Homework 2 Report for -

ME 592

Data Analytics and Machine Learning for Cyber-Physical Systems Applications

Spring 2022

Group Theme - Agriculture

Submitted By

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Answer to Question 1

Using python code and computer vision library (cv2) the given 8 images were

1. Scaled using random parameters from 1-3
2. Rotated with random angle from 0-360 degree
3. Shifted and Warped

We used cv2.getrotationmatrix functionality of open cv. We produced in total 104 images (13 image for each 8 types which could be found at the link –

Two examples of the images are given below. –

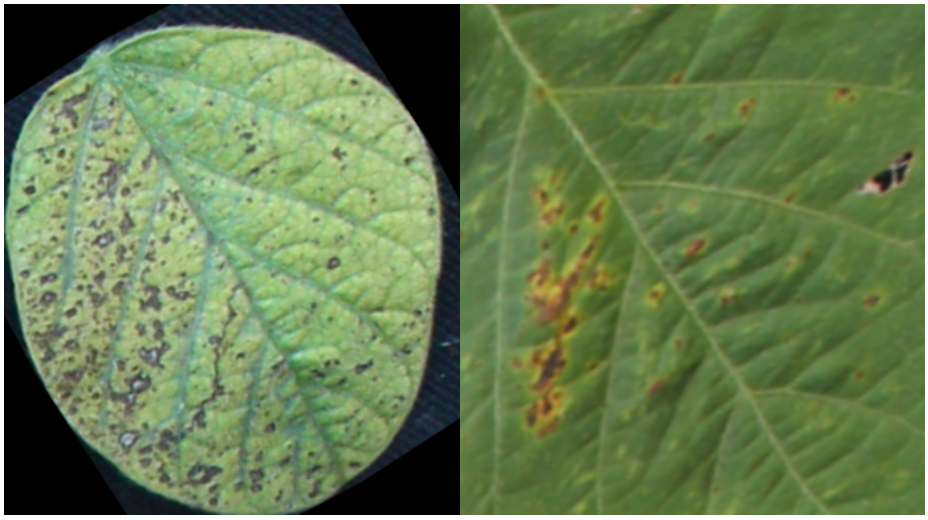


Figure: Rotated and Scaled Image

Answer to Question 2

The images were loaded as Numpy array and (20×20) pixels are cut just from the middle of each of the images using array slicing techniques.

