15400 Project Proposal - Object Recognition With Training Data Collected by Robots

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1 Project Web Page

Link: [http://www.andrew.cmu.edu/user/xis/15300-project.html](http://www.andrew.cmu.edu/user/xis/15300-project.html)

2 Project Description

This is a machine learning Project under the advising of Professor Manuela Veloso, and some of her master students who are working on computer vision problems.

The major focus of this project is to experiment with image data collected directly from the robots within particular context. Most computer vision projects uses models trained with already existing image dataset; the most typical ones include ImageNet, and CIFAR 10, CIFAR 100. These online datasets and libraries sometimes might not be efficient or optimal for training computer vision models on robots that serve special purposes. Thus we want to develop algorithms for robots to collect image data in specific environments and use such constrained data to generate model for object recognition in similar environments. Additionally, if the robots can achieve better learning performance with the context-specific data collected by itself, we can apply such methods for robots working under various situations (e.g., office buildings, hospitals, etc.).

To approach this problem, I will be working with the CORAL lab group directed by Professor Manuela Veloso. I will be using the NAOs or the Pepper humanoid robots for imaging capturing and testing. Since we are collecting constrained and context-dependent image data, I will start with only using the camera on the robots to capture images from the lab room or some areas in the Gates and Hillman Building, and then develop algorithms for robots to drive themselves in those areas to collect data themselves. Then apply different approaches to train neural network models using the data both from the robot and from online datasets (e.g. ImageNet, etc.) and test the models in similar
environments (e.g. labs, classrooms, etc.). We want to see if the performances in object recognition result in significant difference.

3 Project Goals

75%: Develop object recognition using data collected from the robots and online image training dataset; test the models under similar environment and compare the results; check if the self-collected data achieves higher accuracy in object recognition in such environment.

100%: Have a fully developed algorithm for the robots to collect data themselves and make use of the data using the same criteria stated in the goal above.

125%: Compare the performances of the robots in other environments, for example, residence buildings, libraries and outdoor areas, and check if they accomplish similar results.

4 Milestones

1) 1st Technical Milestone for 15-300:
I am planning to get familiar with the platform for the computer vision part of the robots that I will be working with by the end of this semester. I will also get myself familiar with different object recognition approaches using TensorFlow and other libraries.

2) Bi-weekly Milestones for 15-400:
02/02/2018: Develop methods for collecting image data from the robots, and start collecting image data from the lab and office building area.
02/16/2018: Collect data from the robot, label the image data.
03/02/2018: Experiment different training methods to generate models using the dataset from online and the data collected from the robots.
03/16/2018: Refine and optimize the data and models.
03/30/2018: Test the models on similar environments to check if object recognition is successful.
04/13/2018: Develop algorithms for the robots to collect data and learn object recognition without supervision.
04/28/2018: Extend this method to other types of environment and compare the results.

5 Literature Search

The following texts are relevant and might be helpful for this project:


6 Resources

ROS for working with the NAOs or Pepper robots.
OpenCV, TensorFlow for computer vision and object recognition.