Learning Unknown Objects From the Web

When working with and for humans, robots and autonomous systems must know about the objects involved in human activities. Despite the impressive results of modern techniques to recognise and classify objects, these methods are tied down to only the objects that they have been trained for. In an open world, robots will encounter new objects and will therefore have no understanding. A robot could simply ask a user to provide a label for the unknown object such that the object can be added to its known database. However, human support is not always available and humans are not always willing. Fortunately, the internet contains a large collection of data, in particular, images with associated text that can be used by a robot to determine the identity of the discovered object.

The aim of this project is to enable a robot to be fully self-sufficient in its ability to learn unknown objects by exploiting images on the internet. Specifically, a robot should identify objects that it does not know by focusing on the objects that are not detected by a state-of-the-art object detection such as YOLO [1]. The unexplained regions of the scene should be segmented to form object hypotheses that are then looked up on the internet for associated human labels. This label can then be used to find other related objects to create more data for training the object detector.

Tasks

- Develop a prototype system that combines an object detector with class agnostic object segmentation to identify unknown (i.e. not part of training set) objects in images.

- Supply an image search engine with the unknown object images to collect examples of its possible human labels according to the associated text. The text will not be entirely straight forward and the actual object label will need to be determined by analysing the text through systems such as a lexical database (e.g. WordNet [2]) or language ontology. This requires the text to be analysed in order to find the common noun in from the examples that can be associated to the unknown object.

- Using the found label, more examples should be collected from the internet to add to the existing training set. After re-training, the object detector should be able to both recognise the previously unknown object as well as other instances of the same class.

- Demonstrate the system with a mobile robot. The scenario requires the detection system to be implemented on a robot such that while it drives along a predefined path, the robot can store example images of all objects that are unknown to it. The labels and other example data will be searched for to retrain the object detector such that when the robot is redeployed, the previously unknown objects are correctly identified.

Workload split

- Research and theory: 30%
- Programming and implementation: 30%
- Implementation on a robot platform: 20%
- Writing: 20%

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References