The produced 8 images are given in link –

Two example figures are –

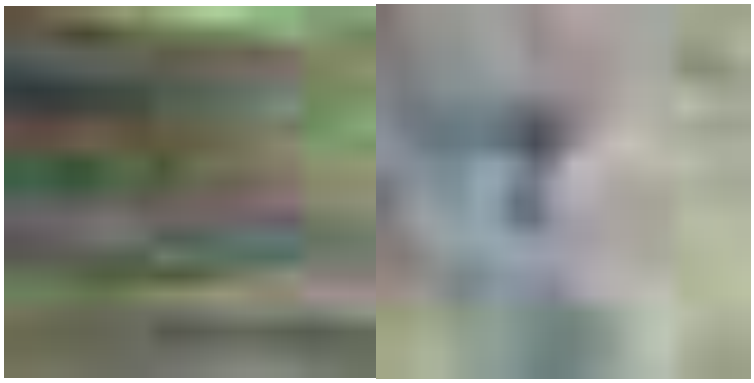


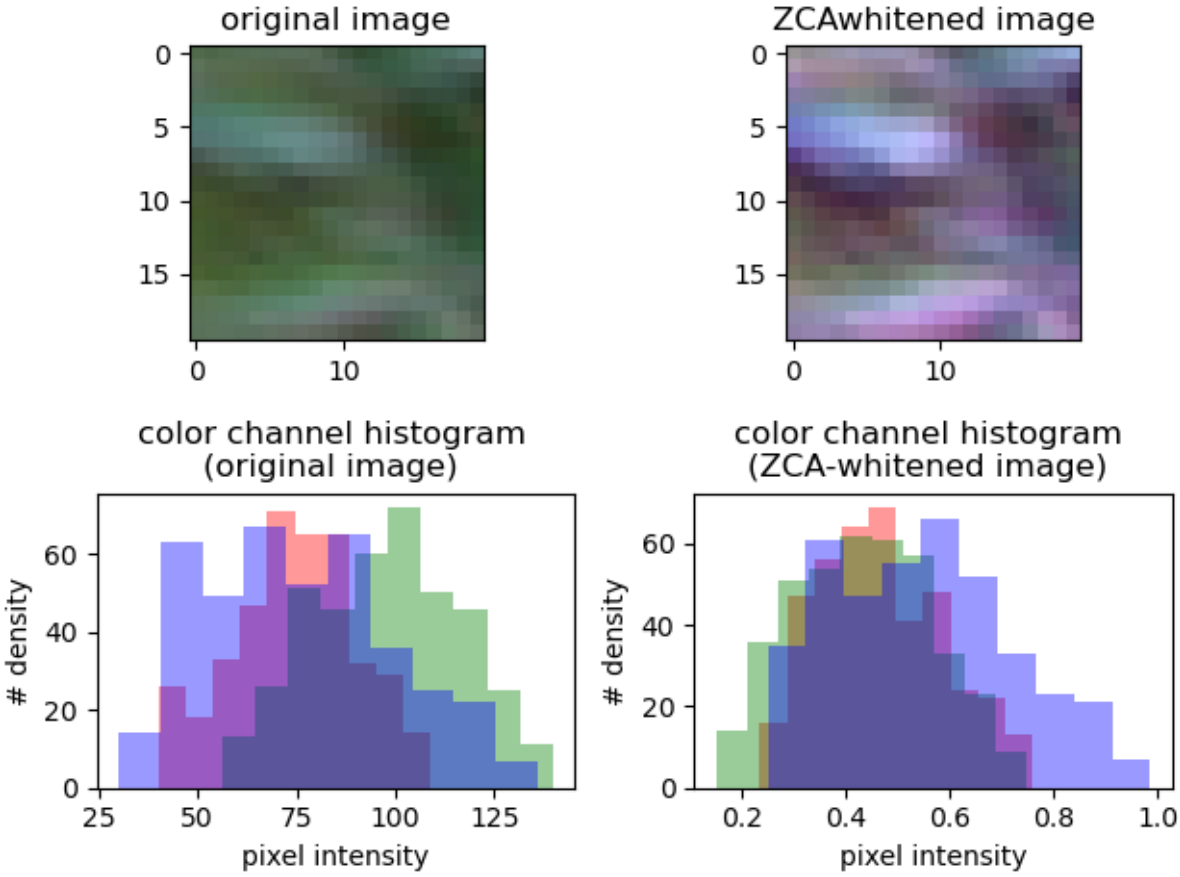
Figure: Two patches consisting 20 by 20 pixels

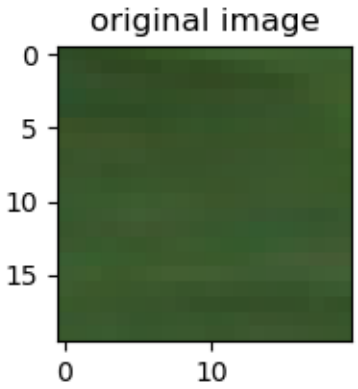
Answer to Question 3, 4 and 5

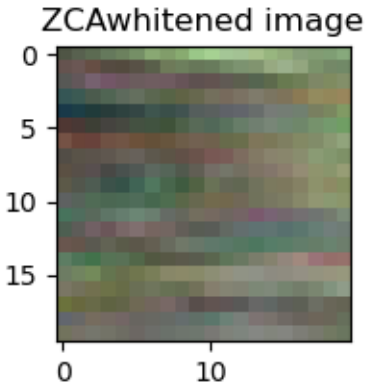
The patches found in the above step are passed through several transformations to obtain the ZCAwhite images. The steps are –

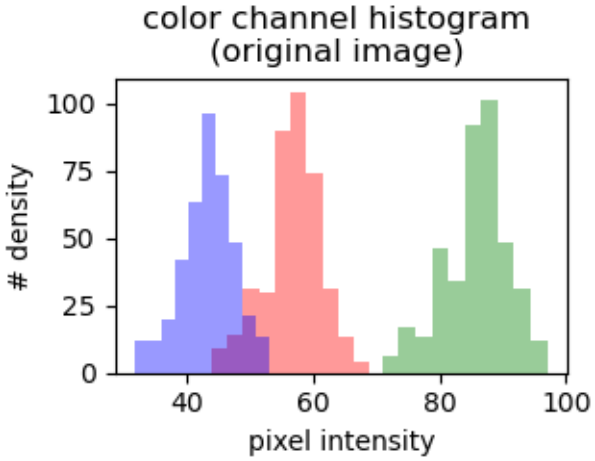
1. They are normalized
2. Covariance is found out
3. Eigenvector is calculated
4. ZCA whitened images were calculated and saved

