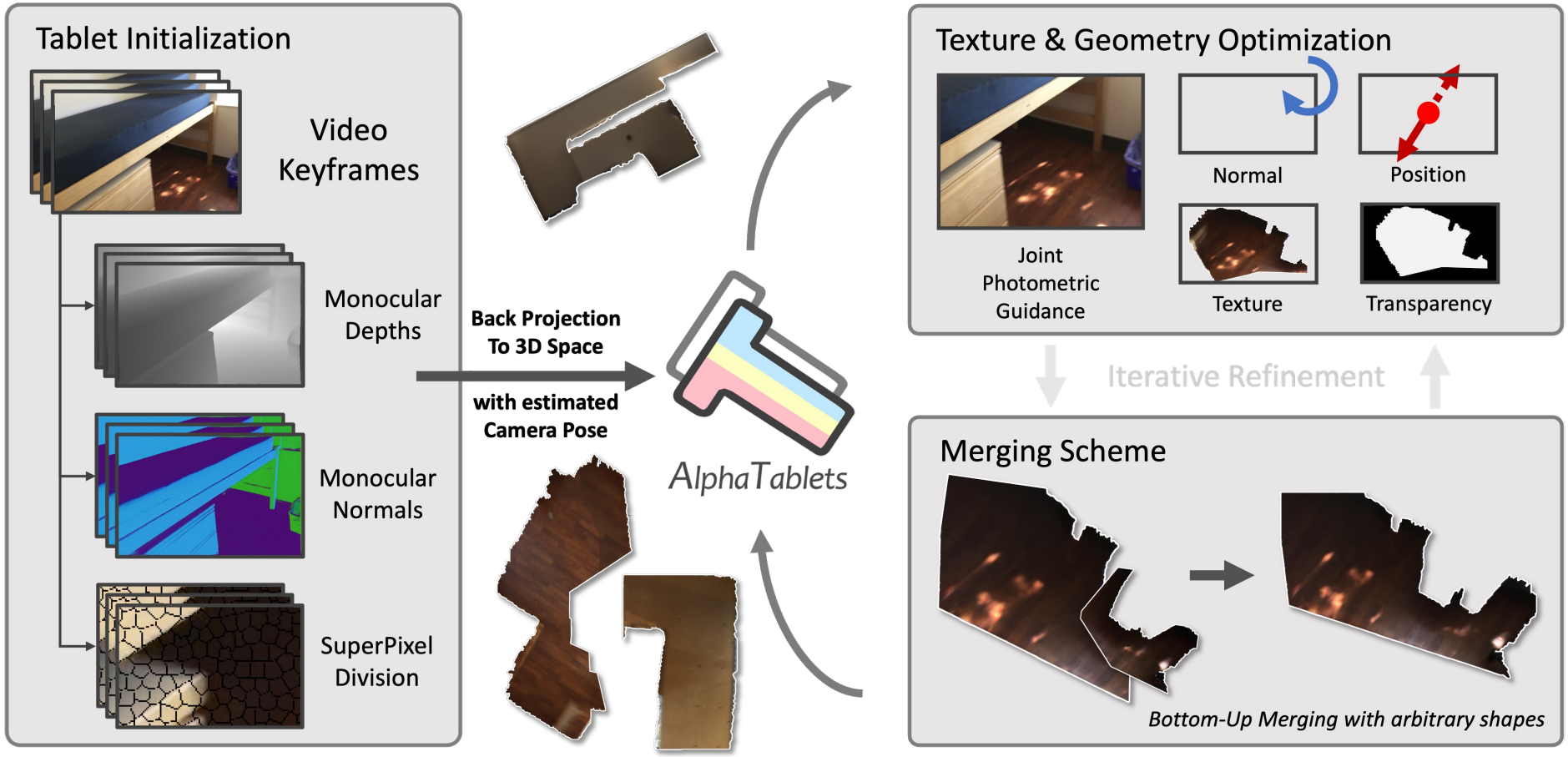

