

Pickachu: 3D Vision-Language Model for Generalized Robotic Manipulation

Pranay Junare (junar002@umn.edu)
Aditya Bidwai (bidwa001@umn.edu)
Samra Huseynova (husey012@umn.edu)

Motivation:

Recent major advancements in large-scale foundational models for vision, language, and action have proven to provide generalization by reasoning about perception and action in a unified manner. Thus, we investigate the usage vision-language models for task generalization in robotic manipulation.

Problem Definition:

Input: Natural language instruction L , set of RGB-D images $\mathbb{R}^{H \times W \times 4}$ from 4 static cameras
Output: 6-DOF end effector pose in $SE(3)$

Proposed Idea:

- **Simulation Environment:** CoppeliaSim with RLBench tasks
- **Visual Observation:** Four RGB-D cameras
- **Loss function:** Cross-entropy loss
- **Transformer:** Multi-view Transformer with 8 attention layers, SigLIP2^[4] for language emb.
- **Training:** Using Imitation-learning
- **Dataset:** Pre-generated dataset provided by seminal work PerAct^[2]

Limitations and Discussions:

- Model evaluated on 25 task variations in simulation using CoppeliaSim.
- Demonstrates strong generalization to unseen instructions, achieving a success rate of **84%** (21/25 tasks completed).
- Consistently succeeds on short, unambiguous language goals (e.g. "leave the coffee out")
- Struggles with more complex or spatial tasks (e.g. "pick up and place", "move to bottom shelf"), which accounts for all 4 failures.

Future Plan:

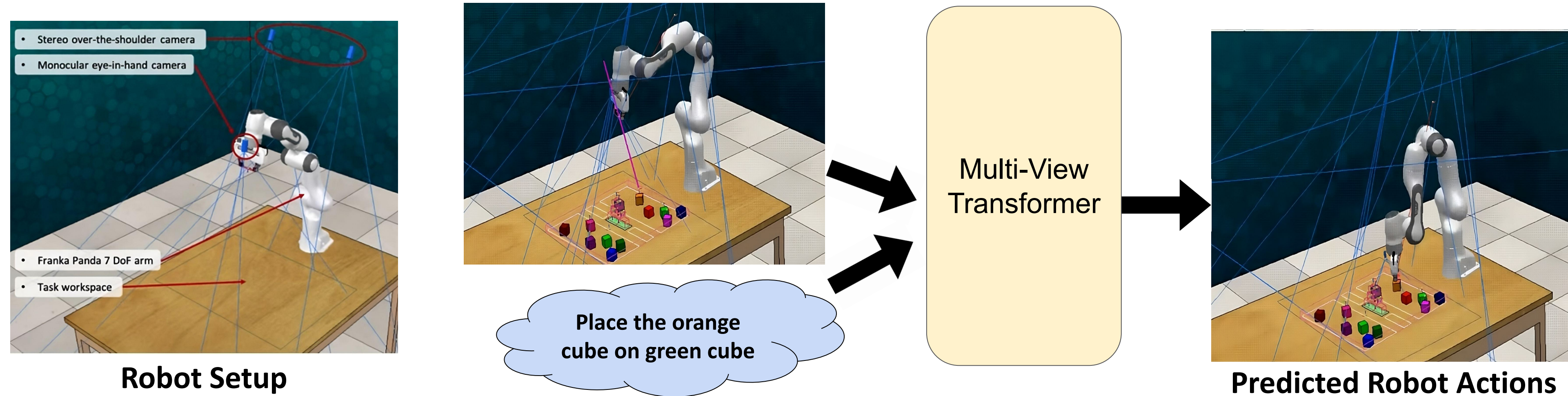
- Scale to different task categories, such as open a jar, turn the tap, open, etc.
- Test our trained model on more complex failure cases in simulation.

References:

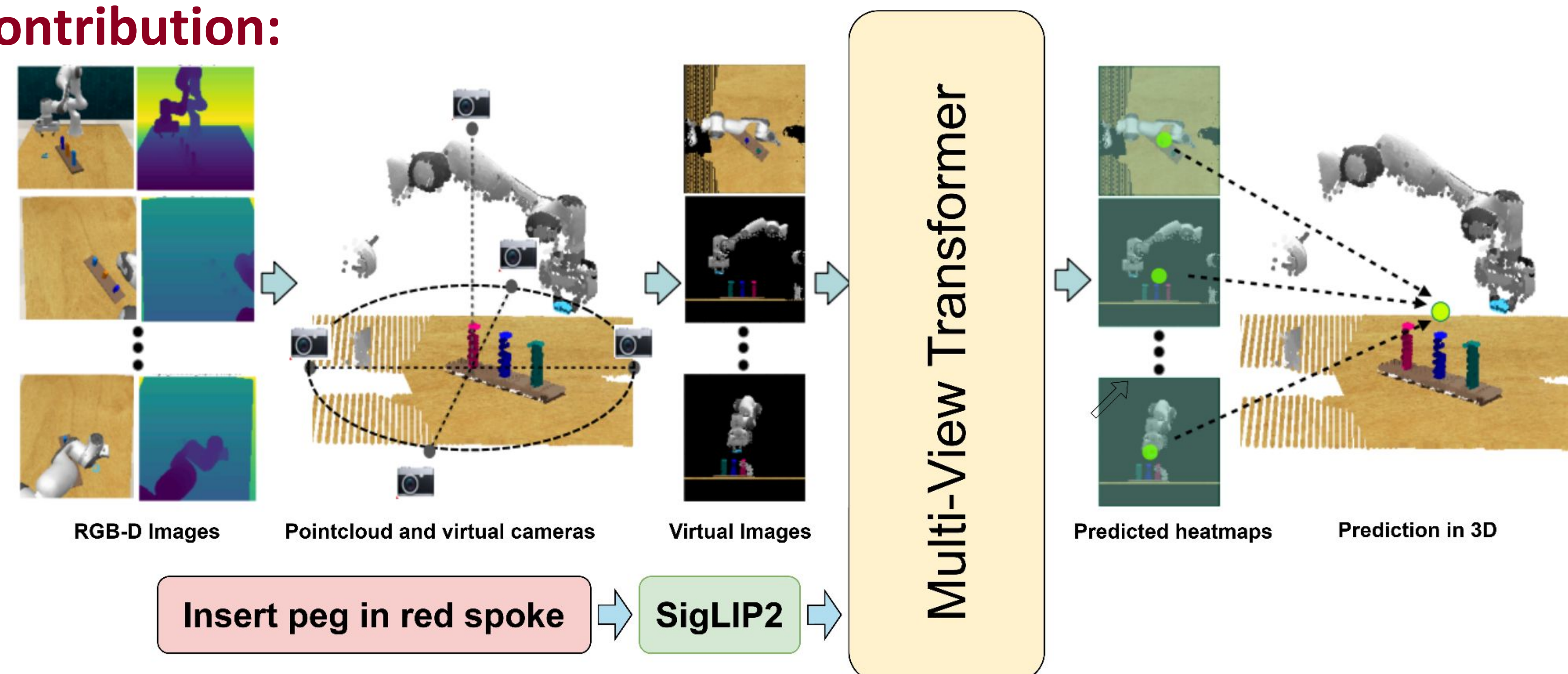
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Can Multi-Modal Learning help perform complex 3D manipulation tasks?

Objective:



Contribution:



Experimental Results and Comparisons:

