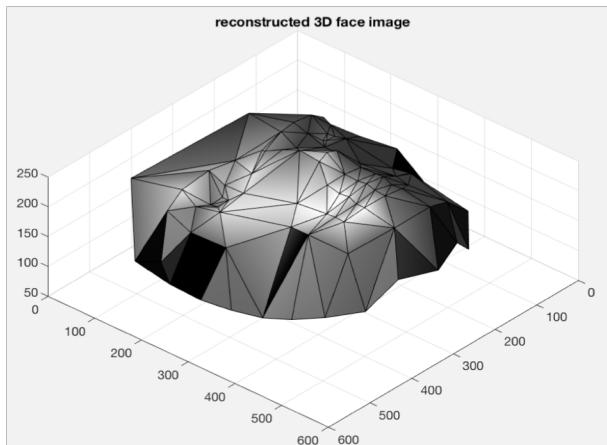


3D FACIAL MODELING

TUFTS UNIVERSITY
ELECTRICAL ENGINEERING

JIACHENG QU
JAN 25, 2019



Objectives

- To discover and analysis existing facial modeling methods.
 - implementations of the modeling method
 - necessary testing and verification
- Trimming of the input photo (this presentation)
 - half-length photo -> passport photo
- Reconstructing 3D facial photo
 - Facial feature locating and depth mapping

Approach

- **Face recognition based on Gaussian skin color detection**
 - skin-color modeling is used here for finding the distribution of skin color
 - YCbCr color space
 - a - Applying thresholds on Chromatic colors Cb, Cr
 - b - Maximum Likelihood Adaptation
 - multivariate Gaussian distribution
 - Using the **OPENING** method to sew up the filtered face
 - output a clear and cropped passport photo.
- **Facial feature locating and depth mapping**
 - 108 facial feature points based on CMU 58 point facial mapping

