Digital Image Processing

Project - Multi-Threshold Lip Contouring

REPORT

Problem Statement – Lip contour detection from high-resolution lip image through multi-threshold approach for most optimum contour.

Main Goals – Given high resolution lip images. We broke the problem of lip contour extraction into two base sub-problems of locating the upper and lower lip contours

using a novel threshold selection algorithm and combining them into the solution for the original lip contour.

Input – High-resolution lip Image

Output – Optimum Lip Contour

Motivation –

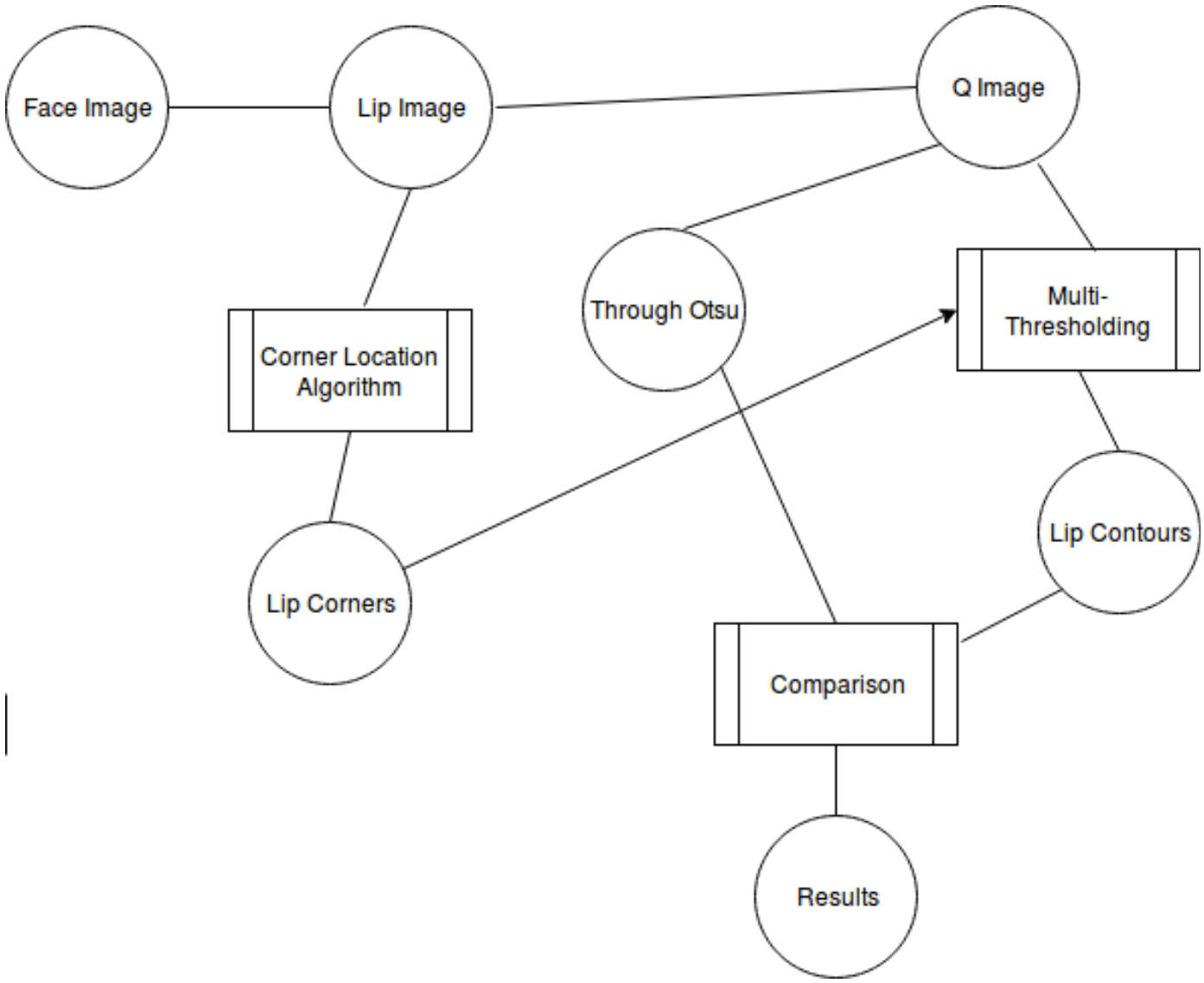
Automatic lip contour detection has become an essential issue in face image analysis. Our approach is a low complexity algorithm for robust and accurate lip contour extraction revealing shape details, which might be of value in diverse applied fields such as automated lip biometric and Human-Machine interaction.
A number of lip segmentation methods based on different methods have been proposed. Early approaches utilized basic image processing techniques, such as threshold specific colour channels to obtain the lip region. Such approaches are of low computational complexity, but are vulnerable to complexion
diversity and variability in the illumination conditions.

