Interactive Spatial Estimation

Precision and Practicality for Real-World Impact

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Introduction

Spatial estimators are crucial for tasks requiring accurate positioning and depth information, such as robotics, AR/VR, and autonomous systems. However, existing solutions often lack interactivity, flexibility, or accuracy in diverse environments. Many solutions fail to integrate object segmentation and depth estimation seamlessly for practical use cases.

Objective

To create a user-friendly, efficient spatial estimation system capable of identifying object centroids and calculating spatial coordinates interactively, with applications in robotics and beyond.

Methodology

Pipeline Overview:

- **SAM**: Segments objects in a frame.
- **CREStereo**: Generates depth maps for spatial calculations.
- **Integration**: Combines segmentation and depth to output spatial coordinates.

Comparison with Existing Tools:

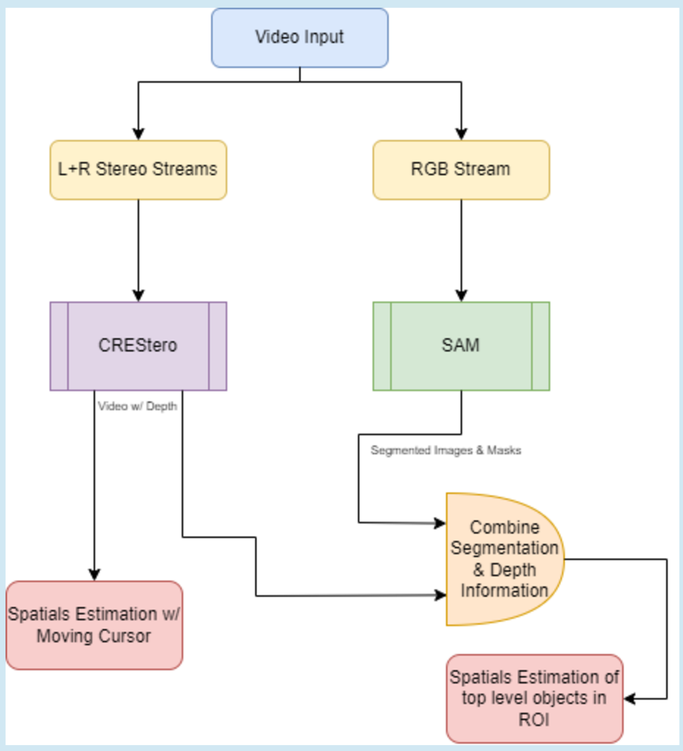
Most existing spatial estimation systems either focus solely on depth estimation or object segmentation, lacking an integrated approach. They are often computationally intensive, impractical for real-time use, and provide limited interactivity.

Applications:

- Robotics, AR/VR, autonomous navigation, and industrial automation.

Use Case: Implemented in a robotics lab block-picking task, enabling precise object localization for robotic arms.

Results

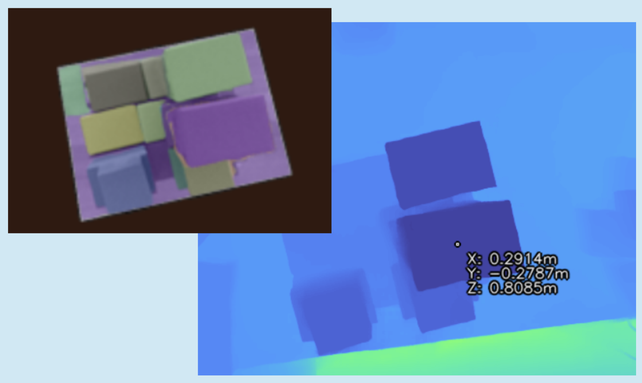


Accuracy:

- High segmentation accuracy with SAM.
- Precise depth measurements with Crestereo.
- Achieved smooth performance with real-time frame rates.
- ~1-2 cm error margin in depth estimation.

Efficiency:

- Combines strengths of segmentation and depth estimation for practical scenarios.
- Outperforms traditional spatial estimators in flexibility and precision.



Key Features

- **Region-Based Estimation**: Select a region to find centroids of objects at the same depth level.
- **Point-Based Estimation**: Cursor-based spatial estimation for any frame point.

Conclusion

This system bridges precision and usability, enabling real-time spatial estimation. It is practical for robotics and adaptable to other fields like AR/VR and navigation. Future work includes adding dynamic tracking and multi-camera support.

Proven in robotics: A next-gen spatial estimator enhancing object-picking tasks with real-world precision