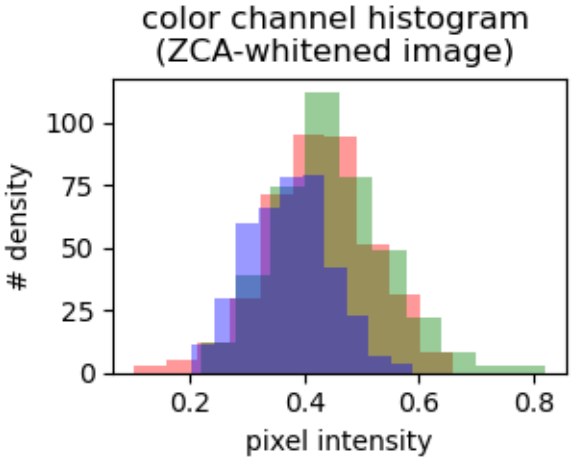
From the saved ZCA images color channels were extracted and plotted using histogram. Only the first one is showed here. All the codes are available in GitHub.

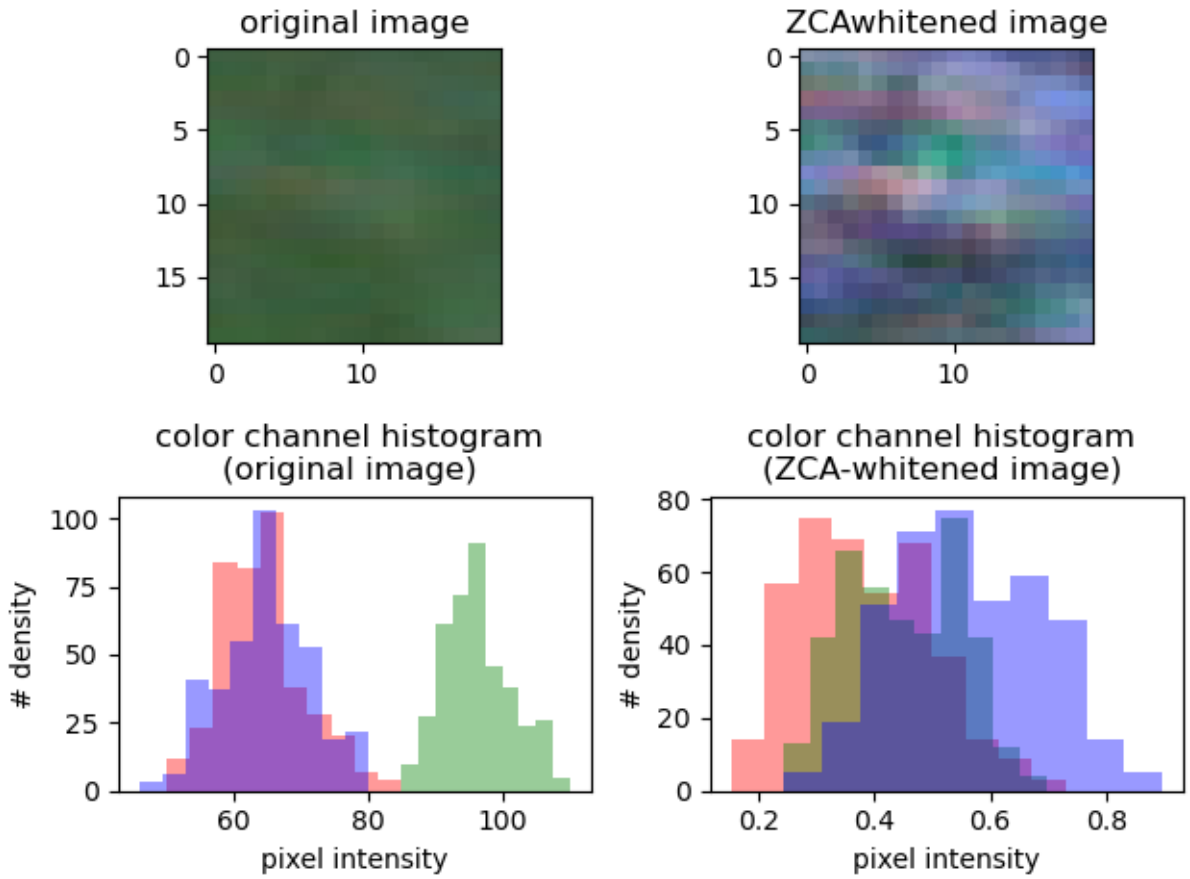