Image Pipeline

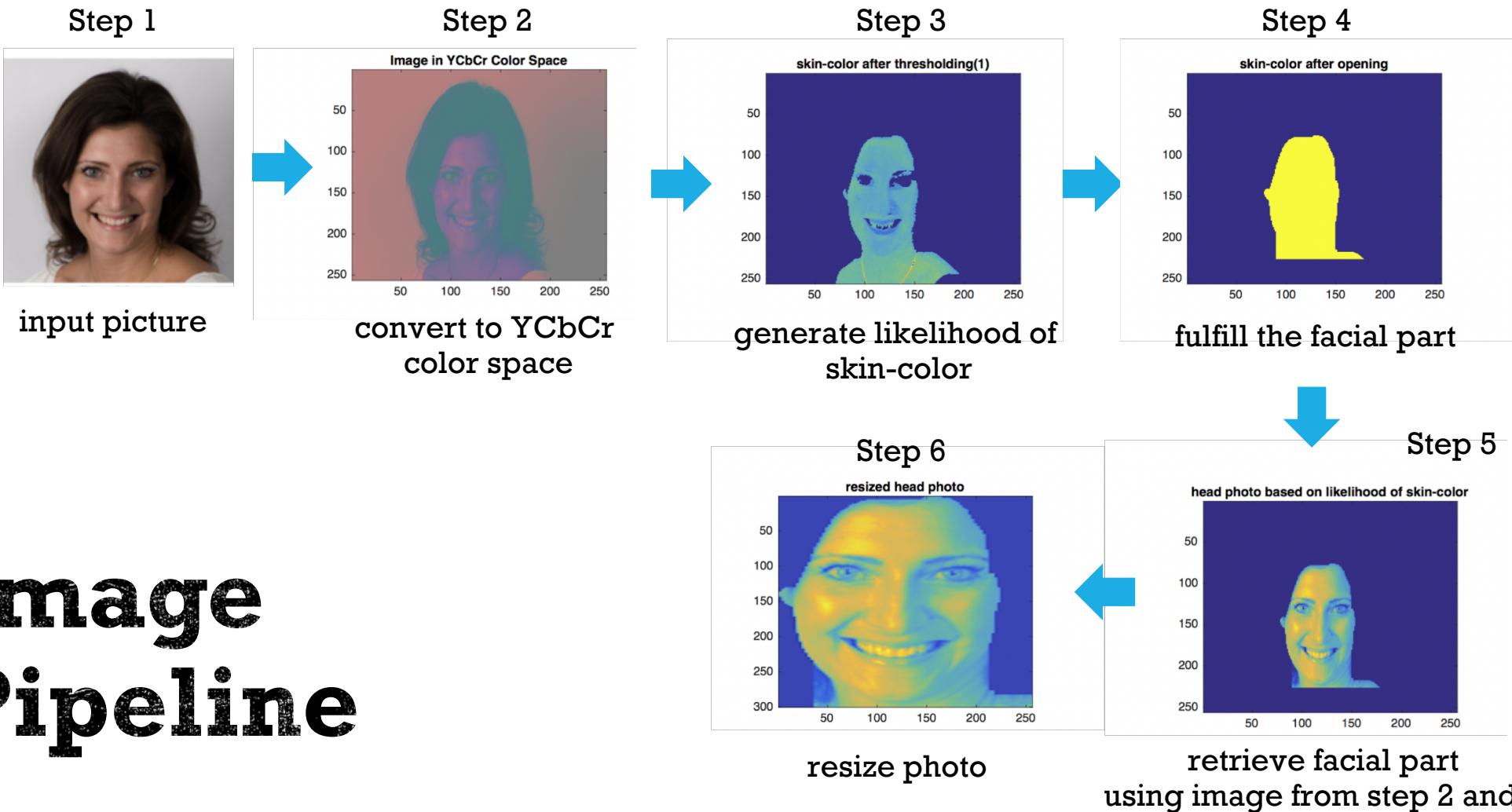


Image Morphology - skin-color detection

$$\mu = (Cr, Cg)$$

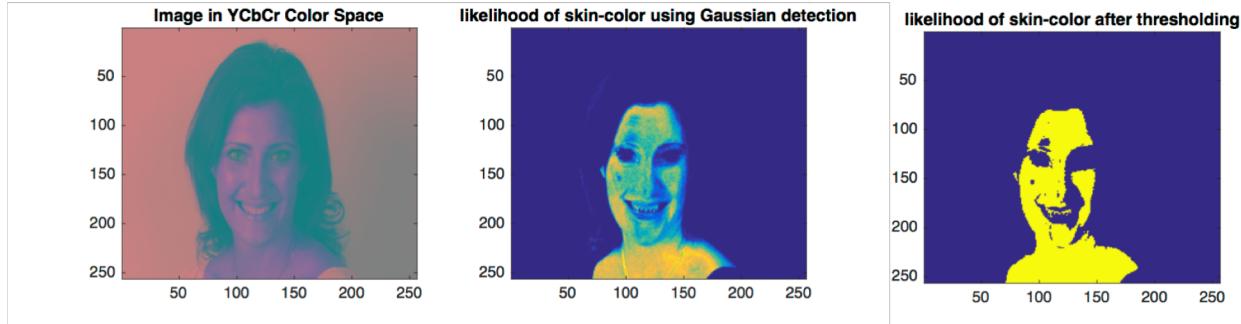
$$\Sigma = \begin{bmatrix} \sigma_{rr} & \sigma_{rg} \\ \sigma_{gr} & \sigma_{gg} \end{bmatrix}.$$

$$p(x; \mu, \Sigma) = \frac{1}{(2\pi)^{d/2} |\Sigma|^{1/2}} \exp(-\frac{1}{2} (x - \mu)^T \Sigma^{-1} (x - \mu))$$

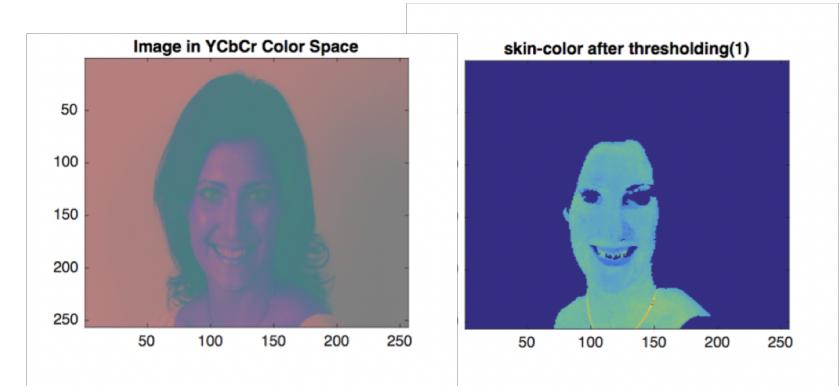
$$m = (156.5599, 117.4361)^T$$

$$C = \begin{bmatrix} 299.4574 & 12.1430 \\ 12.1430 & 160.1301 \end{bmatrix}$$

Maximum Likelihood Adaptation



vs



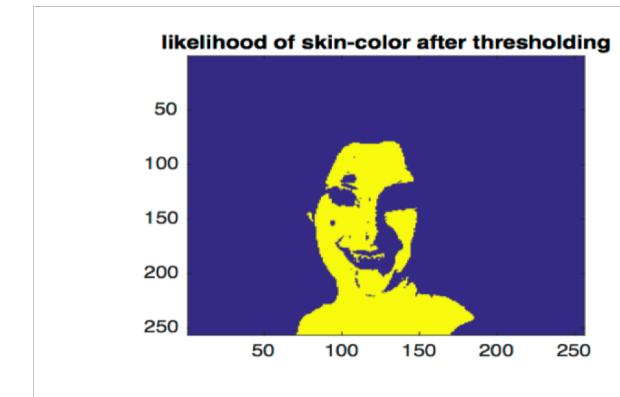
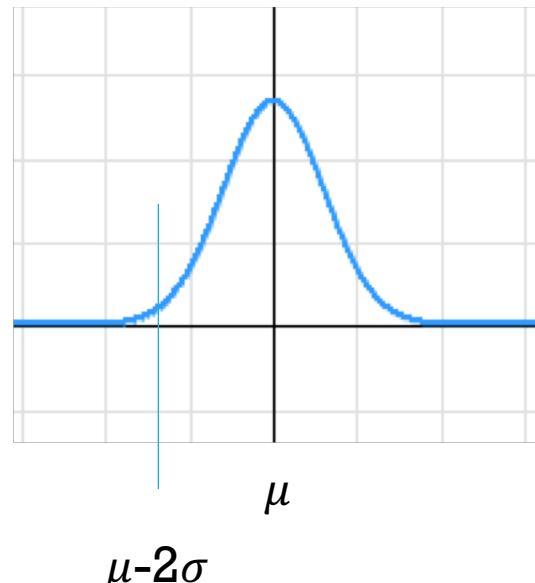
Applying thresholds on
Chromatic colors Cb, Cr