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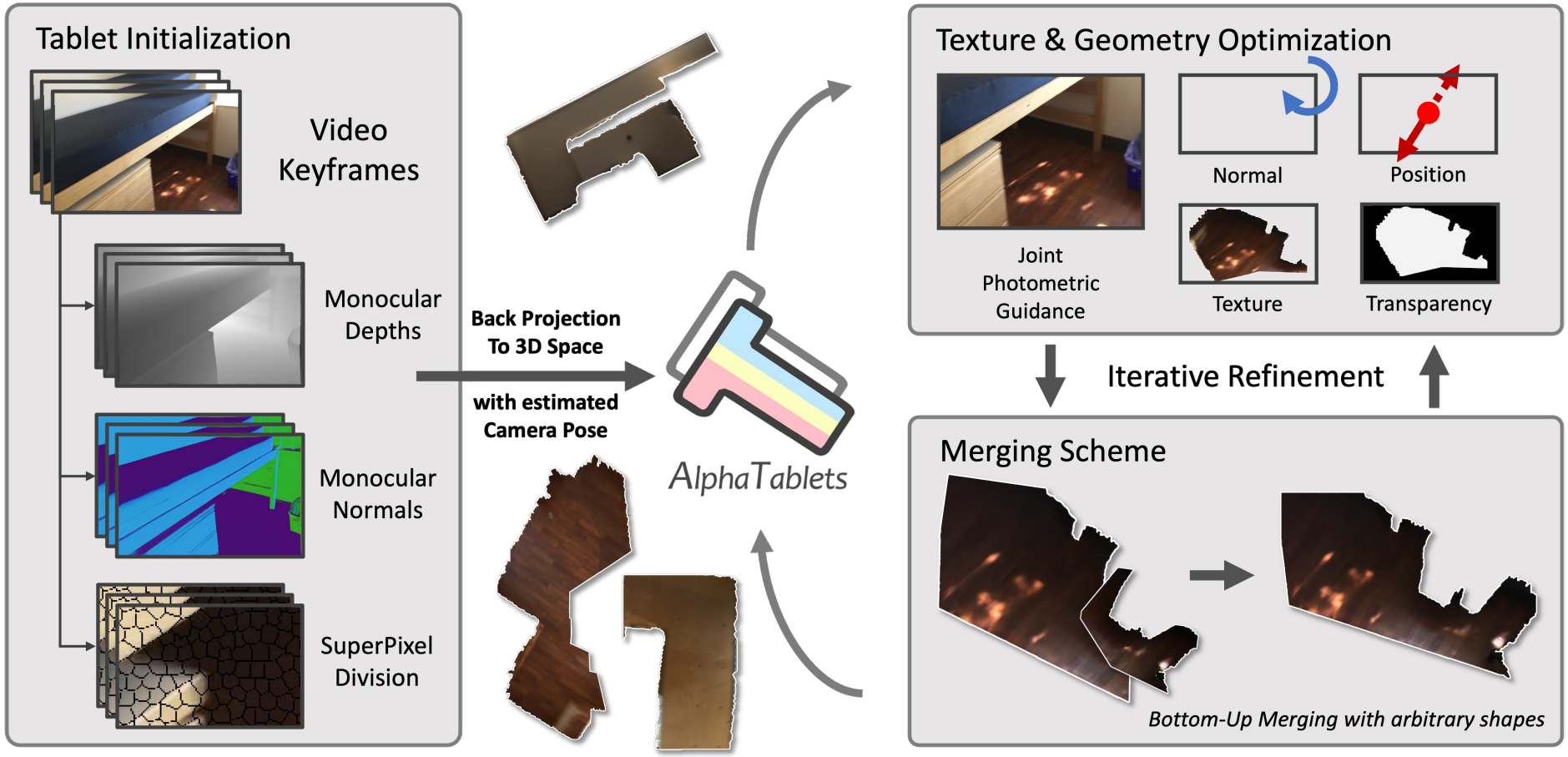

