CS 260 Image Processing PROJECT

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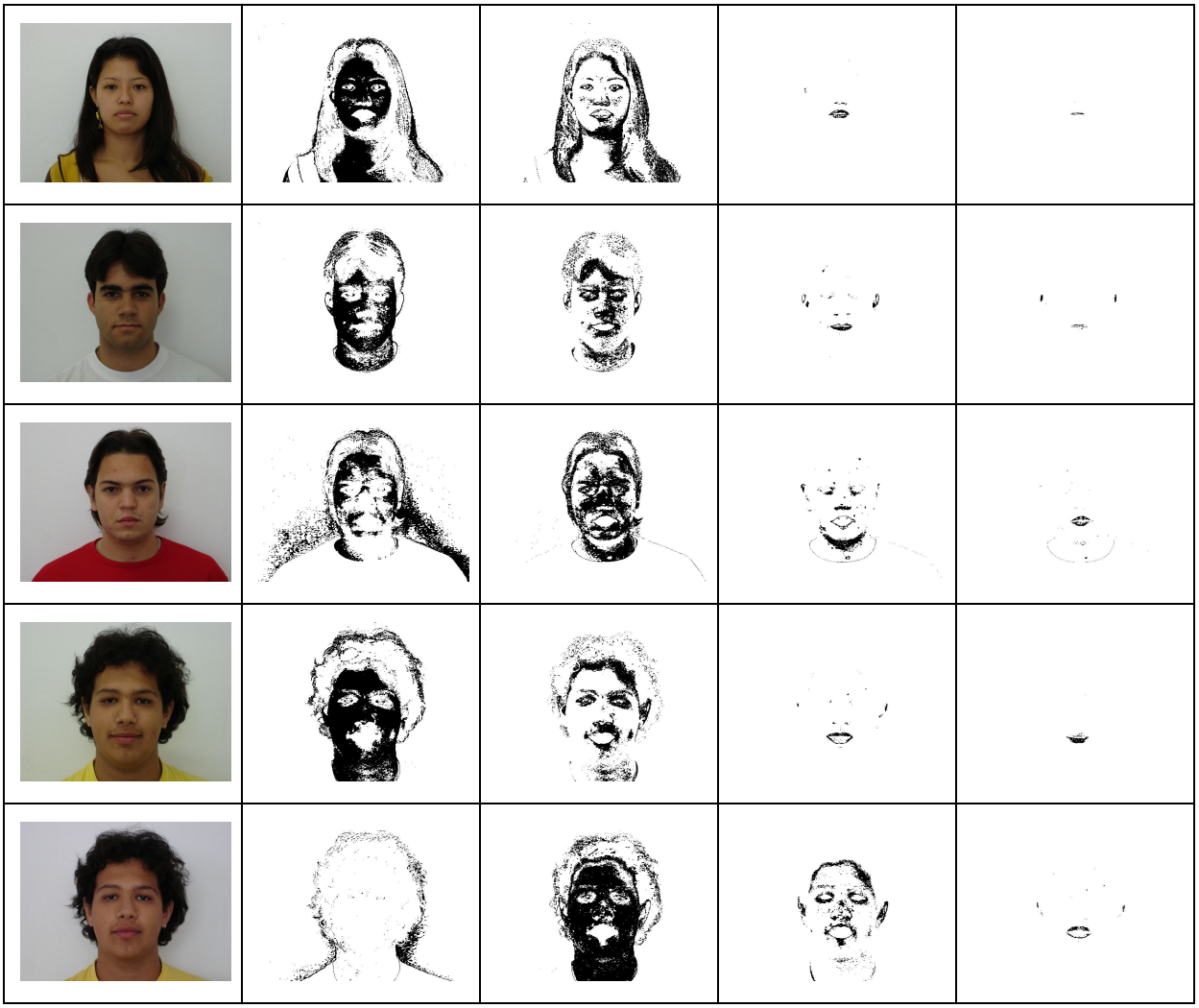
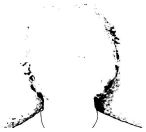
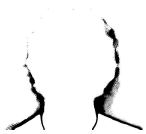
Stage 1



As f01 should select pixels mainly concentrated along the face bounds, I consider only the 3rd photo as a representative of the standard behaviour from x_11.jpg set. I have also selected 42_14.jpg as a good representative for the standard behaviour.

