Progress Report

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1 To Do

- PVNet implementation: Test and document, learn and rewrite.
- Implement pose estimation: Keypoint uncertainty, understand RANSAC.
- Look into methods of generating uncertainty data.
- Pose Estimation Servery: On pause.
- Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers - a review, [1]: Will read after PVNet implementation.

2 Reading List

- [2]
- [3]
- [1]

3 Progress

The following items are listed in the order of priority:

- Pose Estimation, PVNet [4]: After successfully setting up Cuda 9.0 and GCC 6.3 on my machine, I tried to compile PVNet's Cuda source code once again and it failed due to other deprecated dependencies. I finally reached out to Joe, explained the situation to him, and mentioned I had to disable Ubuntu's automatic package manager through universal repositories. He recommended using the Docker implementation as fixing the long chain of dependency issues is not worth the time or the effort.

  I followed the Docker implementation for PVNet-Clean, which is still based Cuda 9.0 (PVNet Docker implementation is updated to Cuda 10.2 but it is messier) and setup the environment successfully. I confirmed the setup by running PVNet Docker with the appropriate Nvidia container and compiled all five Cuda source code modules without any errors or significant warnings.

Moreover, I downloaded the dataset and the pretrained models and setup them up to be used by the project. Next, I will perform some testing, document the results in a systematic fashion and then continue and propagate the same procedure throughout the entire code base. In the process, I will most likely come up with ideas for improvement and naturally begin a rewrite. Nevertheless, I should do a full rewrite because at this point, it will only make me implement and analyze source code faster.

- YCB Dataset [5]: Start with YCB data and look into Berk Calli's work.
- Normalized Objects [6]:
- Implement features from PoseCNN, DOPE, and BayesOD. - On pause.

4 Plans

The following items are listed in the order of priority:

- Pose Estimation in Simulation [7]: Use Nvidia Isaac SDK for in-simulation pose estimation training.
- Look into domain randomization and adaptation techniques.
- Project Alpe with Nolan: On pause for right now.
- UR5e: Finish ROS Industrial tutorials.

5 2021 Goals and Target Journals/Conferences

- Submit a paper on pose estimation with uncertainty to ICIRS.
- Get comfortable with TensorFlow and related Python modules.
- Keep writing.

References

[1] G. Du, K. Wang, S. Lian, and K. Zhao, "Vision-based robotic grasping from object localization, object pose estimation to grasp estimation for parallel grippers: a review," *Artificial Intelligence Review*, pp. 1–58, 2020.

[2] L. Ferraz Colomina, X. Binefa, and F. Moreno-Noguer, "Leveraging feature uncertainty in the pnp problem," in *Proceedings of the BMVC 2014 British Machine Vision Conference*, pp. 1–13, 2014.

[3] K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition. corr abs/1512.03385 (2015)," 2015.

[4] S. Peng, Y. Liu, Q. Huang, X. Zhou, and H. Bao, "Pvnet: Pixel-wise voting network for 6dof pose estimation," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 4561–4570, 2019.

[5] B. Calli, A. Singh, A. Walsman, S. Srinivasa, P. Abbeel, and A. M. Dollar, "The ycb object and model set: Towards common benchmarks for manipulation research," in *2015 international conference on advanced robotics (ICAR)*, pp. 510–517, IEEE, 2015.

[6] H. Wang, S. Sridhar, J. Huang, J. Valentin, S. Song, and L. J. Guibas, "Normalized object coordinate space for category-level 6d object pose and size estimation," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, June 2019.

[7] Nvidia, "Nvidia isaac sdk — nvidia developer." `https://developer.nvidia.com/Isaac-sdk`, 2021. (Accessed on 02/05/2021).