

A Comparison of Computer Vision Techniques for Classifying and Localizing Fruits in Images: Handcrafted Features Vs. Deep Networks

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ABSTRACT

Fruit detection is an important initial step to make autonomous robots for various agricultural tasks such as harvesting fruits, analyzing ripeness, and detailed mapping of fields according to fruit density. We can couple a fruit detector with mechanical sensors and components to create a fully-functioning autonomous robot to harvest fruits at a far greater rate. The objective is to discover the optimal approach for fruit detection from images, a relatively unseen research. We use a machine learning-based method to classify different fruits by not only determining what is the object of interest, but also its location by bounding box prediction. We approach this problem in two ways: 1) Handcrafted Features, 2) Deep Networks. While implementing handcrafted image features such as color histograms, Histogram of Oriented Gradients (HOG), and GIST, we train a logistic regression classifier to learn a fruit detector. We also train a detector under a state-of-the-art method—deep learning—and compare the results on 250 test images with handcrafted learning features, both qualitatively and quantitatively over three trials. We analyze the deep network by changing the amount of training data to observe its effect on detection performance. After experimentation, we found that deep networks perform far better than handcrafted features, as the mean average precision (mAP) for the deep network was 45.3% higher than that of the combined handcrafted detector.