ISYE 8803 Exam 1 Problem 2

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1 Problem 1

In this problem, I analyze an image of a person wearing a face mask and apply various techniques to extract information about said image specifically when trying to segment and determine where and if there is a mask located in the image. The original image that I analyze here is of size 720x1280x3 (height, width, RGB) and can be seen in Figure 1. Because I dont care much about the words in the image, I further crop the image I analyze to just the left half of the original image. Additionally, for feature extraction, object detection and edge detection, I don't need the RGB information so I also converted the image to grayscale which can be seen in Figure 2. Figure 3 shows the histogram for this new grayscale image.

Figure 1: Original image.

Figure 2: Cropped and grey image.

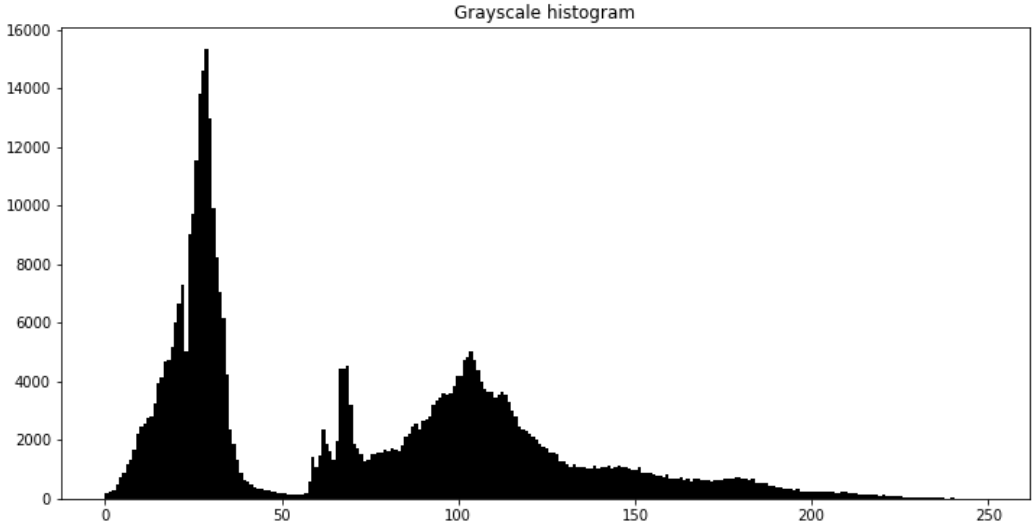

Figure 3: Histogram of grey image.

I complete a very simple mask extraction/object detection task by selecting rows and columns that contain just the mask, like a bounding box as Figure 4 shows. I then can threshold the image to black and white with a finely tuned threshold value to extract the mask from the region of interest. There are many ways one could do this such as Otsu's method, finding contours, or performing watershed. One I thresholded the image to black and white, I remapped the region of interest back to the space of the image and can visualize it in Figure 4.

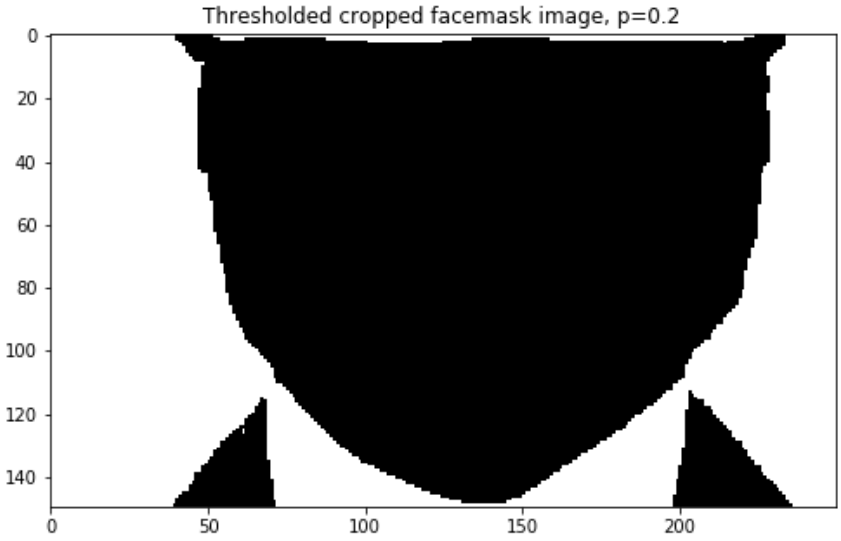

Figure 4: Cropped region containing the mask.

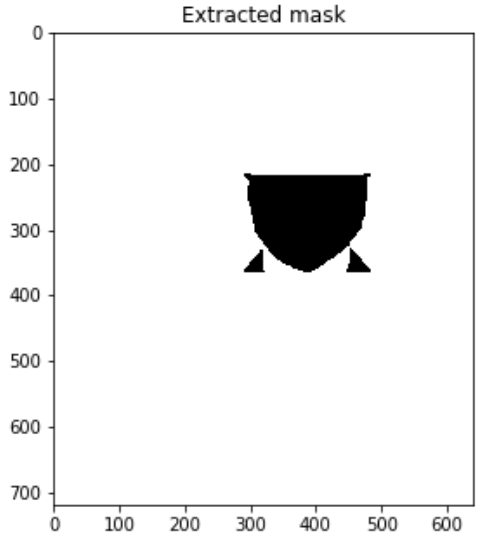

Figure 5: Extracted mask in full image.

