Perception and AI Skin detection
ESIEE Paris 2023 - 2024

Gloria Desideri and Julie Nonsocomesechiama

Contents

Chapter 1

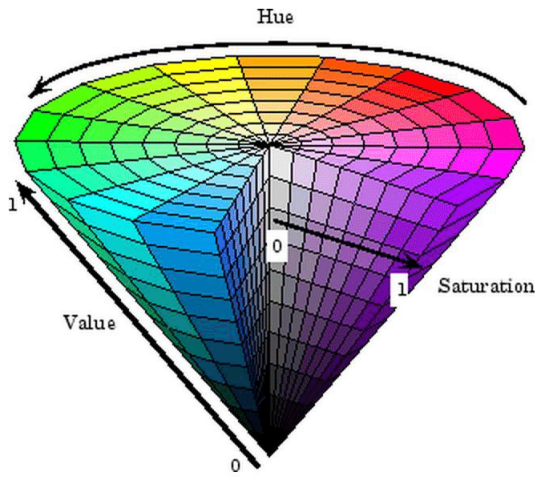
Introduction

The main objective of this practical session was to wxperiment with color manipulation to understand the impact of color coding and light conditions. We had to perform skin segmentation from images of hands in three different light conditions: normail lighting, down lighting and upligthing. We were aslso asked to use two different color spaces. For the purpose of this lab we choosed the HSV and the YCrCb spaces.
The YCbCr color space, also known as YUV, is a color encoding system often used in video and image compression. It separates the chrominance (color information) from the luma (brightness information) to allow for greater compression efficiency.

- The Y represents the luma or brightness of the image
- Cb represents the difference between the blue and green components of the original color
- Cr component represents the difference between the red and green components of the original color

The HSV (Hue, Saturation, Value) color space is a model that represents colors in a way that's closer to how humans perceive them. Unlike the RGB (Red, Green, Blue) color model, which uses primary colors, HSV separates the color information into three components:

- Hue: This represents the type of color. It is usually represented in degrees from 0 to 360, where 0 (or 360) is red, 120 is green, and 240 is blue. Other colors fall within these ranges.
- Saturation: This measures the purity of the color. A saturation of 0 represents a shade of gray, while a saturation of 1 represents the full color.
- Value: This represents the brightness of the color. A value of 0 represents black, a value of 1 represents the brightest version of the color, and values in between represent various shades of the color.



Chapter 2

Data

The assignment asked for a few images in three different lighting conditions. We sampled four images from the 11k hands dataset.

Figure 2.1: Hand 1

Figure 2.2: Hand 2

Figure 2.3: Hand 3

Figure 2.4: Hand 4

Using an online tool we also got the same images without background which allowed us to automatically extract a binary groud truth. In order to obtain three different lighting conditions we used the PIL python package enhancer, setting the factor to 0,5 for down lighting and to 1,5 for up lighting.

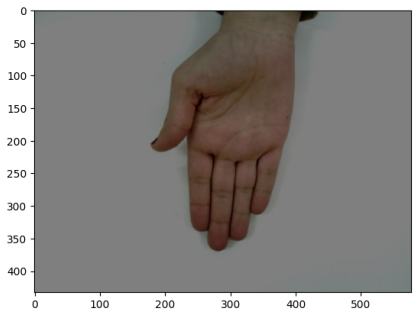


Figure 2.5: Hand down

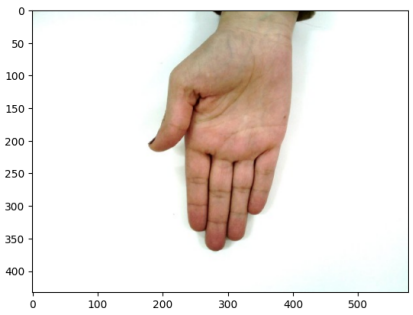


Figure 2.6: Hand normal

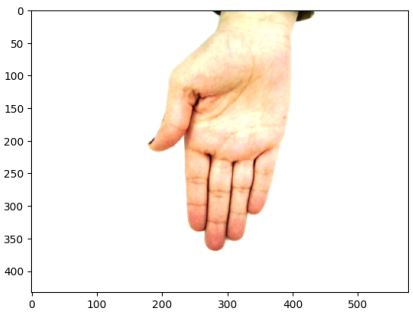


Figure 2.7: Hand up

Chapter 3

Analysis

The whole process of segmentation and analysis was carried out using the OpenCV python package for both color spaces. Before proceding with the segmentation we performed a histogram analysis which gave us some insights for the tresholds of the segmentation.

3.1 YCrCb space

The first space we analyzed was the YCrCb and below you can see the histograms for the three values.

