# IMAGE SEGMENTATION

# Scenario:

Imagine there are specific part(s) of the image or “regions of interest” that you want to identify for image processing and you wish to remove the unnecessary parts (ex. background) that are not needed for image processing.

# Objective:

- Convert RGB values into XY coordinates via Chromaticity

- Identify the “region of interest” (ROI) of an image through
    1. Parametric Segmentation
    2. Non-Parametric Segmentation (Histogram backprojection)

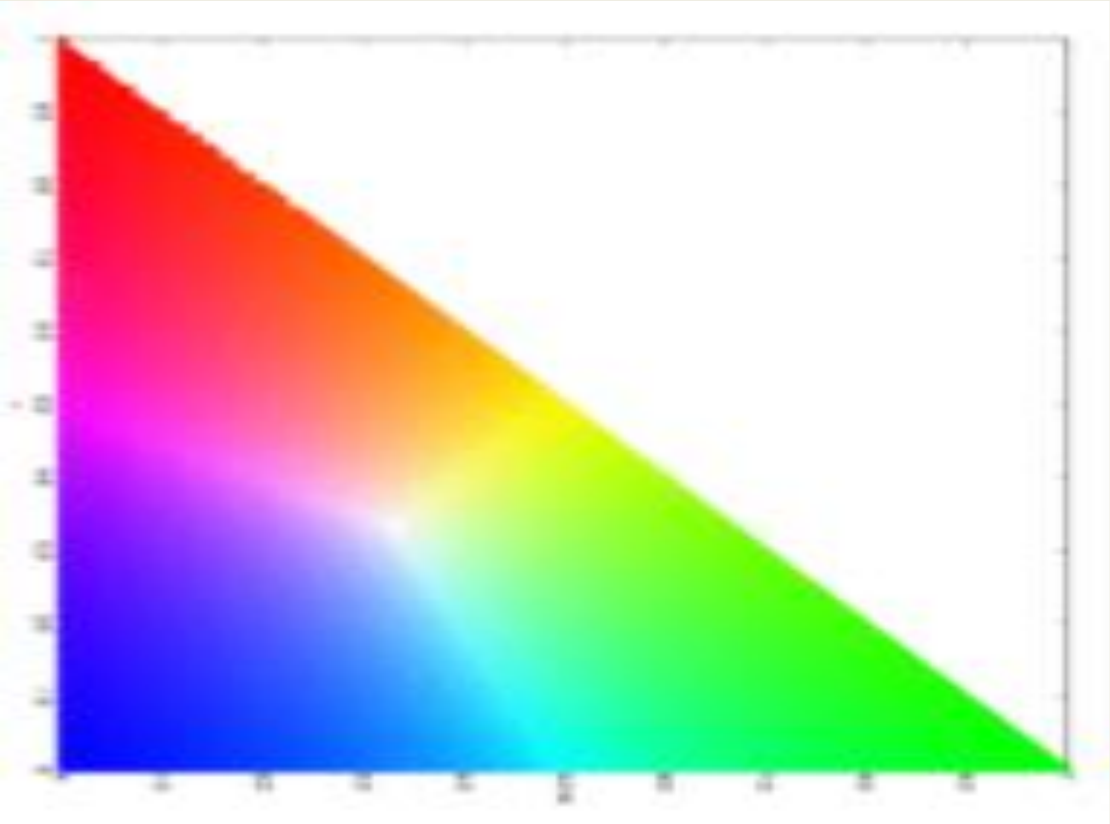
# Normalize Chromaticity Coordinates (NCC)

- 2D way of mapping color

- Let I be the sum of pixels values of R,G and B
- $I = R + G + B$
- Let $r = R/I$ and $g = G/I$ since B is dependent of R,G and I, it is not needed.
- Now RGB can be expressed as XY coordinates in terms of r and g.