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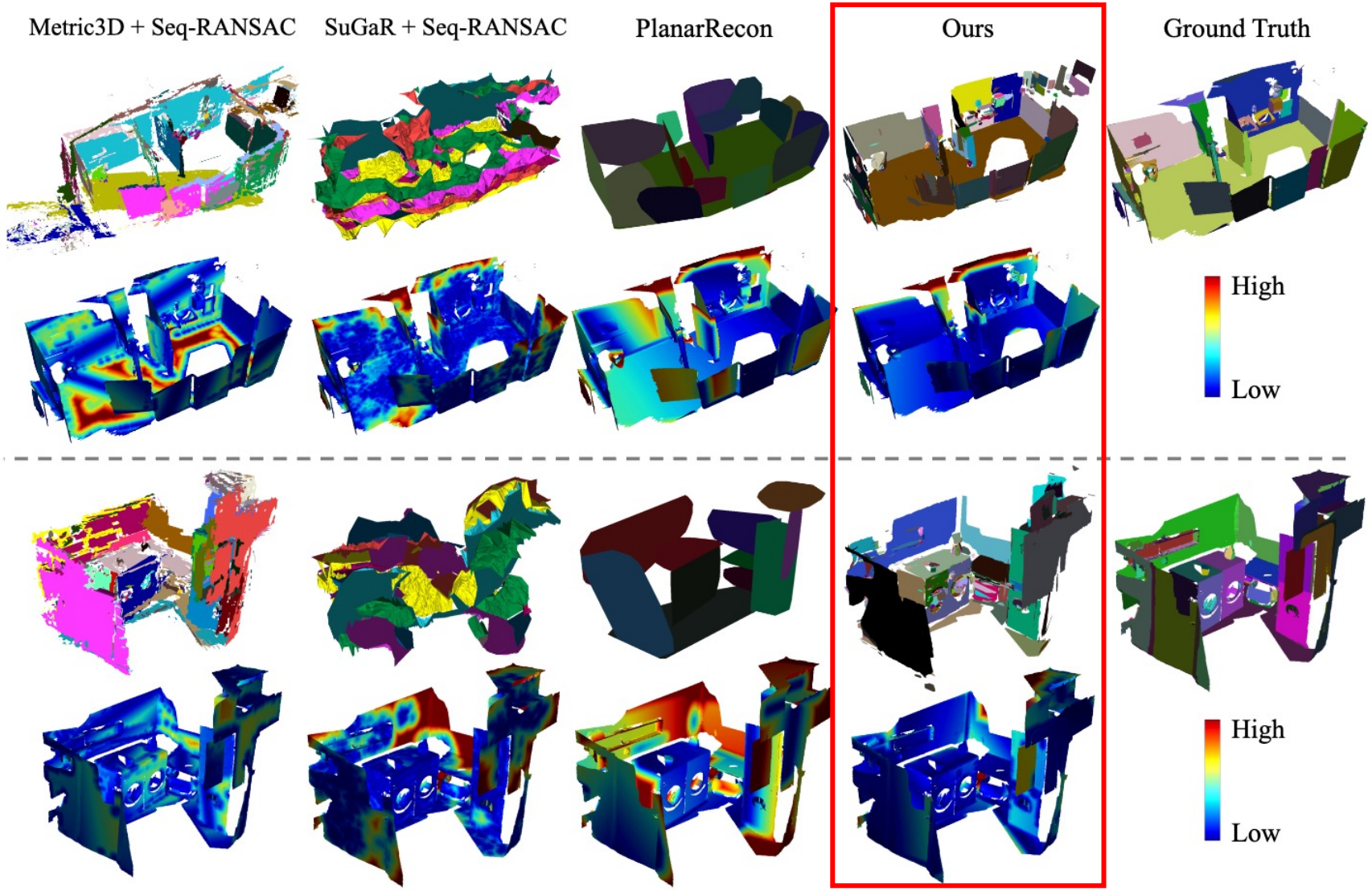
Experimental Results