The above methods provide varied degree of accuracies but there is no optimum algorithm in this field.

NOVELTY :

In this project we propose a method for multi-thresholding for lip contour extraction from face images. Cropped image of lip is obtained from face image of high resolution, followed multi-thresholding.

Project Overview



Muti-Threshold Lip Contouring Algorithm

Converting Lip image from RGB to YIQ - The Q component image has brighter lips as it has less overlap between skin and lip pixels.

Lip Corners Location Extraction – The algorithm uses statistics on Q image to exteact location of Lip corners.

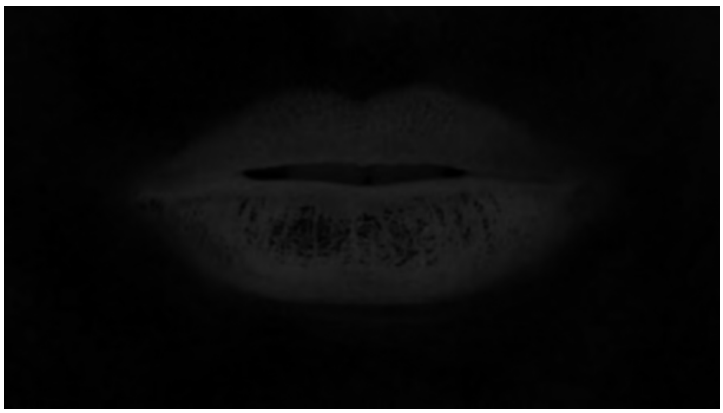
Contour Detection Algorithm - The proposed algorithm is suggested to extract contours of lips.

Qualitative Evaluation- Comparison to normal methods for lip contour detection.(like Otsu Threshold segmentation and K-means)

RGB TO YIQ

The RGB model is inefficient for lip segmentation since RGB values are sensitive to illumination intensity, and there is significant overlap between lip and skin in all three channels. It has been observed that the lips are brighter in the Q channel suggesting Q channel for lip detection.
So we are converting our lip image to YIQ and retaining the Q-component for lip contour extraction.

The pixel differentiation is also not affected by facial hair in Q component image.



Lip Corner Location Detection And Extraction Algorithm

Lip corners location is a prerequisite step, for the subsequent lip contour detection because the corners will be used to split the image into upper and lower part.Assume a lip image matrix of size **m**x**n** pixels, and (Lx,Ly), (Rx,Ry) the image coordinates of the left and right lip corner respectively. Image is converted to YIQ color space and the Q chromaticity is retained. The column wise standard deviation of Q matrix forms the signal: stdn , from which **Ly** and **Ry.** The values of **Rx**,**Lx** are computed through the coordinate with the maximum Q value of **Q(**i,**Ry)** and **Q(**i,**Ly).**Finally, the image row

((Lx+Rx)/2 , j) is used to split the image into the upper and lower lip part.

Contour Detection Algorithm

For contour detection we stored the values between Qmin and Qmax for thresholding at each value.

-> Qmin and Qmax obtained from thresholding the image by Otsu.(For casual threshold)

-> Starting a loop from Qmin to Qmax

-> Starting a loop from Qmin to Qmax we thresholded the given image using the current threshold and found the connected components of area greater than a specified limit.

-> Morphological filters are then applied through opening followed by closing which helps to separate the lip component from

neighbouring small components.(radius of disc for opening = 10 & for closing = 20)

-> Find contours function is then applied to find the contours of lip image after thresholding the image with the current threshold. Maximum area contour is picked and contour coordinates are saved.