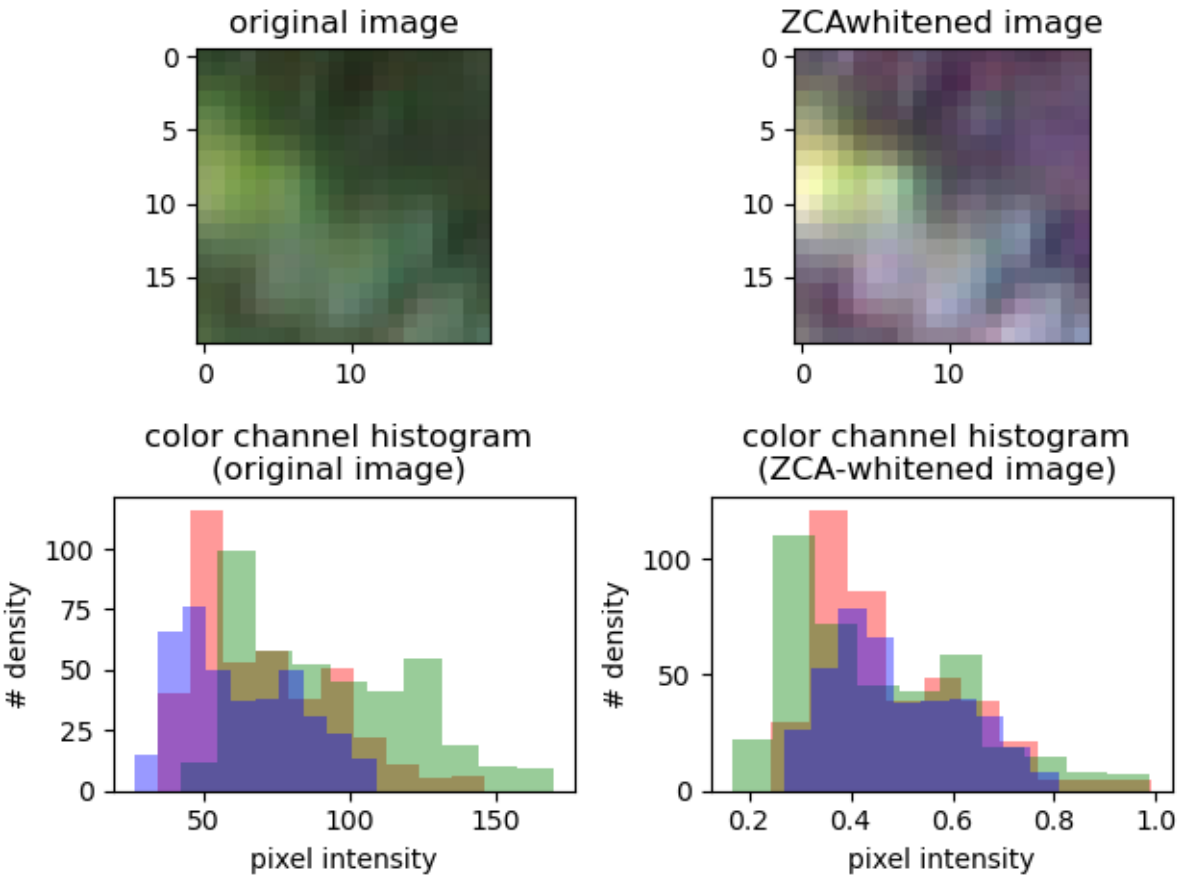

original image
0
5
10
15
0
10

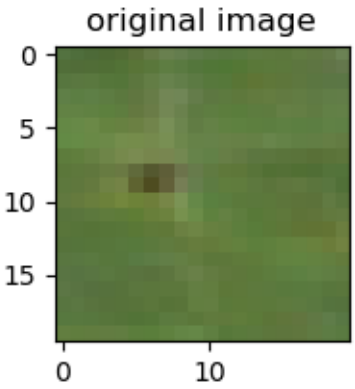

ZCAwhitened image
0
5
10
15
0
10

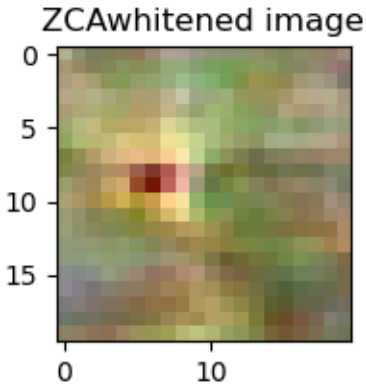

color channel histogram
(original image)
density
100
75
50
25
0
40
60
80
100
pixel intensity

