

# Image Processing Final Project

## Stage 0

For Stage 0 all the codes and images are uploaded in the Stage0 subfolder in the github. All the developed plugins are uploaded under the ID#.

## Stage 1

1. For the first part, three filters are applied before extraction of the Binary Layers which are Mean Filter, Median filter and Gaussian Blur. The filters are applied using different radii. For example, we can clearly see the difference between 23-11 and 26-11 when applied gaussian blur before the extraction. For 23-11 the radius is much larger compared to 26-11 thus for 26-11 the facial features are seen more clearly compared to 23-11. Same applies for mean and median filters.
2. For the 2nd part, the gaussian filter, with 3x3 kernel with different weights, is applied to the images. As we can observe there is no prominent difference between the binary layers. The details of facial features are clearly seen for different weights.
3. For the 3rd part, the pictures 23-01 and 23-12 are chosen and their binary layers are extracted with gaussian blur, with radius 2, applied before extraction. We can see from the 23-01\_binary2 picture that it mostly extracted lips and ears which is the desired outcome, however, for the other ones the result is not very clear. For the picture 23-12 the extracted binary layers correspond to the standard behavior that we want to observe. Also we can observe the difference between moments and eccentricity between 23-01 and 23-12 which is uploaded in the excel file in the folder. For the original 23-11 image and 23-12 the difference between the Normalized Central and Central moments is not that large when comparing 23-11 and 23-01 where we can see a large difference.

## Stage 2

1. The picture chosen for this part is the cropped 23-11 which is exhibiting standard behavior. Its Normalized Cumulative Histograms are calculated for each RGB channel and the results are uploaded in the excel file.
2. The Normalized Cumulative Histograms for each RGB channel are computed for the other images and are matched with the Benchmark Histogram of 23-11 image. The colors are clearly changed, the yellowish shade appears after doing the histogram equalization. After that when extracting the binary layers 25-11 and 26-11 perform much better extraction than before, however, the behavior of 24-11 is not satisfying. It can be because of the somewhat similar behavior of extraction of binary layers of 23-11 and 24-11.
3. For this part the same steps are done only converting RGB to HSV, the Normalized Cumulative Histogram for each HSV channel is computed and uploaded in the excel file.

### Stage 3

Eccentricity shows the “elongatedness” of the region. It can be used when trying to find a head in the image.

Here is the formula of eccentricity taken from the textbook.

$$\text{Ecc}(\mathcal{R}) = \frac{a_1}{a_2} = \frac{\mu_{20} + \mu_{02} + \sqrt{(\mu_{20} - \mu_{02})^2 + 4 \cdot \mu_{11}^2}}{\mu_{20} + \mu_{02} - \sqrt{(\mu_{20} - \mu_{02})^2 + 4 \cdot \mu_{11}^2}},$$

After running the code and computing the eccentricity for some images, the results showed that when the eccentricity is larger than the 60 we can state that it is not a head. For example, when taking an image of an egg and computing its eccentricity, we get 90, thus we can conclude it is not a head.