-> For differentiating between lip and skin pixels and finding the best boundary we observe pixels at certain level up and down (assume l pixels) from the extracted contour and find the value of -

Qup pixels= {c1+l, c2+l, ……., cn+l}

Qdown pixels= {c1-l, c2-l, ……., cn-l}

Now calculate the value **->**

$$D = \sum (||qup(i) - qdown(i)||) / (l*l)$$

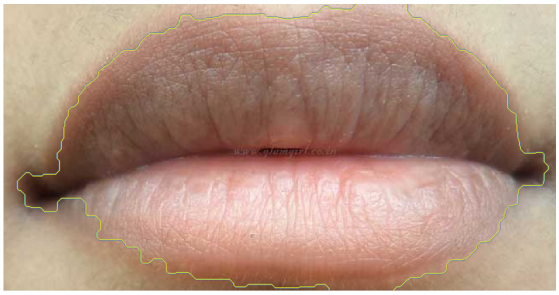
And this updated difference is now checked if it has maximum value among all previously found D values. If yes the store this as best

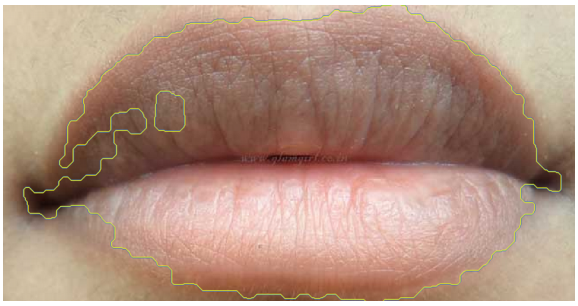
contour corresponding to the particular threshold and if not loop is continued.

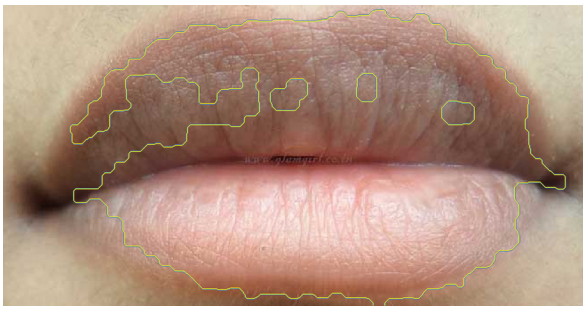
(Multi-Threshold applied to check for best contour)

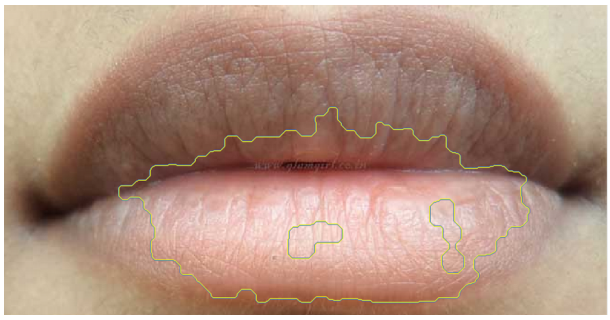
We have used the Qmin and Qmax to be around Otsu threshold which minimizes the computation time.

On the right we have attached intermediate images from multi-thresholding algorithm