# Normalize Chromaticity Coordinates (NCC)

r



g

This is what the color representation of a NCC looks like (yes the red and green axes were interchanged in my coding which explains in the results)

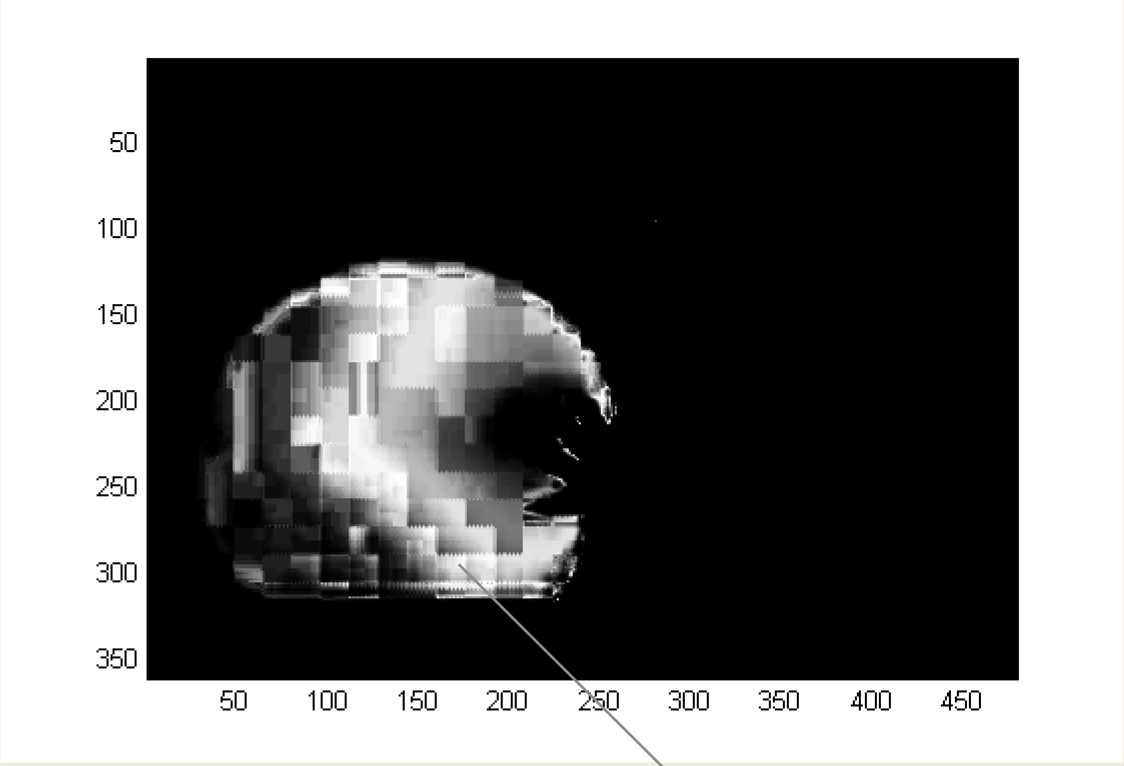
# Parametric Segmentation:

- This method gives per pixel the probability that the specific color of the pixel appears based from the desired region of interest.
- The “desired region of interest” is used to form a probability distribution that can help find the “region of interest” of an image.
- An example of a probability distribution is a Gaussian distribution (which was used in this procedure):
- $p(r) = \frac{1}{\sigma_r\sqrt{2\pi}} e^{-\frac{(r-\mu_r)^2}{2\sigma_r^2}}$ where $\sigma$ is the standard deviation and $\mu$ is the mean of the color pixel values r of the desired region of interest.