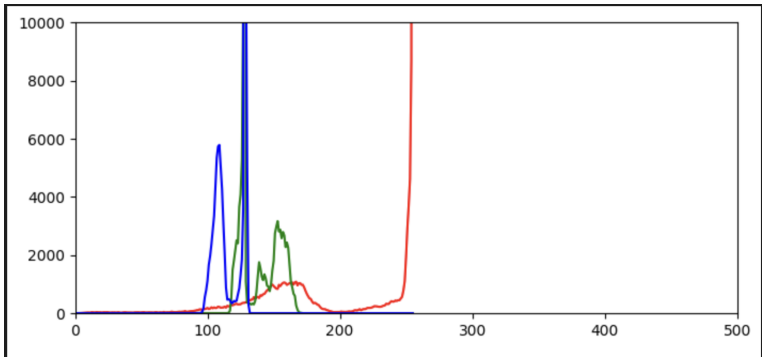


Figure 3.1: Normal image

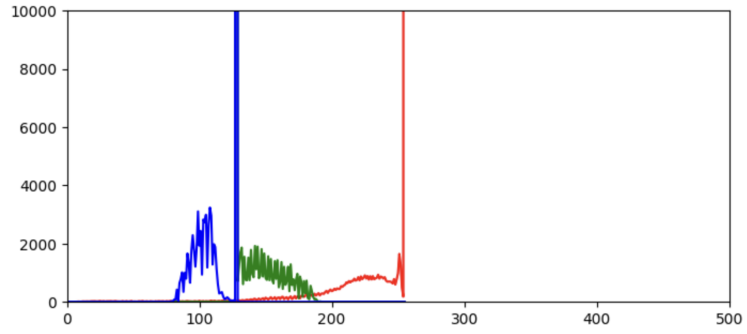


Figure 3.2: Up lighting image

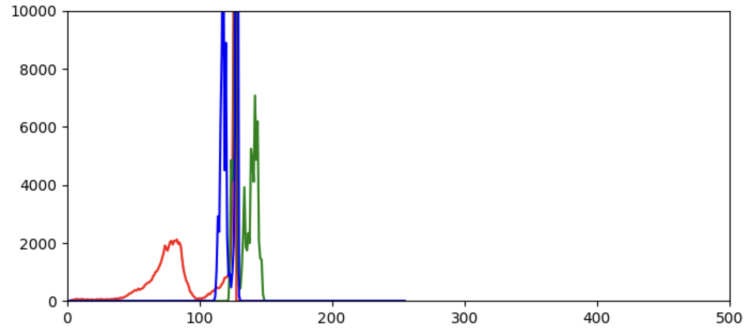


Figure 3.3: Down lighting image

Here is evident how the image with poor lighting conditions is less bright (red line) while the up lighted image has an higher brightness, also the two channels representing the differences are accentuated with poor and normal lighting.

