Style Transfer for Headshot Portraits

Team Name: A3D
Mentor TA: Manasvi Vaidyula

Repo URL: [a3d-link]

Adhiraj Deshmukh - 2021121012 - CSD
Aparna Agarwal - 2021121007 - CSD
Anjali Singh - 2020102004 - ECE
Deepthi Chandak - 2020102013 - ECE

Index

- ❑ Objective
- ❑ Motivation
- ❑ Understanding of the Paper
- ❑ Approach
- ❑ Outputs
- ❑ Limitations/Failures
- ❑ Conclusion
- ❑ Dataset
- ❑ Contributions

Objective

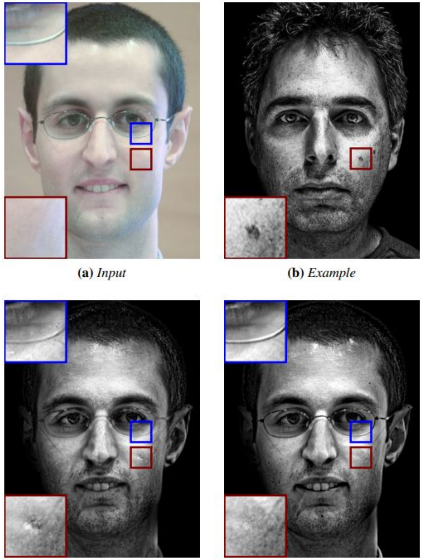
The main objective of our project is to transfer the visual style of the example portrait made by an artist onto another image, which basically means to match the appearance of the input subject to the example.

Motivation

The editing process to create different renditions of headshot photos to achieve a compelling style requires advanced skills because features such as the eyes, the eyebrows, the skin, the mouth and the hair, all require specific treatments.

The tolerance for errors is low, and one bad adjustment can quickly turn a great headshot into an uncanny image. Many compelling looks require maintaining a visually pleasing appearance while applying extreme adjustments.

Understanding of the Paper



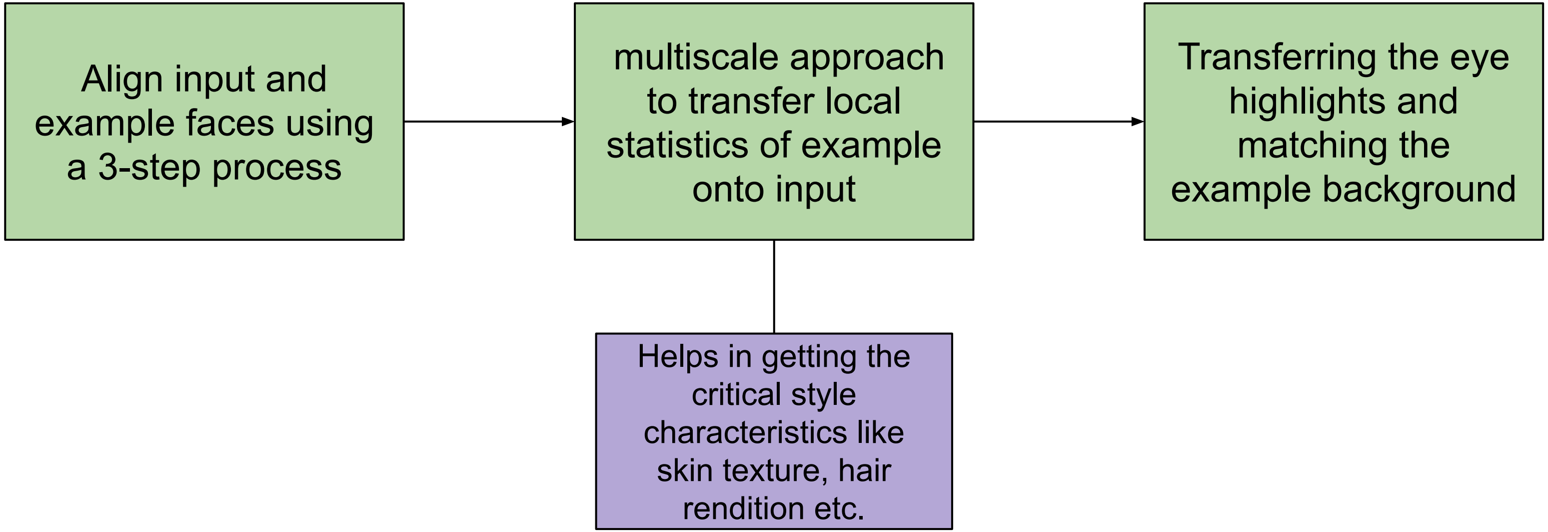
(a) *Input* (b) *Example* (c) *Without robust transfer* (d) *Our robust transfer*

The paper uses a multiscale technique to robustly transfer the local statistics of an example portrait onto a new one. This technique matches properties such as the local contrast and the overall lighting direction while being tolerant to the unavoidable differences between the faces of two different people.