$$\begin{aligned} Cb &\in [100, 150] \\ Cr &\in [150, 200] \end{aligned}$$

Image Morphology

- Multivariate Gaussian Distribution (MGD)
with thresholds

probability density function: p

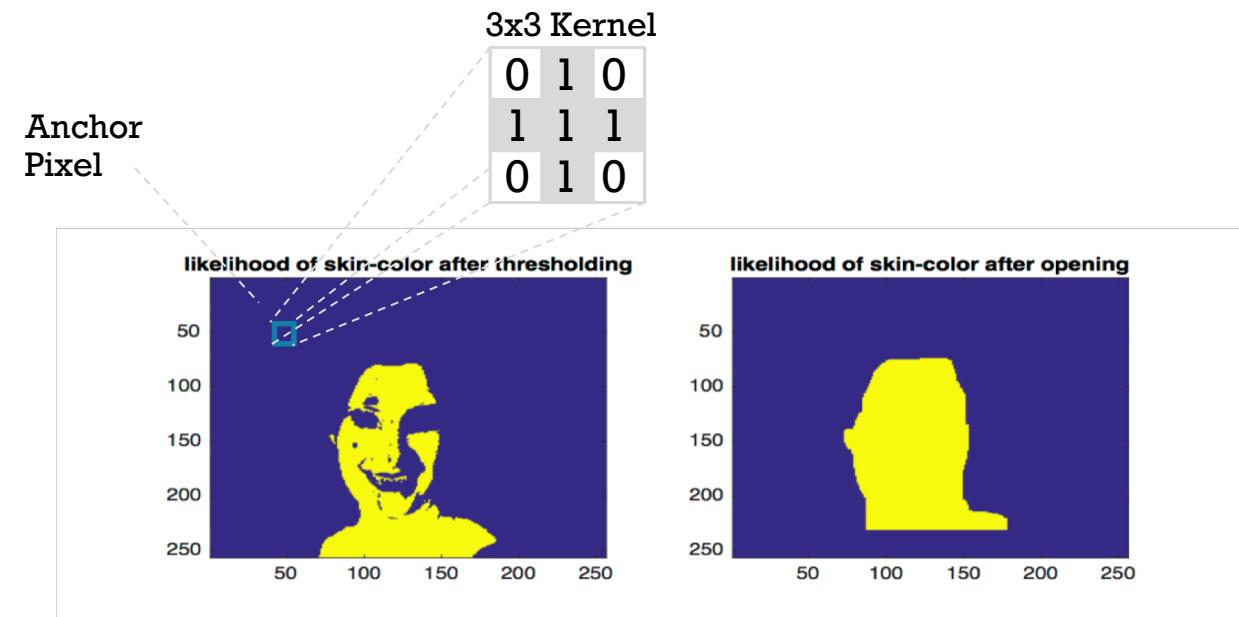
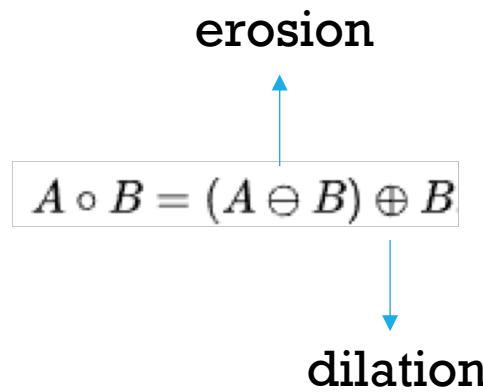


Yellow pixels indicates
the prediction of skin-color

Image Morphology

- the OPENING Method

OPENING
method:



Part2 - Improvements

- automatically detect feature area on faces, and set feature points properly
- set more control points, and it needs to be done automatically
- use more control points to get a more precise result

Conclusions - Results

- Detected and retrieved the facial part
- Created a rough 3D reconstructed human face
- No need to set eyes and mouth positions after optimizing our Gaussian detect algorithm

THANK YOU!

Thank You For Watching My
Presentation.

Q & A