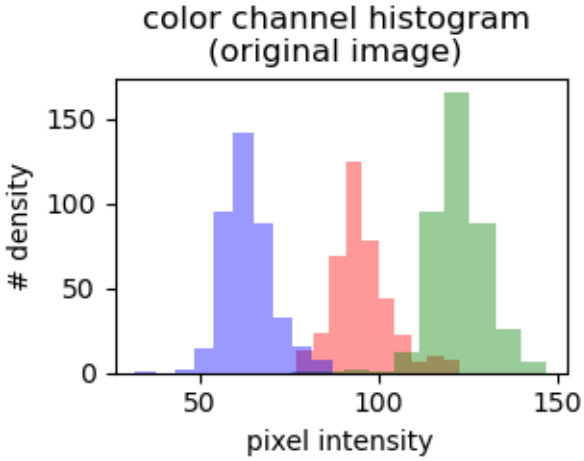

color channel histogram
(ZCA-whitened image)
density
100
75
50
25
0
0.2
0.4
0.6
0.8
pixel intensity

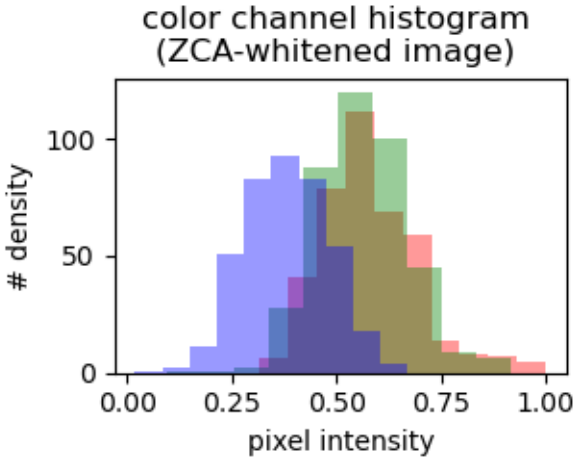

original image
ZCAwhitened image
color channel histogram
(original image)
color channel histogram
(ZCA-whitened image)
density
pixel intensity
density
pixel intensity

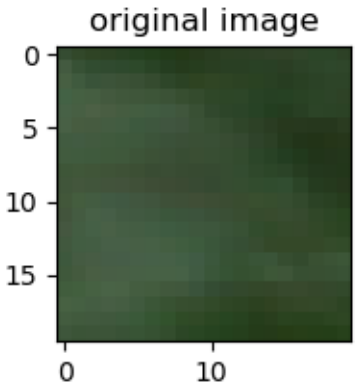

original image
ZCAwhitened image
color channel histogram
(original image)
color channel histogram
(ZCA-whitened image)
density
pixel intensity
density
pixel intensity

