Monocular Markerless 6D Pose Estimation of ANYmal

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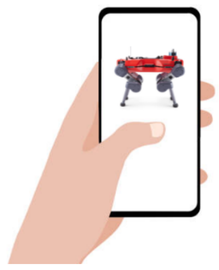

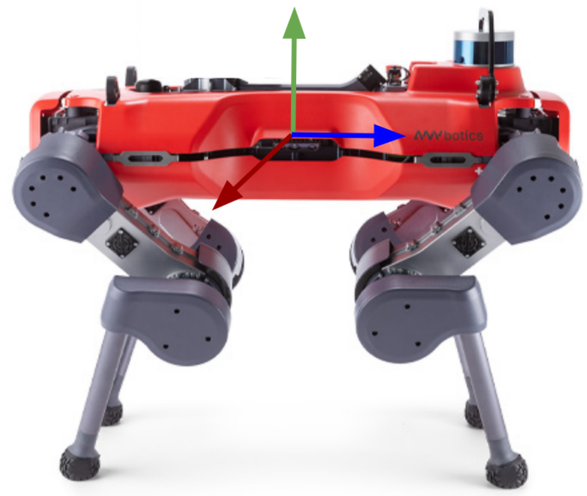

Motivation

Localization is an important task when it comes to tracking robots accurately in complicated and changeable environments. Previous methods rely on additional sources like depth sensors or QR codes placed in the surrounding environment. We propose to remove the dependency from these external sources with state-of-the-art 6D pose estimation deep learning methods.

Previous Methods:

✔ Easy to deploy.
✘ Depth sensors are noisy and sensitive.
✘ Potential occlusions of QR codes may lead to failure cases.

Our Proposed Method:

✔ More portable solution and it depends on RGB images only.
✔ Can be easily deployed in AR mobile applications.

Objectives

• Generate an accurate dataset including RGB images, ground truth 6D pose of the base of ANYmal, and the mask of ANYmal in each frame.
• Train and fine-tune EfficientPose[1] algorithm on the generated dataset, to improve accuracy and generalization capabilities.

Dataset Generation

• Camera calibration (GoPro HERO 10) using Kalibr [a].
• Implementation of Apriltag detection module on ROS.
• Position and quaternion averaging of multiple faces detected in each frame to reduce jitter.

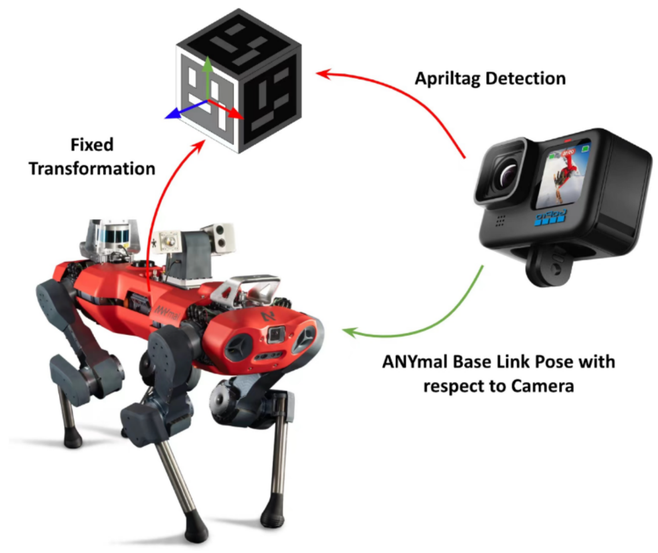

Figure 1: Left: Diagram of data generation. Right: Results of generated poses.