# Parametric Segmentation:

Original Image

Resulting Image



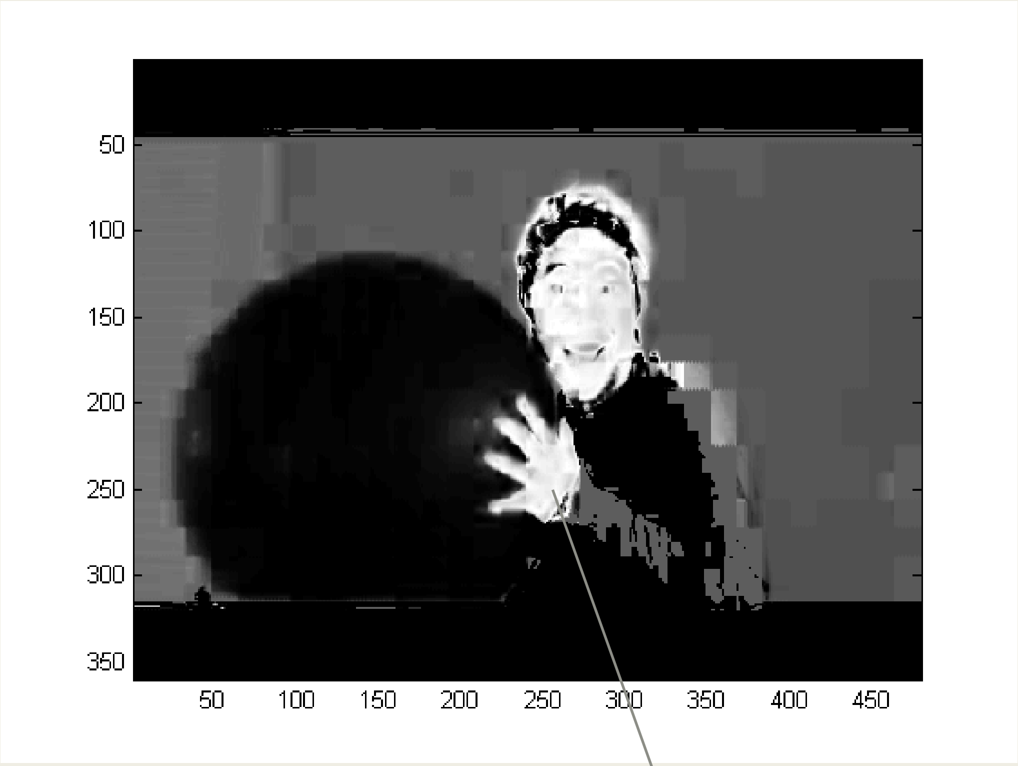

Desired Region of Interest

Region of Interest found through segmentation (white)

