Lab 4: Image Processing

Spring 2021

BRAE 428

Dr. Bo Liu

Emma Gray, Chandler Jones, Gracely Speth

Abstract

The future of agriculture relies heavily on machine vision. Machine vision is used in shape and color analysis, counting, manufacturing automation, and robotics. As the technology advances, we see a large increase in the machine vision used in Agricultural robotics and automation projects in order to increase precision in many processes. With the use of machine vision in processes like sorting produce and optical scanner is able to scan many more objects at once than the human eye therefore increasing efficiency and decrease manual labor needs.

Introduction

This lab is designed to show students how to create basic machine vision through MATLAB. With the simple addition of a USB webcam, MATLAB has the potential to take in and process visuals in the real world. Code can be created to sense motion, take measurements, read barcodes, sort objects by their physical characteristics, inspect defects, etc. In this lab students will use their USB cameras and MATLAB to create a program that can count the dollar amount of coins on a surface.

Materials and Methods

Materials:

Camera

Computer

Printer Paper

Coins

MATLAB

MATLAB Applications

Methods:

1. First securely mount the camera onto the workbench at a fixed height that will not change over the entirety of the lab.
2. Connect the camera to the computer.
3. Open the Color thresholder application on MATLAB. (you may have to search for the camera in the threshold application)
4. Lay a piece of printer paper under the camera and lay multiple coins on the paper. (make sure none of the coins touch and the lighting is quality)
5. Acquire an image from the camera and take a snapshot.
6. Choose the color space you want to represent the color components of the image. The color threshold app will display the aspects of the snapshot controlled by the different color schemes. Choose a scheme that allows you to create a clear image.
7. Adjust the color bars of the Color Threshold application to acquire a solid back background.
8. Export this image into the Workspace by using the Export tab. (make sure to define the image as binary)
9. Now go to the Image Region Analyzer application and load your image from the workspace.
10. Chang the image to ‘Binary’ and click OK
11. Add a filter that filters out the small white spots that are considered ‘noise’. (usually less than 2000, will give you a very clear image)
12. Now fill the holes inside the white areas that are the coins by selecting the ‘Fill Holes’ button.
13. When you are finished editing your image click Export and send your image to the workspace.
14. Now you can load your image data into your script and write a code to count the coins based on the data you choose to analyze.

Results

Our final code was able to correctly count the dollar amount of coins captured by an image. Shown below are pictures gathered during our laboratory which show the process of identifying coins