Table 1: **3D geometry reconstruction results on ScanNet.**

Method	Comp ↓	Acc ↓	Recall ↑	Prec ↑	F-Score ↑
NeuralRecon [46] + Seq-RANSAC	0.144	0.128	0.296	0.306	0.296
Atlas [31] + Seq-RANSAC	0.102	0.190	0.316	0.348	0.331
ESTDepth [29] + PEAC [13]	0.174	0.135	0.289	0.335	0.304
PlanarRecon [50]	0.154	**0.105**	0.355	0.398	0.372
Metric3D [19] + Seq-RANSAC	**0.074**	0.379	0.426	0.161	0.231
SuGaR [18] + Seq-RANSAC	0.121	0.324	0.385	0.296	0.327
Ours	0.108	0.161	**0.481**	**0.447**	**0.456**

Table 2: **3D plane segmentation results on ScanNet.**

Method	VOI ↓	RI ↑	SC ↑
NeuralRecon [46] + Seq-RANSAC	8.087	0.828	0.066
Atlas [31] + Seq-RANSAC	8.485	0.838	0.057
ESTDepth [29] + PEAC [13]	4.470	0.877	0.163
PlanarRecon [50]	3.622	0.897	0.248
Metric3D [19] + Seq-RANSAC	4.648	0.862	0.209
SuGaR [18] + Seq-RANSAC	5.558	0.775	0.082
Ours	**3.468**	**0.928**	**0.273**



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Experimental Results

TUM Dataset

Replica Dataset

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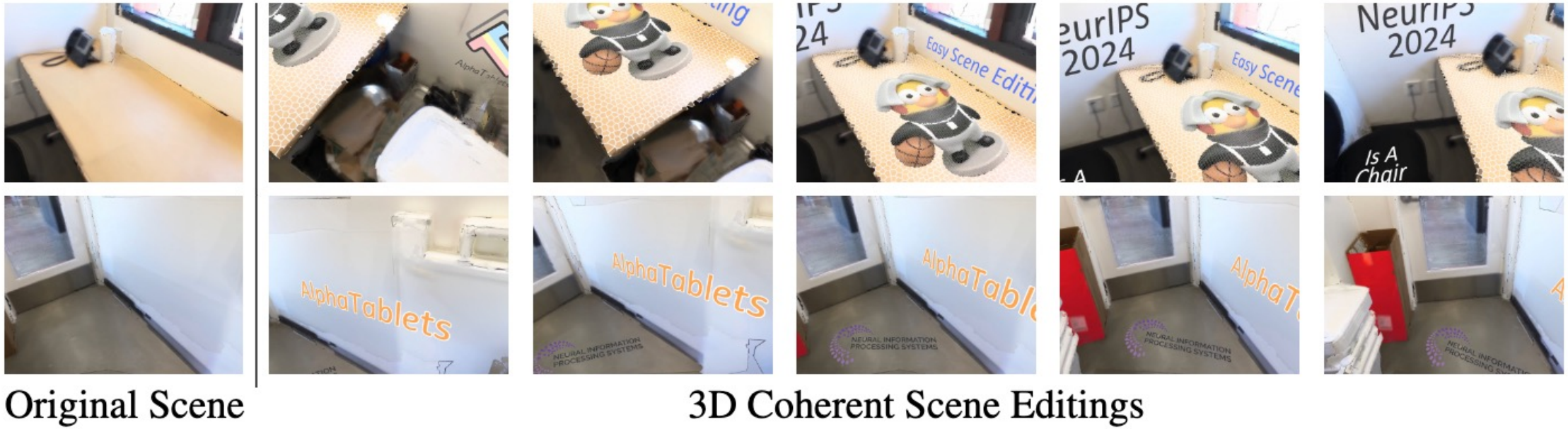
Applications



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Thanks for listening!

Contact: hyz22@mails.tsinghua.edu.cn
Project Page: https://hyzcluster.github.io/alphatablets