# Parametric Segmentation:

Original Image

Resulting Image

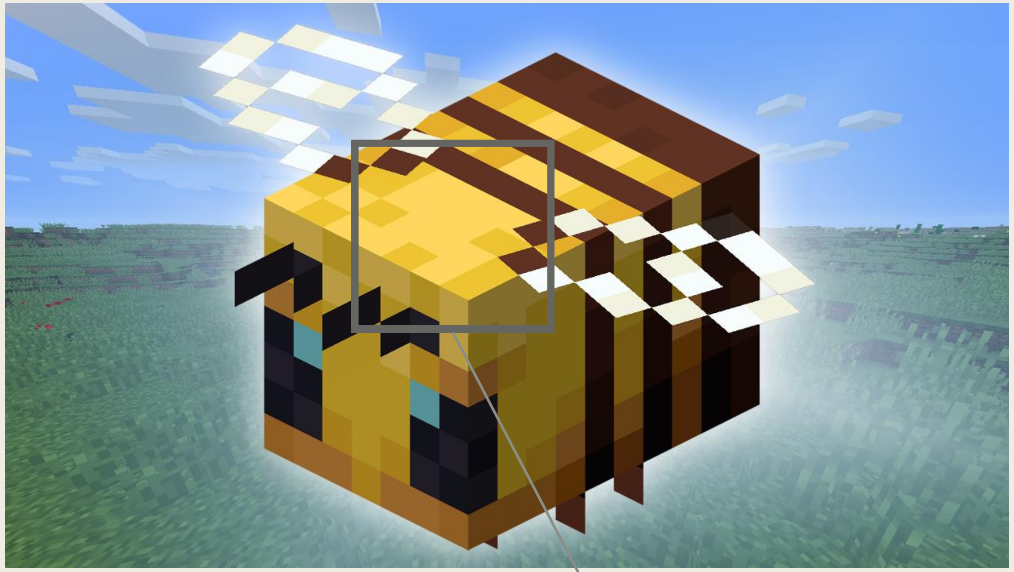



Desired Region of Interest

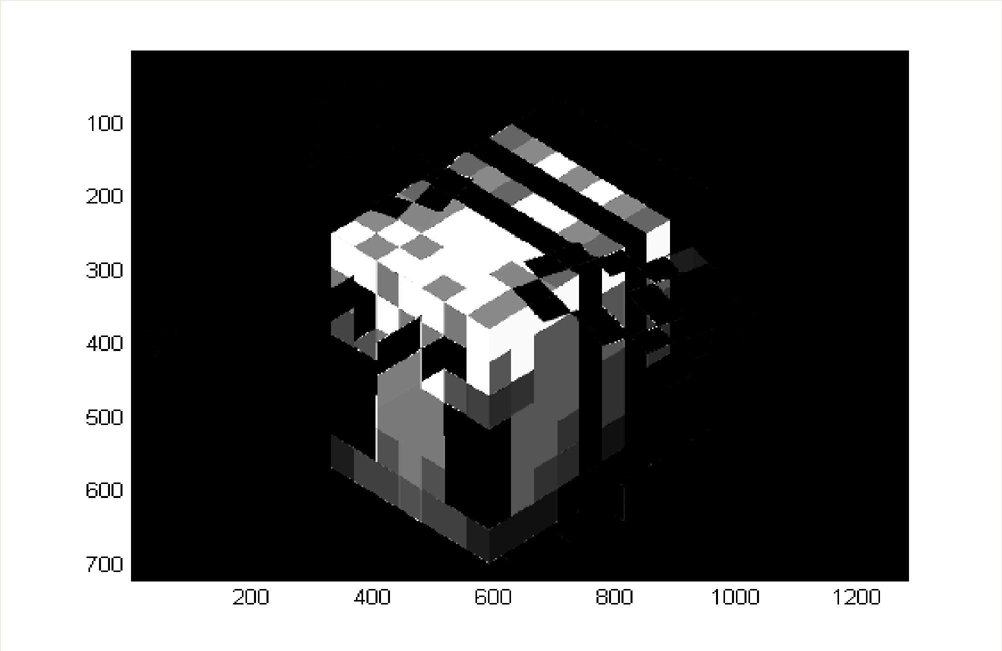
Region of Interest found through segmentation (white)

# Parametric Segmentation:

Original Image



Resulting Image




Desired Region of Interest

Region of Interest found through segmentation (white)

# Parametric Segmentation Results:

- This method was able to identify the proper regions of interest.
- Colors of background that are close to the color of the region of interest (ex. Brown ROI, Gray BG) can have high probability with this method. It can be resolved by setting a certain threshold value.
- Regions of Interest with many colors show that many shades of gray appears thus is possible to identify the image as a whole.
- Brightness affects the result of the region of interest (dark areas of green were not recognized)

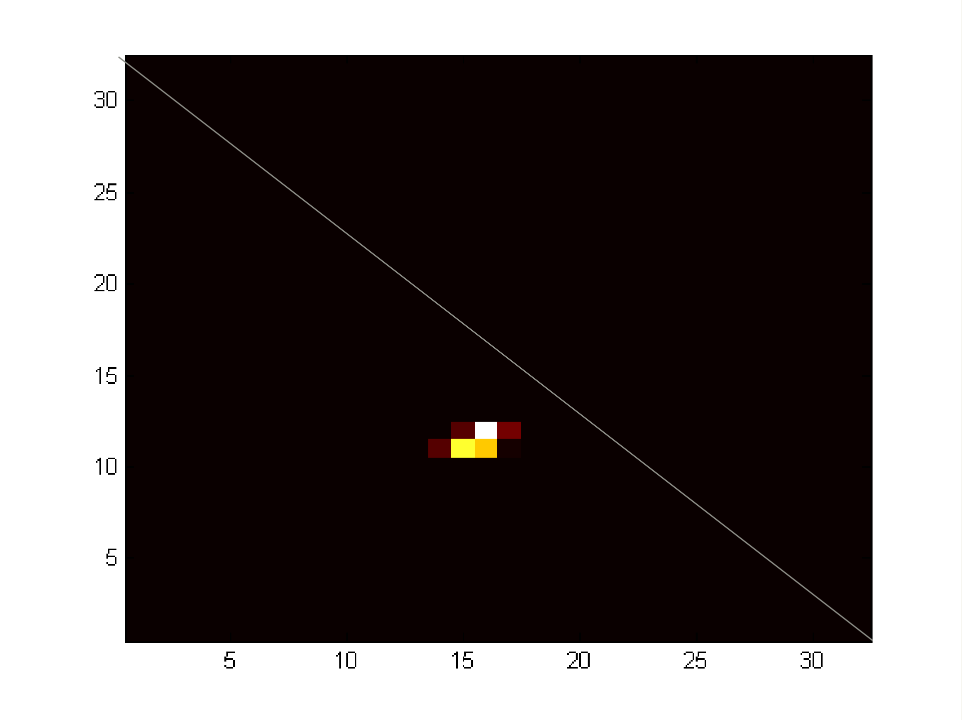
# Non-Parametric Segmentation via Histogram Backprojection

