Monocular Pose Estimation for Human-Robot Co-Localization

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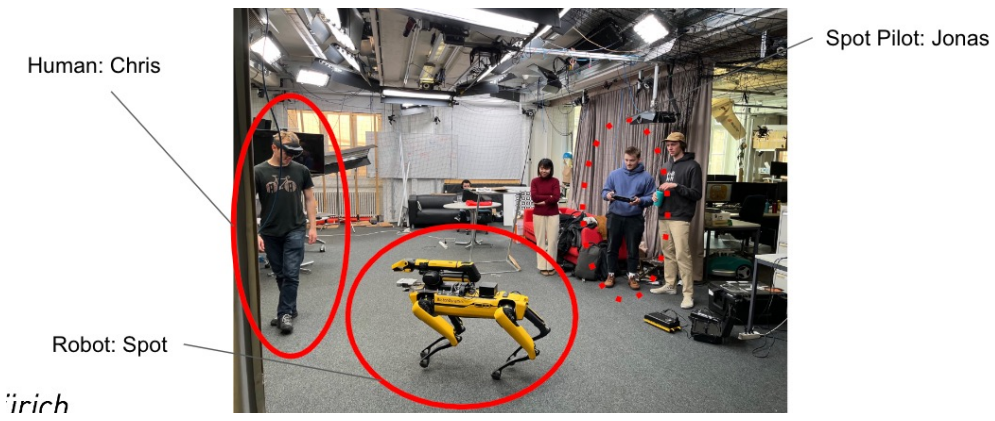
1 Introduction

Identifying the relative position between mobile robots and people is a crucial task which allows cooperation between human and machine.

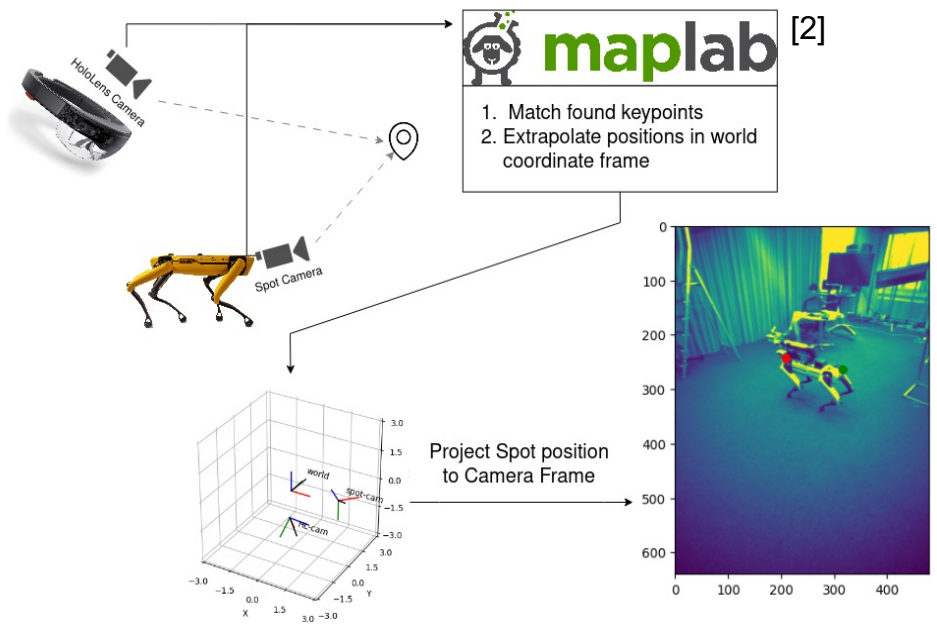
This projects aims to train, test and implement a 6DoF pose estimation algorithm for SPOT. This algorithm can be leveraged, to quickly establish the spatial relationship between person and robot. Given the video stream from the HoloLens the goal is to reconstruct the position of the robot relative to the user. Potentially, this is useful in a multi-agent SLAM scenario.

2 Roadmap

- Record real-world data of SPOT with the HoloLens
- Set-up a pose estimation algorithm (i.e OnePose++ [1])
- Create a synthetic data pipeline to generate more training data, i.e with BlenderProc [3]
- Process the real-world data & extract relative poses between HoloLens and SPOT robot
- Run OnePose++[1] algorithm and get the position of the robot

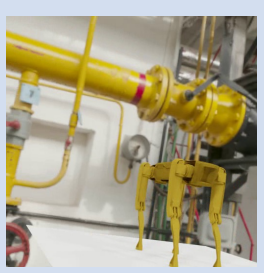
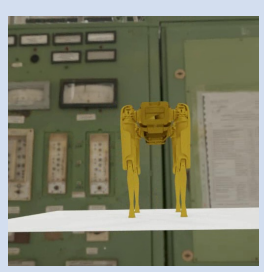


3 Processing HoloLens data



4 Training OnePose++ with synthetic data

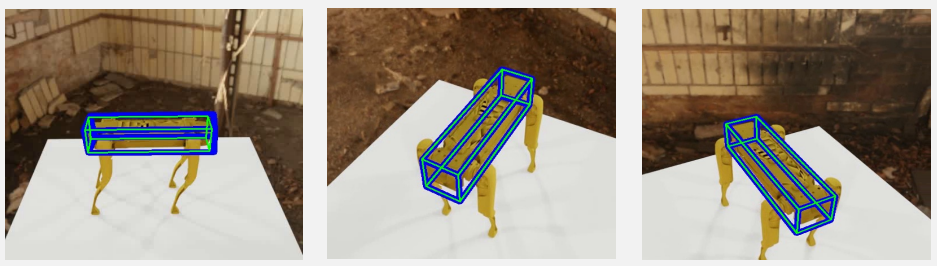
- **OnePose++ [1]** : Pose Estimation Method under one-shot CAD-model-free setting
- Training images (**7** scenes, **700** frames) generated using Blender[3]

5 Results and Discussion

Results:

- Modular and extensible pipeline to easily create synthetic datasets for SPOT
- Sample dataset consisting of various poses & scenes to train algorithms for SPOT specifically
- Post-processing pipeline for ROS bags (work-in-progress)



- Trained/Tested pose estimation algorithm exhibiting robust performance even in the scenario with occlusion

Further Work:

- Test current algorithm with real-world data, optimize it and deploy it on the HoloLens
- Extend synthetic/real dataset to handle various lighting/occlusion scenarios

References

[1] Xingyi He, Jiaming Sun, Yuang Wang, Di Huang, Hujun Bao, and Xiaowei Zhou. Onepose++: Keypoint-free one-shot object pose estimation without cad models, 2023.

[2] A. Cramariuc, L. Bernreiter, F. Tschopp, M. Fehr, V. Reijgwart, J. Nieto, R. Siegwart, and C. Cadena, "maplab 2.0 – A Modular and Multi-Modal Mapping Framework," IEEE Robotics and Automation Letters, vol. 8, no. 2, pp. 520-527, 2023. doi: 10.1109/LRA.2022.3227865

[3] Maximilian Denninger, Dominik Winkelbauer, Martin Sundermeyer, Wout Boerdijk, Markus Knauer, Klaus H. Strobl, Matthias Humt, Rudolph Triebe. "BlenderProc2: A Procedural Pipeline for Photorealistic Rendering" Journal of Open Source Software 2023