3.2 HSV

We proceded our analysis with the HSV space

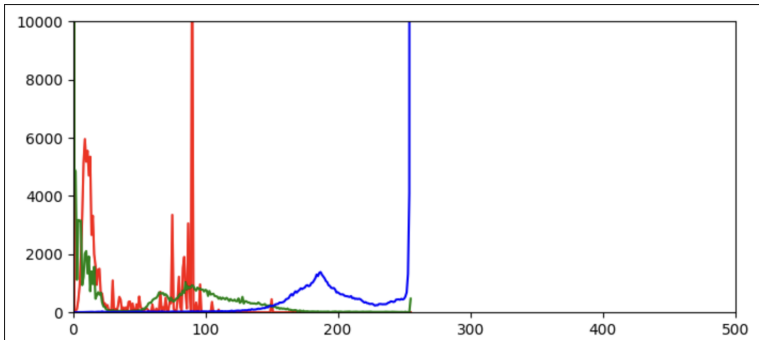


Figure 3.4: Normal image

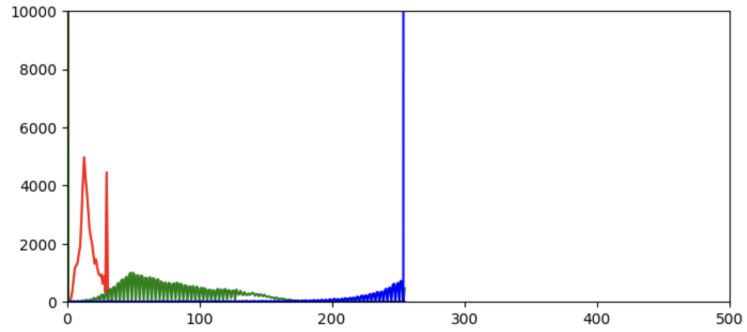


Figure 3.5: Up lighting image

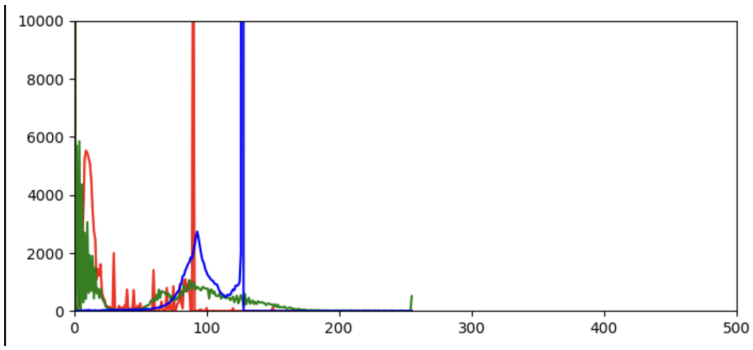


Figure 3.6: Down lighting image

Here we can see how the image with great brightness has the higher S and V values. Also the histograms give much insight for the hue value, which is from 0 to 100 for normal and poor lighting and more restricted for up lighting.

Chapter 4

Segmentation and results

Next we proceded with the segmentation task. In particular we used the precision function as our performance measure

$$\frac{\mathrm{TP}}{\mathrm{TP}+\mathrm{FP}}$$

Namely we performed a summation over the result of the logical AND between the identified region and the ground truth then we devided the result for the summation over the identified region. Both the identified region and the ground truth are binary images.
We used different parameters according to the space and light condition. In particular for the YCrCb space we used:

0,133, 77 ,[255, 173, 127] for normal lighting

0,129, 77 ,[150, 150, 127] for normal lighting

0,120, 77 ,[255, 190, 127] for normal lighting

For which we obtained a mean precision of 0.96047 for normal lighting 0.96509 for brighter images and 0.92717 for poor lighting.
And for which we report the following sample results

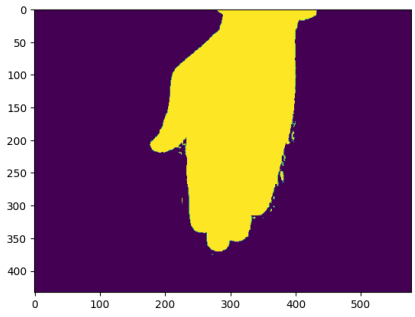


Figure 4.1: Hand down

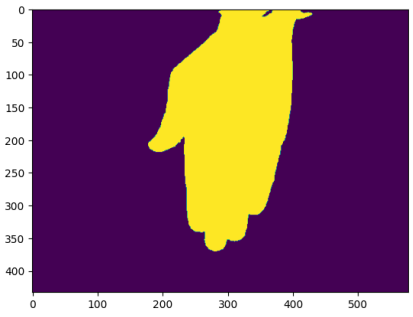


Figure 4.2: Hand normal

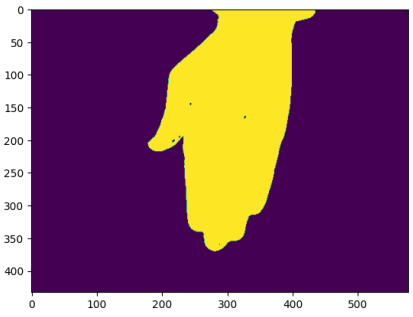


Figure 4.3: Hand up

For HSV we used:

0,50, 0 ,[200, 255, 255] for normal lighting

0,10, 150 ,[100, 255, 255] for normal lighting

0,50, 0 ,[200, 255, 255] for normal lighting

For which we obtained a mean precision of 0.98234 for normal lighting 0.96509 for brighter images and 0.982198 for poor lighting.

And for which we report the following sample results

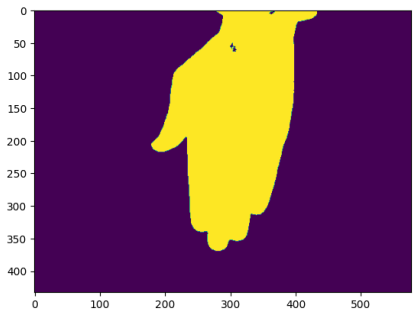


Figure 4.4: Hand down

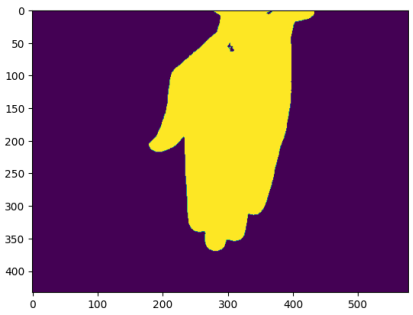


Figure 4.5: Hand normal

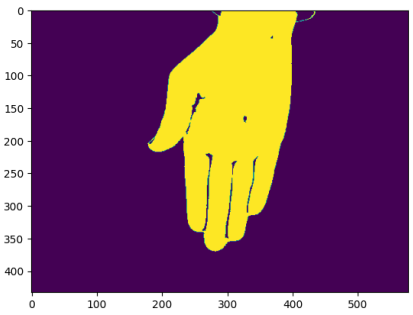


Figure 4.6: Hand up