- The “desired region of interest” also used here.
- Instead of a distribution function, it counts how many pixels belong to a certain set of color (or bins) from the desired region of interest using a 2D histogram.
- The probability of a color appear is based on how many pixels the relatively appear in the 2D histogram.
- In this case we made a 2D histogram with 32x32 bins.

# Non- Parametric Segmentation:

Original Image

2D Histogram



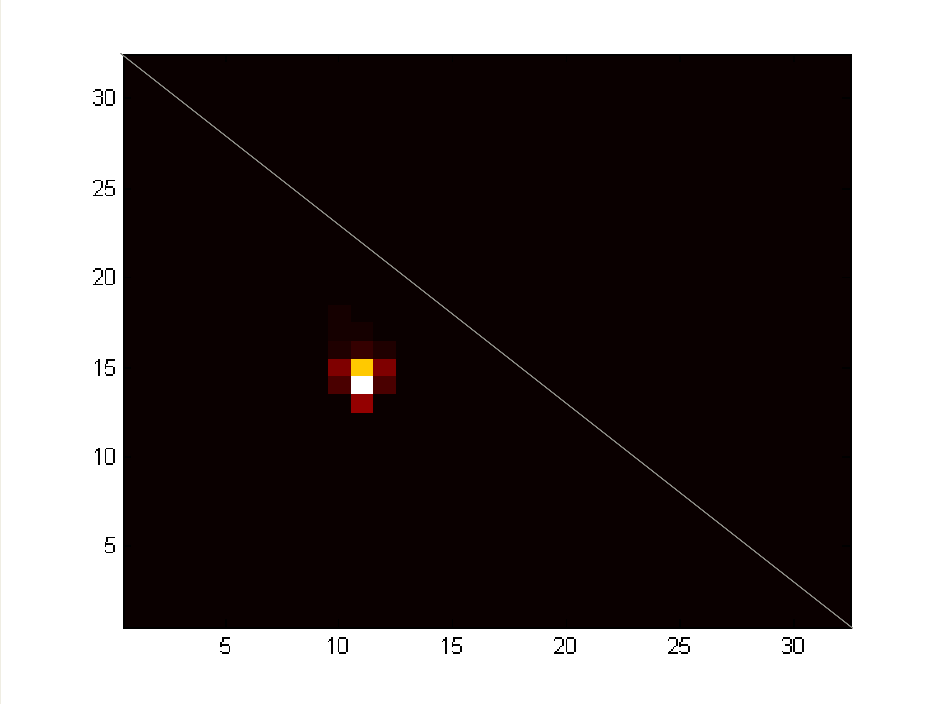

Desired Region of Interest

Desired Region must have a lot of green concentrated

# Non- Parametric Segmentation:

Original Image

2D Histogram (Hand)