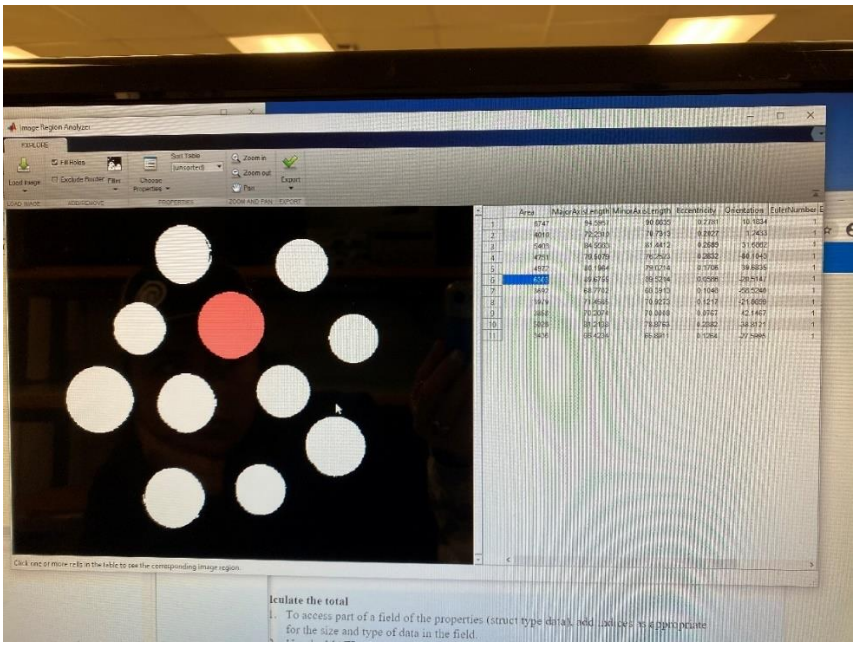

Figure 1. Identification of a Quarter

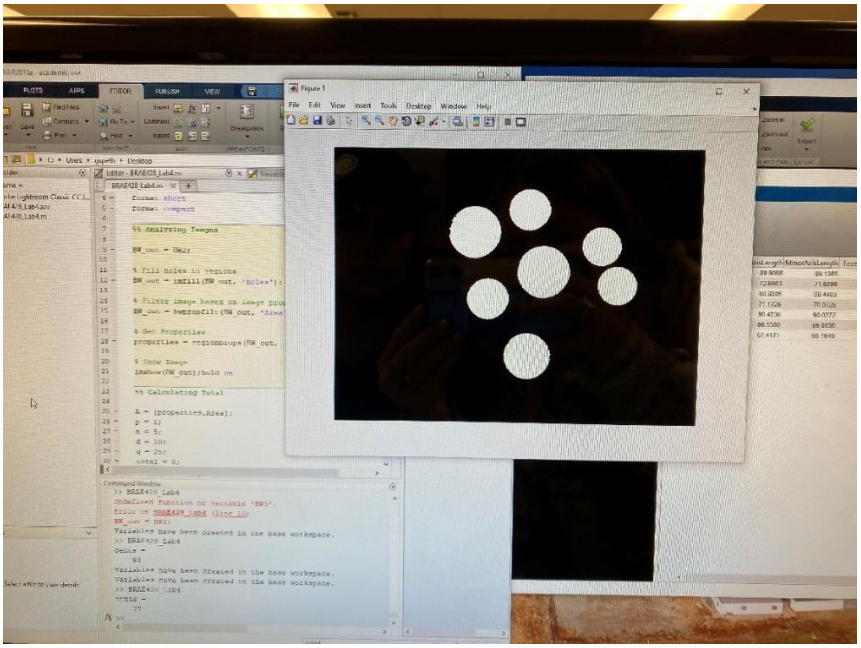

Figure 2. Identification of an Assortment of Coins & Subsequent Amount

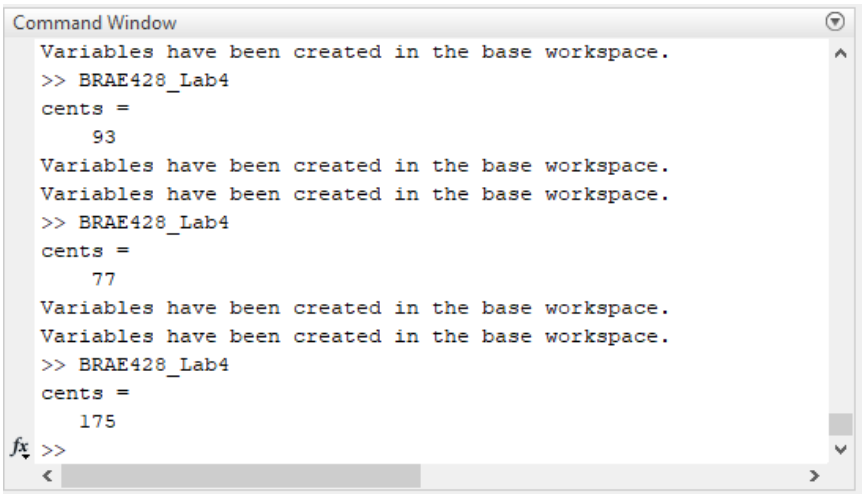

Figure 3. Series of Code Outputs from Coin Visual Analysis

As can be seen from the above and below images, our code was able to properly count the value of coins down to the cent. After adjusting the area ranges, we had few if any mislabeling of our coins, which assured us that the coin count was relatively stable.