Stage 1 _ Results

	Median - Radius 3				
	Median - Radius 5				
	Mean - Radius 3				
	Mean - Radius 5				
	Gaussian - Radius 3				
	Gaussian - Radius 5				
	Median - 5 Gaussian - 5				

Further experiments: Applying smoothing filters after binary layer extraction.

Minimum filter - after Radius - 3 Layer - 1	
Median filter - after Radius - 3 Layer - 1	
Gaussian filter - after Radius - 3 Layer - 1	
Maximum filter - after Radius - 3 Layer - 1	
Minimum filter - after Radius - 3 Layer - 2	

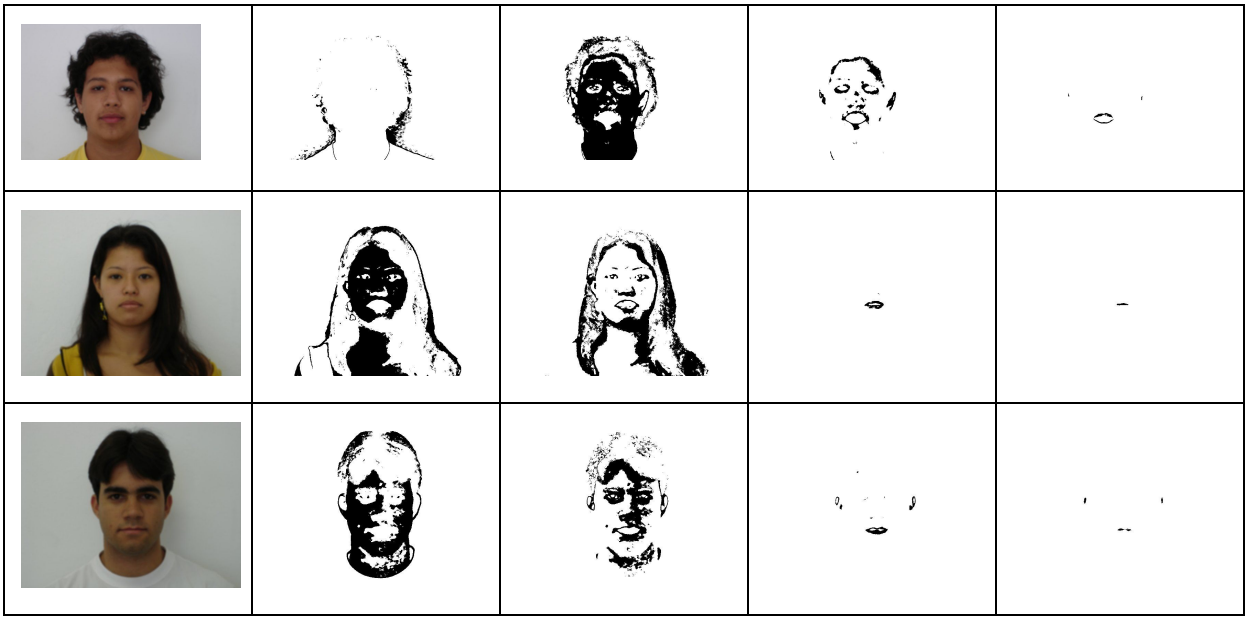
Minimum filter - after Radius - 3 Layer - 3	
Median filter - after Radius - 3 Layer - 3	
Median filter - after Radius - 3 Layer - 2	

After the experiment, I came to a conclusion that both median and Gaussian filters contribute to smoother region selection.

As Median filter is non-linear, I decided to go with a convolution of mean and Gaussian filters.

