Cloud Robotics: Experiments and Requirements

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Abstract

This document briefly describes research being performed in the area of cloud robotics at the University of Minnesota's Center for Distributed Robotics (CDR) along with an outline of the specific experimental requirements of this research.

1 Introduction

The field of robotics is beginning to take advantage of cloud computing resources [1], [2], [3]. Cloud robotics makes use of advances in cloud computing and big data, and allows for the potential of developing a new generation of robotics applications. Enhanced by cloud computing, robotic systems are in a position to become ubiquitous in many diverse environments.

2 Research Experiments and Requirements

At the CDR, we are interested in developing robotic algorithms that utilize a cloud computing infrastructure. Current research involves the intelligent throttling of sensor data between a robot and remote computing infrastructure for object classification and tracking using covariance descriptors and machine learning techniques [4]. The purpose of this work is to conserve bandwidth and reduce network latency by limiting the amount of data transmitted between a robot and the cloud.

We are also working on incorporating these algorithms into a cloud-based object recognition engine for robots. This requires the following:

- Access to computational power for handling object recognition tasks on data uploaded by robots. Many of these algorithms are amenable to parallel computation and would realize a substantial speedup.
- Storage and memory resources to allow machine learning classifiers the scalability to train on large dynamic datasets. Classifier models created in the cloud can be downloaded and propagated by robots connected to the network.

- A programming environment that allows access to and integration with open source databases and the Robot Operating System (ROS) [5]. This environment would help streamline the deployment of heterogeneous robotic teams.
- Performance metrics would allow us to compare our algorithms and enable a more complete quantitative analysis in published research. These metrics are difficult, if not impossible to obtain from proprietary cloud service providers.

3 Conclusion

Limited by onboard computation, memory, and programming, robots are poised to become interconnected to one another with vast resources at their disposal through cloud computing. Cloud robotics will open new areas of research for the utilization of small and low-cost robots in an increasing number of applications. The CDR is not only interested in making use of the resources provided by the NSFCloud initiative, but also in providing feedback that will shape the development of experimental cloud computing facilities.

References

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