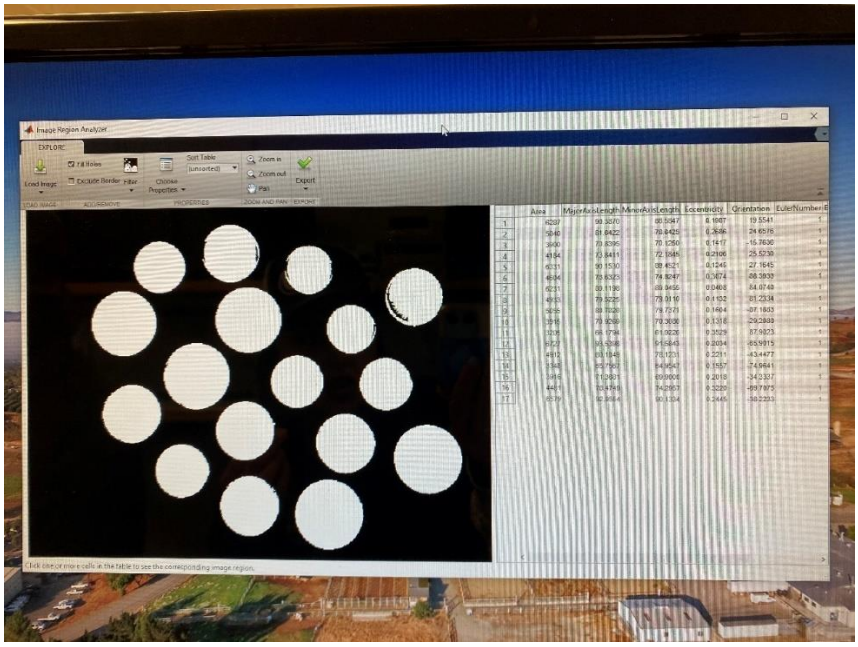

Figure 4. Coin & Machine Learning Side by Side

Discussion and Conclusion

In conclusion, our code worked quite well for analyzing the area of coins. No other metric was used so calculating the year or the design of the coin would not be easily convertible.

Our image was first converted into black and white to ease the calculation of the area. It was rather simple to then associate a property, the coin value, to specific areas. We hypothesize that these methods would be similar, but more complex, for operating machinery based on image recognition. The if, then methods would hold true as one of the best way to properly harvest ripe fruit, remove debris from otherwise quality agriculture, or any other of the many places where a systemized modification of the process could be developed.

We further hypothesize that including the dollar coin or coins from foreign countries into our analysis may break our program. Since the dollar coin is very similar in area to the quarter, our program may have trouble identifying the difference between these two using only the area method. Adding color, or a second camera which measures the height may be the defining feature we need to distinguish these coins using similar difficulty methods as prescribed in this lab.

Attached Code

```
% BRAE 428 Lab 4
% Gracely Speth

format short
format compact

%% Analyzing Images

BW_out = BW4;

% Fill holes in regions
BW_out = imfill(BW_out, 'holes');

% Filter image based on image properties
BW_out = bwpropfilt(BW_out, 'Area', [2000 + eps(2000), Inf]);

% Get Properties
properties = regionprops(BW_out, ('Area'));

% Show Image
imshow(BW_out);hold on

%% Calculating Total

A = [properties.Area];
p = 1;
n = 5;
d = 10;
q = 25;
total = 0;
coins = 0;
for i = (1:length(A))
    if A(i) < 3700
       coins = d;
       total = total + coins;
    elseif (A(i) > 3701)&&(A(i) < 4500)
        coins = p;
        total = total + coins;
    elseif (A(i) > 4501)&&(A(i) < 6000)
        coins = n;
        total = total + coins;
    else
        coins = q;
        total = total + coins;
    end
end
display(total, 'cents');
```