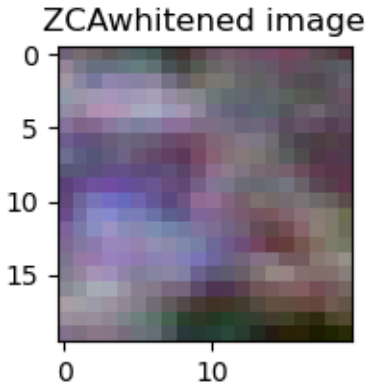

original image
0
5
10
15
0
10

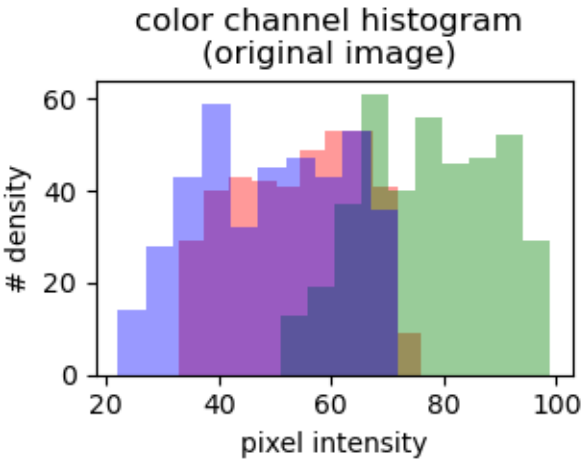

ZCAwhitened image
0
5
10
15
0
10

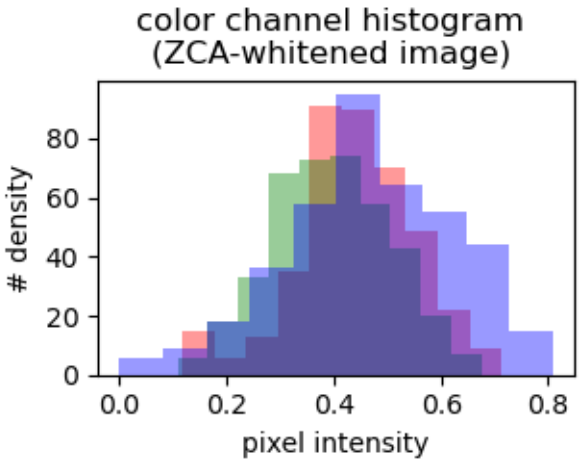

color channel histogram
(original image)
density
150
100
50
0
50
100
150
pixel intensity


color channel histogram
(ZCA-whitened image)
density
100
50
0
0.00
0.25
0.50
0.75
1.00
pixel intensity


original image
0
5
10
15
0
10


ZCAwhitened image
0
5
10
15
0
10


color channel histogram
(original image)
density
0
20
40
60
20
40
60
80
100
pixel intensity


color channel histogram
(ZCA-whitened image)
density
0
20
40
60
80
0.0
0.2
0.4
0.6
0.8
pixel intensity

Answer to Question 2

In the first figure titled ‘1.jpg’ we applied image segmentation to extract only the seedlings image out. The resultant image is as below –

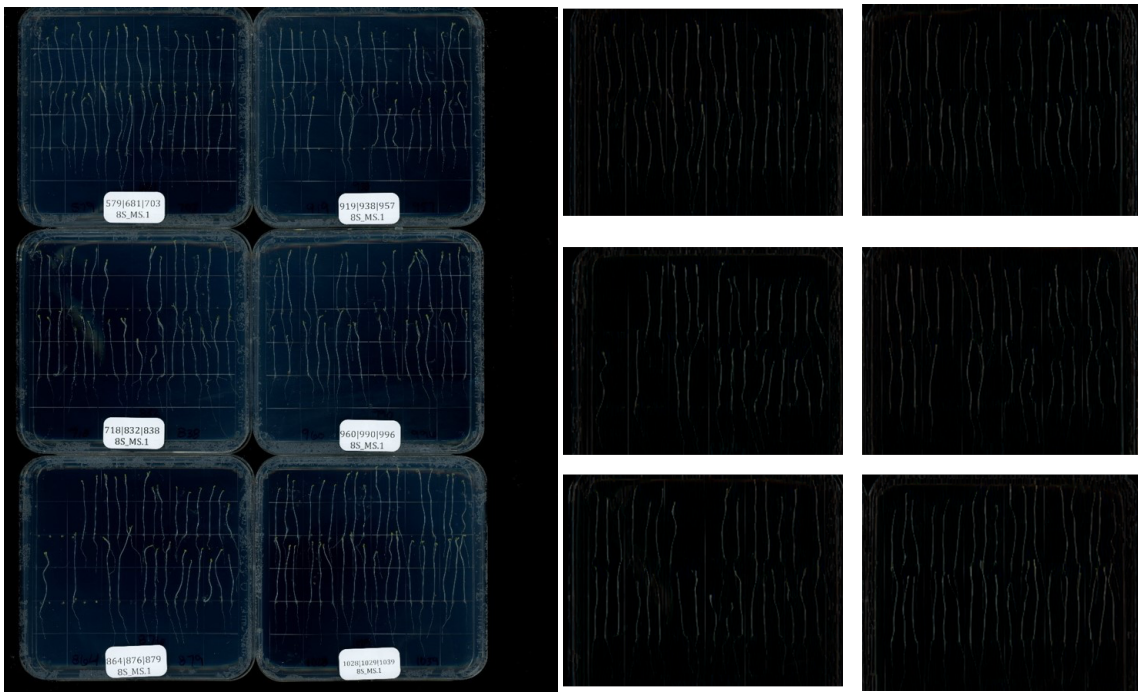


Figure: Left raw image of seedlings, right – extracted image, using segmentation technique the ROI of middle portion excluding the edges are extracted out.

In the second figure titled ‘2.jpg’ we applied HSV transformation mask of open CV to extract the region containing the seedlings only.

The resultant image is as below –

All the codes are available in GitHub.

Link: https://github.com/farabi1038/ME-592/tree/main/HW2

Figure: Left – Given image, right – extracted only the seedlings using HSV transformation