Innopolis University
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Practical Machine Learning and Deep Learning

Computer Vision System for Counting Agricultural Goods

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Project Overview

This report details a computer vision system customized for Unmanned Aerial Vehicles (UAVs) to count agricultural goods, specifically focusing on blueberries. The project involves segmentation of blueberry images using Meta AI's SAM (Segment Anything) model. Subsequently, the segmented blueberry objects are to be utilized to train a classification model that determines whether an object is a blueberry or not.

Project Repository

The project's repository can be found on GitHub, using the following link: [https://github.com/HamadaSalhab/Computer-Vision-System-for-Counting-Agricultural-Goods]. It's entitled to contain the most up-to-date code associated with this project, along with some documentation in the future once the project is nearly ready.

Project Topic

The project's primary goal is to develop a robust computer vision system tailored for UAVs to automate the counting of agricultural goods, focusing on blueberries. The process involves segmentation of blueberry images to isolate the objects of interest and subsequently training a classifier to distinguish blueberries from other objects.

Dataset

The project initially utilized blueberry images for segmentation and subsequent classification. Additionally, we might consider the "MinneApple" dataset, tailored for apple detection and segmentation, for further experimentation purposes. The reason we went with the blueberry dataset was the annotation representation methods. It was easier for us to work with, as it is in .csv formats, compared to the MinneApple that had a separate grayscale image containing the masks for each image in the dataset.

Links for both datasets:

- Blueberries: https://universe.roboflow.com/roboflow-jvuqo/blueberries-ixbl3
- MinneApple: https://conservancy.umn.edu/handle/11299/206575

Work Done So Far

The project team explored other relevant datasets, such as the "MinneApple" dataset, originally intended for apple detection and segmentation. This dataset was utilized to experiment and potentially enhance the classification model's accuracy and robustness.

The project commenced with the acquisition of blueberry images, which were then subjected to segmentation using Meta AI's SAM (Segment Anything) model. The segmentation process effectively isolated blueberry objects from the background.

Intermediate Results

We have tried SAM on a sample image, and we got the following result:

The image on the left shows the original image, and the one on the right shows the masks after the segmentation process has been carried out. As we can see, SAM is doing a fairly good job with segmenting the image. It's clear that it's capable of extracting and highlighting most of the blueberries accurately enough.

Work To Be Done

The segmented blueberry objects (from SAM's output masks) are expected to be then utilized to train a classification model.

The classification model is still under discussion and consideration, however, we're thinking about building one with a VIT-16 backbone, employing an SVM classifier to determine whether an object is a blueberry or not. This approach capitalizes on the strengths of VIT-16 for feature extraction and SVM for classification.

Finally, we are supposed to combine the trained classifier with the masks that SAM has segmented and generated. In short, if the classifier tells that a specific mask is a Blueberry, then it's counted.

Programming Languages, Libraries and Frameworks Used

- Python.
- Opencv.

- Matplotlib.
- PyTorch.
- SAM Segmentation Model: Meta AI's SAM model was employed for the segmentation of blueberry images, enabling the isolation of blueberry objects.

Work Distribution

To begin with, each team member has read and analyzed one of the following papers:

1- Unsupervised Learning of Image Segmentation Based on Differentiable Feature Clustering.

(By Vladislav Lopatovskii)

2- Unsupervised Semantic Segmentation By Distilling Feature Correspondences, by Microsoft & MiT. (By Hamada Salhab)

3- Segment Anything, by Meta. (By Yazan Kbaili)

After that, the team conducted a review session for the above-mentioned papers, and picked the model that best suits the needs of the project depending on multiple factors such as the robustness, the ease of use, and the performance of the model. Based on this criteria, the best fit was the 3rd option (Segment Anything by Meta).