Next, I revert back to using the RGB cropped image and use k-means as a method for segmentation and to extract the mask. I perform k-means clustering for segmentation by varying the number of clusters and visualizing the result. I varied the cluster sizes from 3 to 9 and found that the optimal k was 9. I say this because as it can be seen in Figure 6, the mask really only gets its own cluster (relative to neighboring pixels/objects) and can be seen clearly when the number of cluster is 9. Of course, results may vary because the algorithm is heuristic.

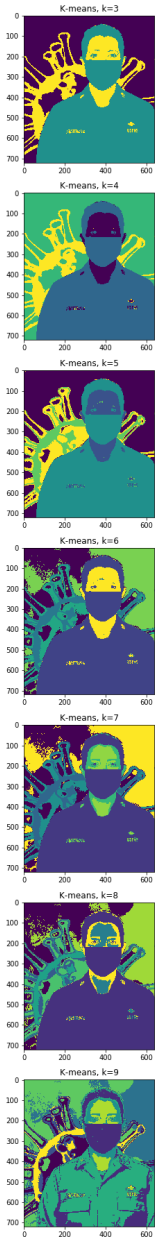

Figure 6: Clustered RGB image when the number of clusters are varied in the k-means algorithm.

Lastly, I implement the Canny edge detector algorithm to try and extract the mask using edges. The edges of the mask can clearly be seen in Figure 7. Combing many of these technique implemented could result in a very accurate non-learning based approach for mask detection.

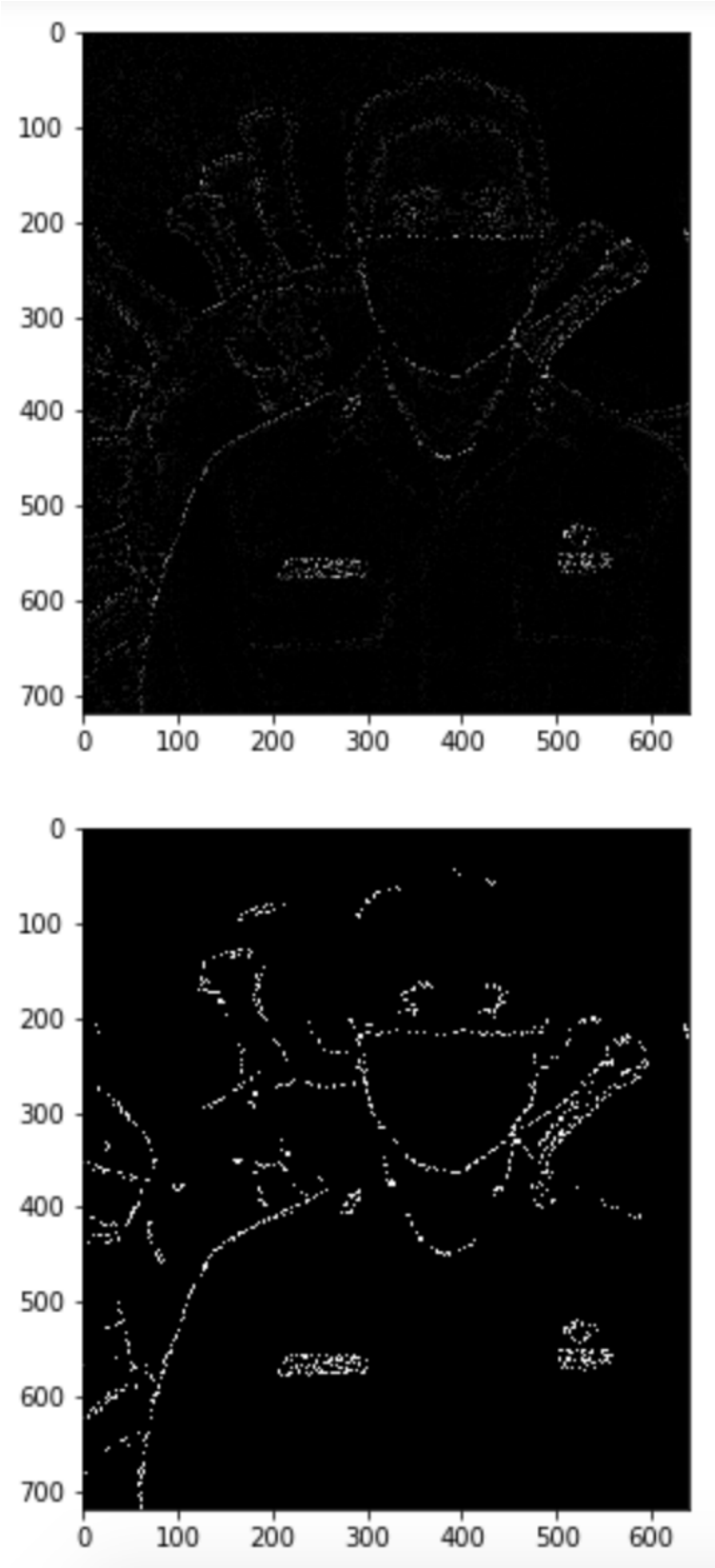

Figure 7: ϕ matrix (Top) and the results of the Canny edge detector algorithm (Bottom).