MEAN 5 * 5	GAUSSIAN 5 * 5
0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04	1/273 4/273 7/273 4/273 1/273 4/273 16/273 26/273 16/273 4/273 7/273 26/273 41/273 26/273 7/273 4/273 16/273 26/273 16/273 4/273 1/273 4/273 7/273 4/273 1/273

RESULT _ CONVOLUTION
0.04 0.2 0.48 0.64 0.68 0.64 0.48 0.2 0.04 0.2 1 2.32 3.12 3.32 3.12 2.32 1 0.2 0.48 2.32 5.28 7.12 7.6 7.12 5.28 2.32 0.48 0.64 3.12 7.12 9.6 10.24 9.6 7.12 3.12 0.64 0.68 3.32 7.6 10.24 10.92 10.24 7.6 3.32 0.68 0.64 3.12 7.12 9.6 10.24 9.6 7.12 3.12 0.64 0.48 2.32 5.28 7.12 7.6 7.12 5.28 2.32 0.48 0.2 1 2.32 3.12 3.32 3.12 2.32 1 0.2 0.04 0.2 0.48 0.64 0.68 0.64 0.48 0.2 0.04

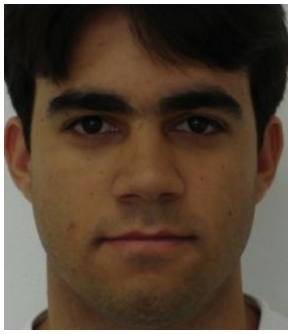


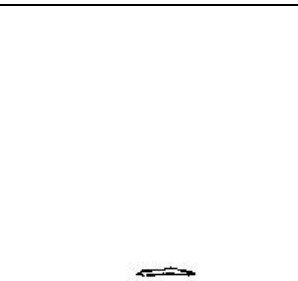
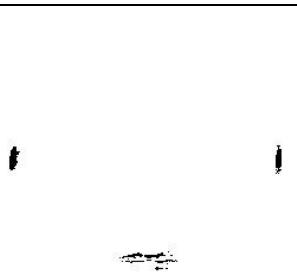
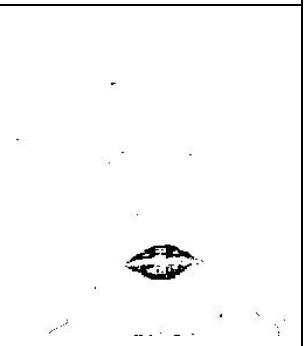
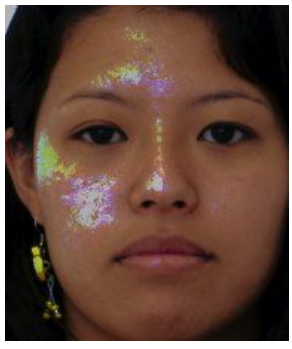
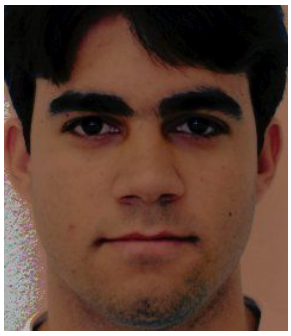
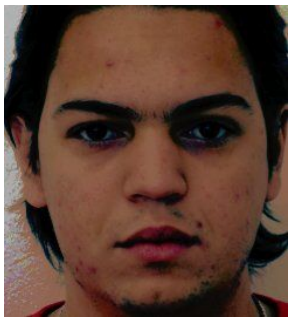
We can observe that we in result of the convolution, we get comparably smoother and more connected regions in case of all images (both with standard and non-standard behaviour).

	Orientation - 0.13660086812050434 - Meaning that the direction is horizontal. ECC - 1.1695088177555866, so it is almost a circle.
	Orientation -89.99071872128717 ECC 1.1695088177555866
	ECC 1.8975154316173357 Orientation -0.10752932454064773 Cropped Image. Applied Gaussian filter 3 * 3. Extracted layer 3 Position horizontal
	ECC 1.316610720987541 Orientation -0.047528244483332246 Cropped Image. Applied Gaussian Filter 3 * 3. Extracted 3rd Layer .

	ECC 1.968763125449221 Orientation -89.736221630458 We can see that the hair part contributed to the vertical perception of the image, so we get the expected 90 degree orientation. If we put the image into a bounding box, we will see that the height is almost twice bigger than than the width, thus resulting in ~ 2ECC.

STAGE 2

	39-11	40-11	41-11
Original			
Layer1			

Layer2			
Layer3			
Layer4			
Matched			

Layer1			
Layer2			
Layer3			
Layer4			

I was able to observe that histogram matching with the benchmark histogram of the image exhibiting standard behaviour radically improved the results of binary layer extraction in case of images

exhibiting non-standard behaviour.