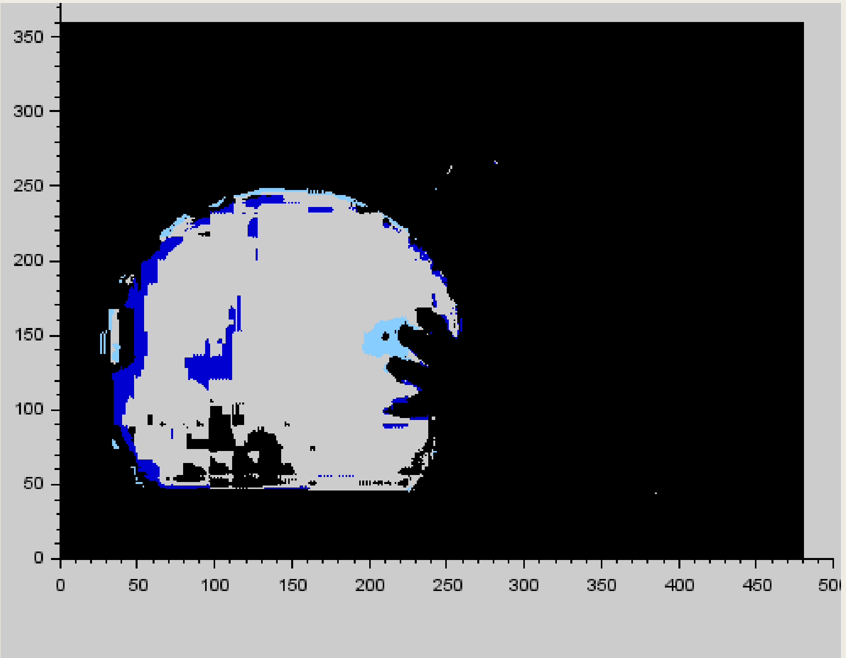



Desired Region of Interest

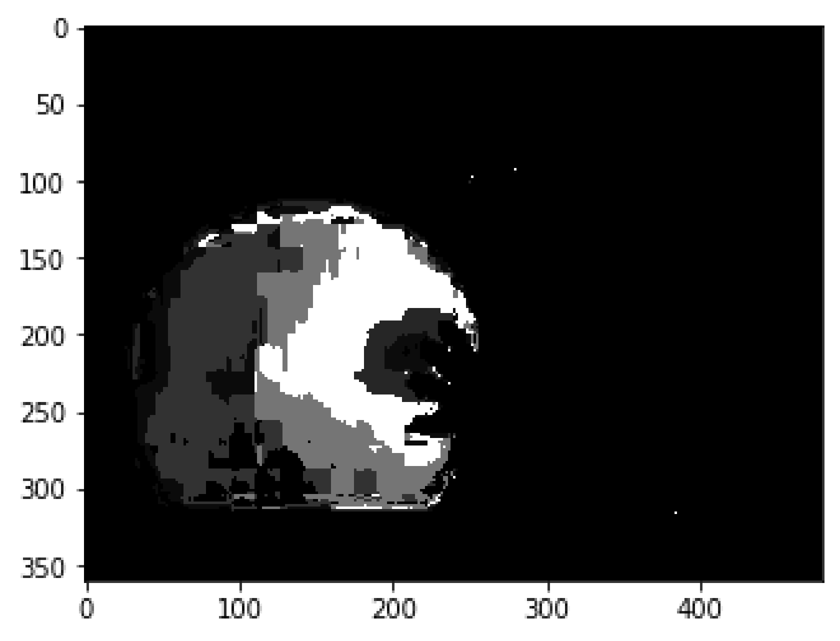
Brown is a family of orange

# Non- Parametric Segmentation:

Scilab result




Transferred to Python Result

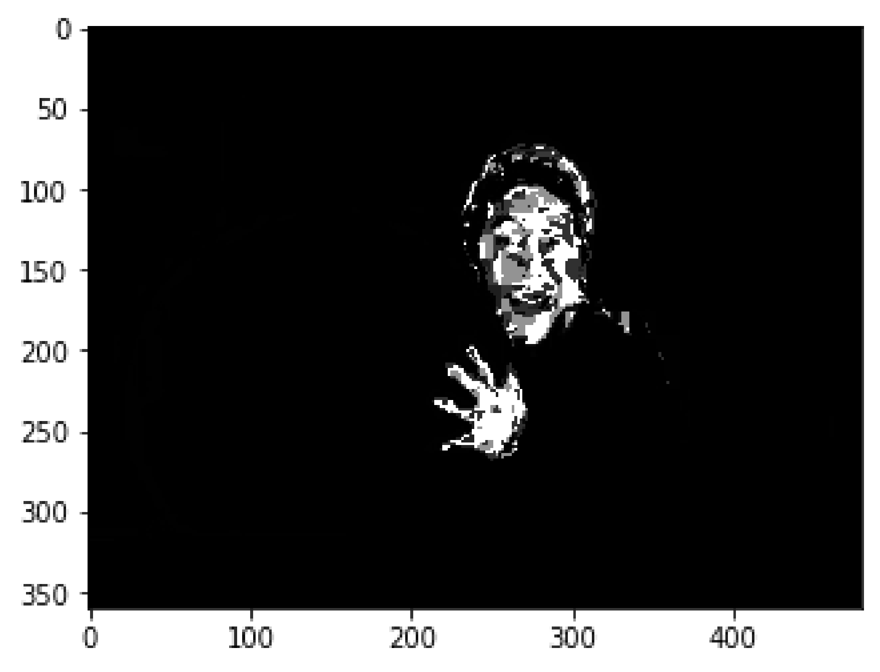


# Non-Parametric Segmentation Feelings and Results

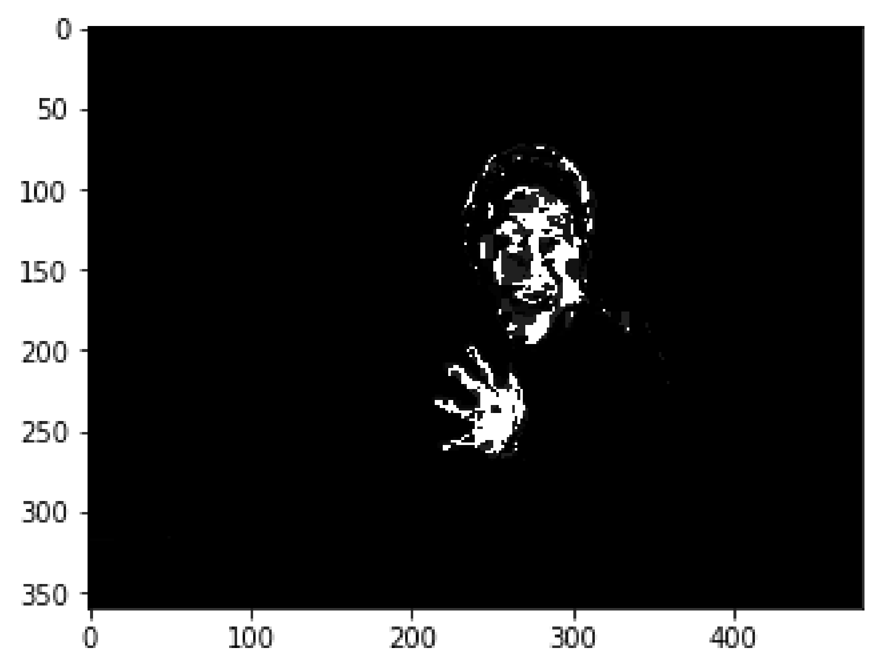
- I tried to change the colormap in Scilab. But it won't work ☹. That's why I converted it to python…
- The result of the ball in this procedure is similar to the parametric segmentation.
- Although there are less unique grayscale values since the 2D histogram grouped 256 pixel numbers into 32 bins.

# Non- Parametric Segmentation:

Using Hand Skin




Using Face Skin



# Non-Parametric Segmentation Results

- The desired region of interest of the face has more unique colors than the hand.
- Because of this, there are more intermediate values as a result when using the face as a desired region of interest while there are hardly any for the face skin.

# References and Special Thanks

- Mam Jing and Sir Onglao for finding the errors in code.
- Reference: https://uvle.upd.edu.ph/pluginfile.php/503097/mod_resource/content/1/A7%20-%20Image%20Segmentation%202019.pdf