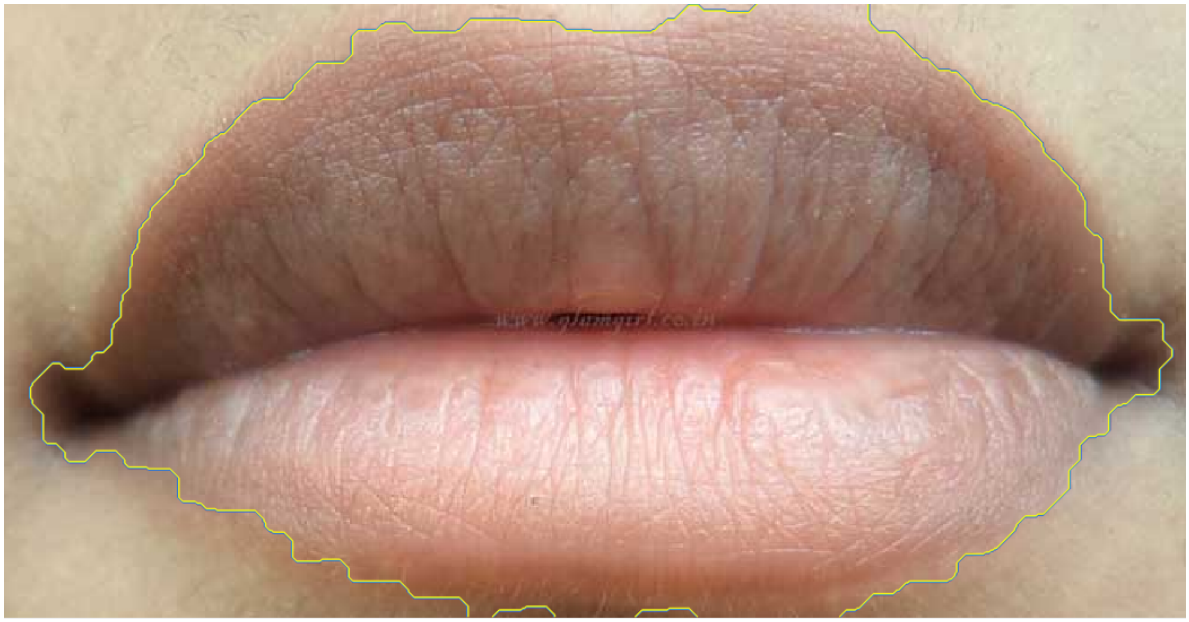




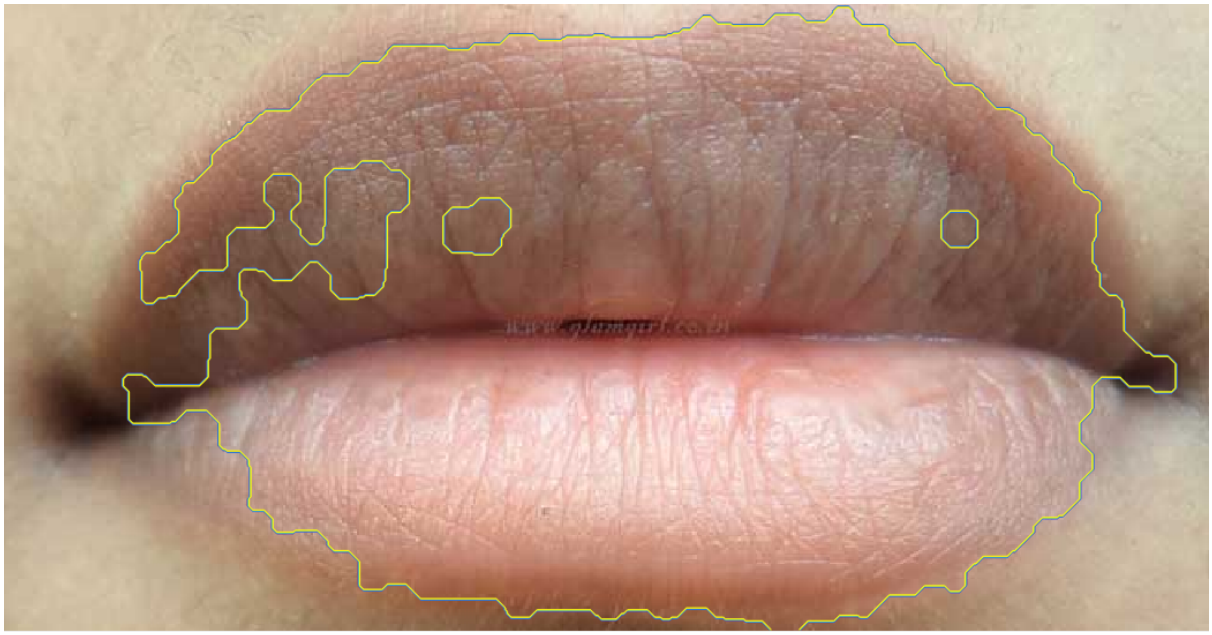
Now the best contour is placed on the original image.

Results are better than normal thresholding techniques to segment lip image.

Our result:



Otsu Result:



Other Applications Results:

- For Lip cancer symptoms on lips:

Our Result:

Other Methods' (Otsu,K-means)

- Solar Cheilosis:

Our Result:

Other existing state-of-art output:

Following is the link for result images for other lips image results:

https://drive.google.com/open?id=1fzJ3akIYdjFRjdGpFzhso3DX-huFUDYp

For references used, codes and other details following is Github link :

https://github.com/PrajwalShingala/