HSVMatched	L1	L2	L3	L4
				
				
				

We can observe a similar behaviour in case of histogram matching with HSV system.

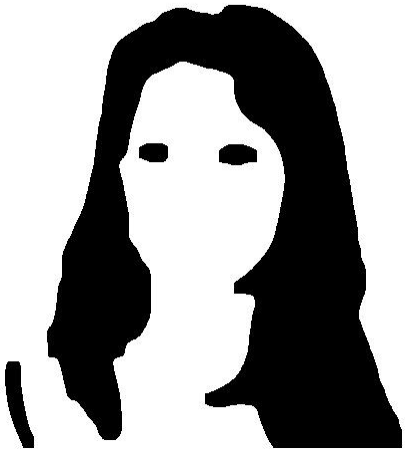
Stage 3

At this stage, I have considered hair detection combined or without eyes.

The following line of processes have been used for the above result:

Minimum Filter 5 * 5 -> Sharpening -> Median 7 * 7 - > Converting to 8bit - > Thresholding (20-30)

Further removal of unnecessary regions and enhancement of important regions can be done by morphological operations like erosion and dilation:

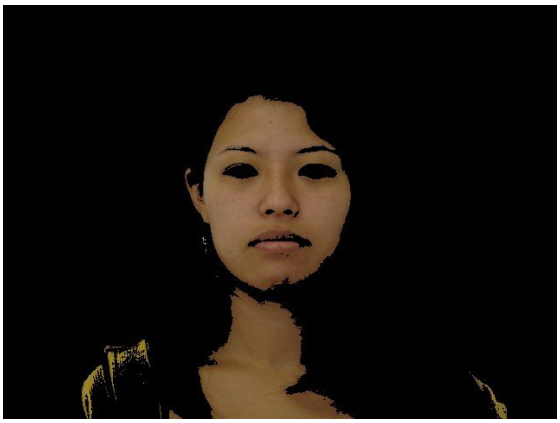


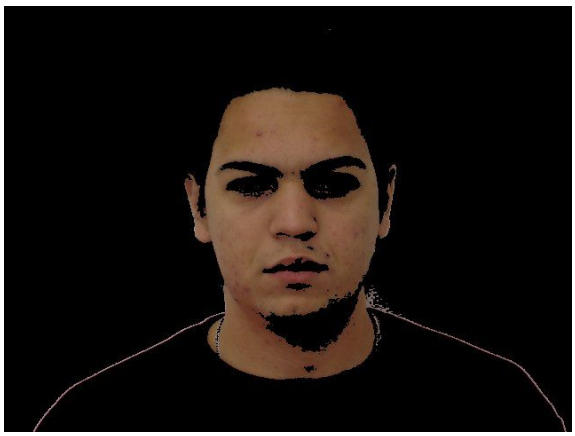
Based on stereotypical perception of genders, the basic calculation and

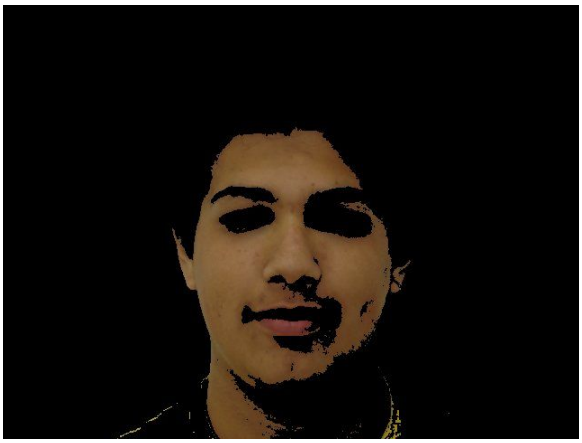
comparison of m00(area) of the extracted region will give us some insights about the gender of the person in the image.

During my Research I came across an interesting article suggesting a human skin detection algorithm based on different color channels:

I have implemented the algorithm based on RGB channels. Here are the apparent results:







[Here is the link of the paper]

The upper results were generated based on the condition below:

R > 95 and G > 40 and B > 20 and R > G and R > B and | R - G | > 15