[a] https://github.com/ethz-asl/kalibr

6D Pose Estimation

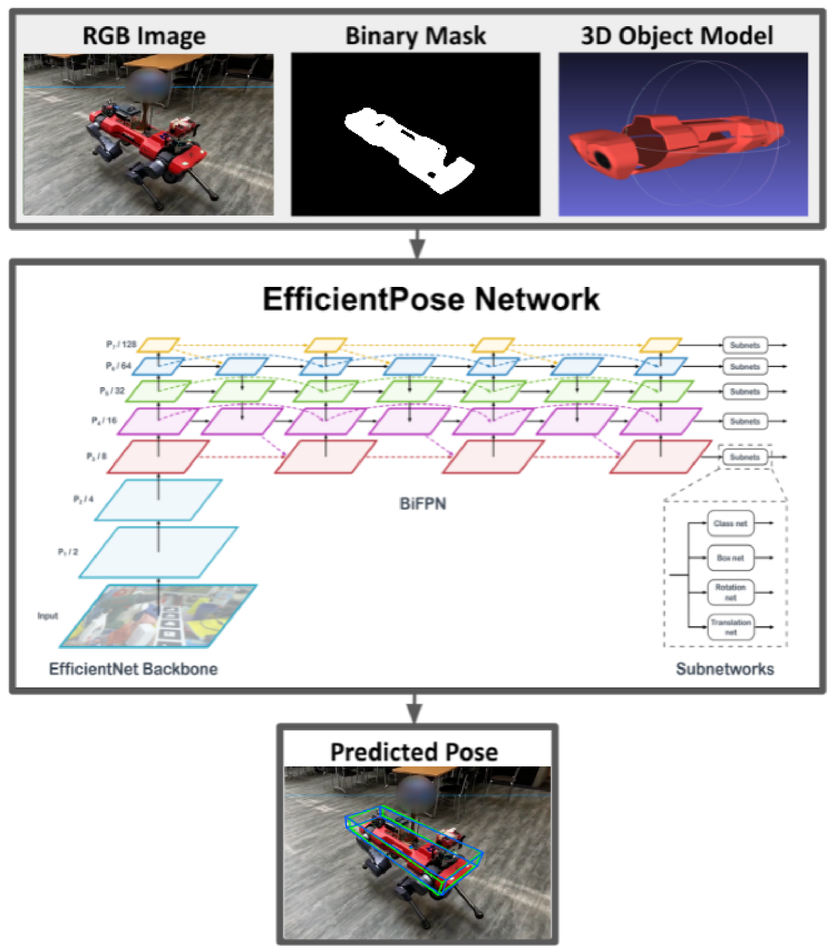

Figure 2: Diagram of 6D pose estimation flow.

Results

The performance of the network's training is mainly evaluated on the ADD metrics and the ADD accuracy score (rate of the ADD being smaller than 10% of the object diameter).

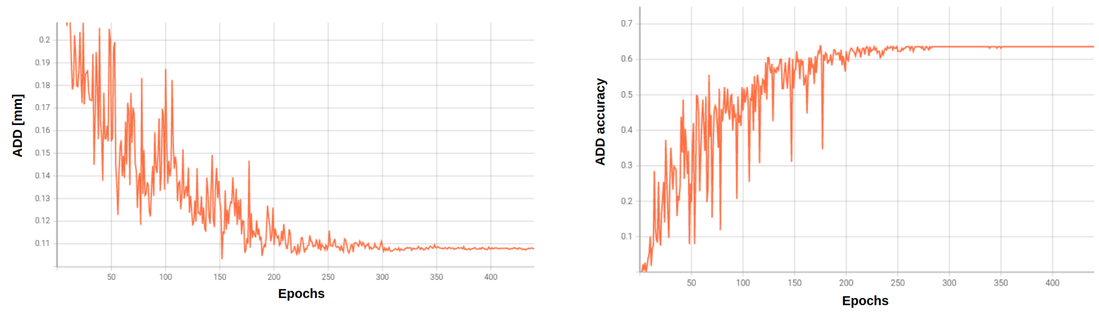

Figure 3: Metrics performance after training the network on a long sequence of the generated dataset (training on the first 70% of the frames and testing on the last 30%).

References

[1] Y. Bukschat and M. Vetter. Efficientpose: An efficient, accurate and scalable end-to-end 6d multi object pose estimation approach, 2020.