AUTOMATIC INSECT IMAGE CROPPING AND IDENTIFICATION

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ABSTRACT

Insect identification can be a valuable part of an automatic plant monitoring system. We explore the beginnings of such a system with this project.

1. INTRODUCTION

This report describes a system for automatic cropping of images that include an insect and identification of the insect using a convolutional neural network. Images are cropped relatively centered at the location of the insect. Image cropping occurs so that the insect is more clearly visible for the network. The network then takes the cropped image and identifies if the insect present is a butterfly/moth or a caterpillar. This identification is presented as a set of two probabilties that sum to one.

2. Image Cropping

As stated, the first part of the system consists of cropping an image with an insect. The cropping algorithm attempts to find the insect in the image and crop the image around it. Described below are the steps that were taken to achieve a working algorithm.

2.1. Initial Attempts

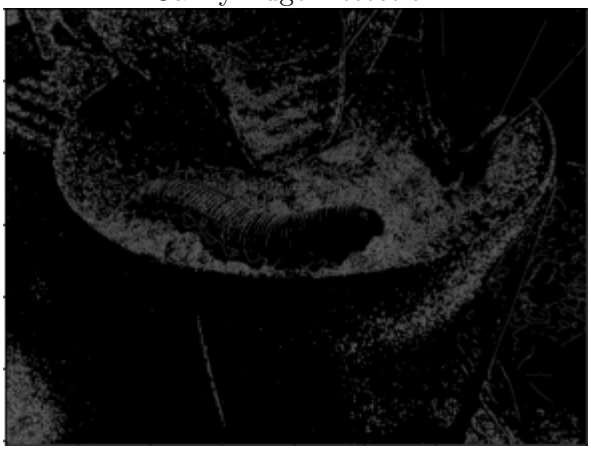
The first idea for image cropping was to use an edge detector to find the insect. In theory, the edge detector would outline the insect so that the algorithm could identify the top, bottom, left, and right edges of the insect. Afterward, the images would be cropped so that only the insect remained (with some amount of addtional outside pixels).

This algorithm was attempted with the Canny edge detector. It was quickly realized that edge dection would not be appropriate for this project, as the insect models I had available had many ridges and complex structure. Also, the plant and dirt that the insects were placed on also had many edges that were detected.

Below is an example of Canny edge detection. The image is of a caterpillar model placed on a potted plant.

Original

Canny Edge Detection



We can see that there are many elements in the image that would cause a problem. The caterpillar in the center has many ridges that get detected as edges, and the dirt in the pot is especially a problem.

2.2. Working Solution

The solution for automatic image cropping uses color as the main point of information. The drawback of this method is that the main color of the insect must be known beforehand. The algorithm works as follows: Store the main color of the insect in the image as a BGR value. Next, scan the image and increase a counter by 1 each time a pixel is found that has a B, G, and R value that is between plus or minus 5 of the stored main color value. The counter is reset every 100 pixels, and if the counter is larger than it ever was previously, the current pixel coordinate that the algorithm is considering is stored as the "max" coordinate. Afterward, the image is cropped with an 800×800 square centered at that max coordinate. Of course, this means that the insect must not be at the edges of the image because the algorithm does not include padding.

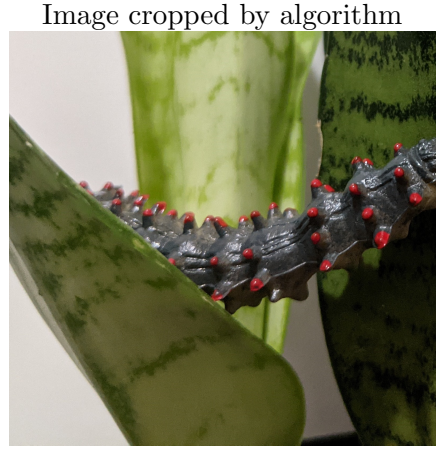
Shown below are the results of the algorithm running on an image of an orange model caterpillar.

Full Size

Red spots (not red spikes) indicate where BGR values matched [*next column...*]

Blue square indicates "max" coordinate

Image cropped by algorithm



Unforunately, I received colors errors when trying to crop images that included other caterpillar models with different colors as well as my butterfly models.

3. Insect Identification

The model insects were identified using a convolutional neural network. The steps taken to design, train, and use the neural network are described in the following sections.

3.1 The Neural Network

The project uses a neural network with three convolutional layers, followed by two linear layers for classification. Training images were taken from the

iNaturalist 2019 Kaggle competition database. Images of caterpillars were in the same folder as their butterfly/moth counterparts (in terms of species). The images of caterpillars had to be manually extracted from the folders.

After extracting the images, there were about 9000 butterfly/moth images and about 810 caterpillar images. The network was intially trained with this large discrepancy, which resulted in the network identifying any image as a butterfly/moth. Next, 810 butterfly/moth images were chosen to match the amount of caterpillar images. Addtionally, a batch size of 10 and 50 epochs were used for training. These values resulted in a network that identified the insect models relatively accurately.

3.2 Results

99 percent for caterpillar

99 percent for butterfly/moth (not cropped)

4. CONLUSION

While I was unable to have everything work perfectly, there are a few aspects of this project that either succeeded partially or fully. Even though the cropping by color only worked for one image, I am satisfied that my solution of using color "frequency" (i.e. resetting the counter every 100 pixels) did actually produce a decent crop. Also, while the neural network is definitely far from perfect, I am glad that only training with 810 images of each insert produced decent identification results.