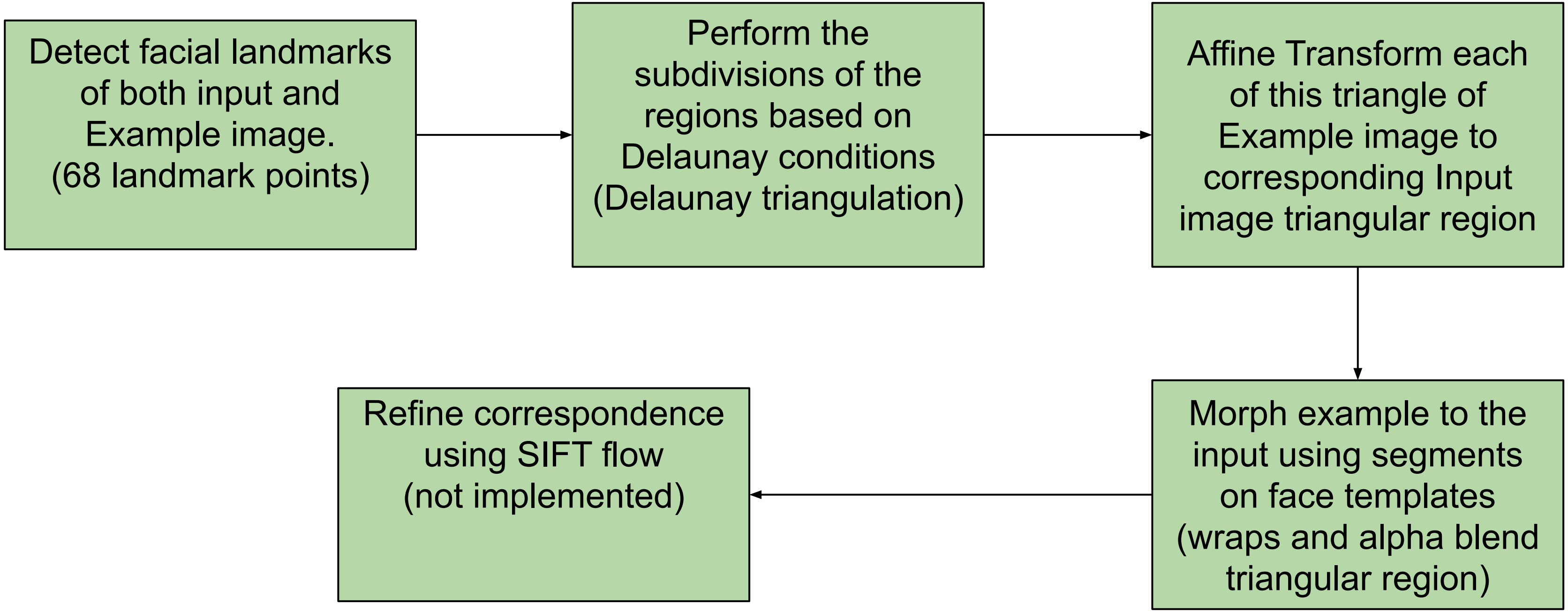
All the facial features are treated differently on the basis of characteristics like lighting etc., this challenge is overcome by an approach specific to faces.

Our Notes
:https://github.com/Digital-Image-Processing-IIITH/dip-m22-project-a3d/blob/main/docs/Paper_Notes.pdf

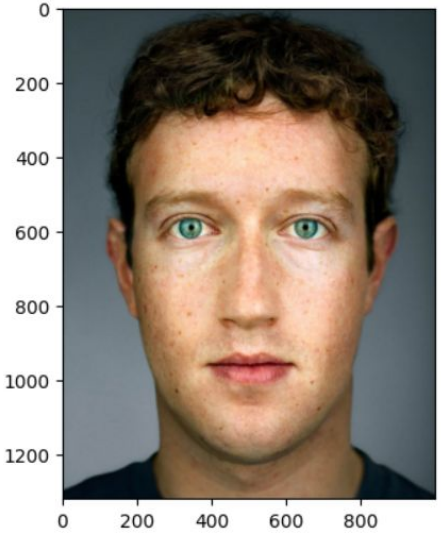
Approach


Align input and example faces using a 3-step process
multiscale approach to transfer local statistics of example onto input
Transferring the eye highlights and matching the example background
Helps in getting the critical style characteristics like skin texture, hair rendition etc.

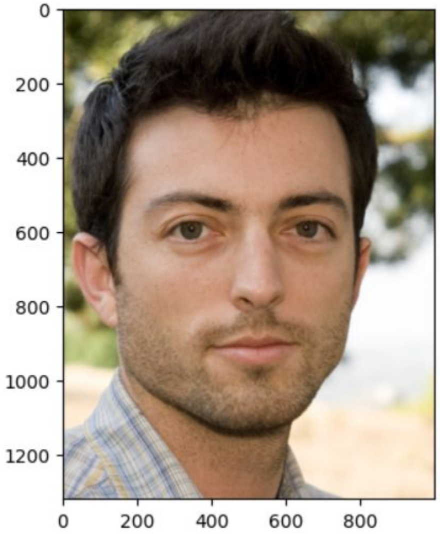
Dense Correspondence Approach

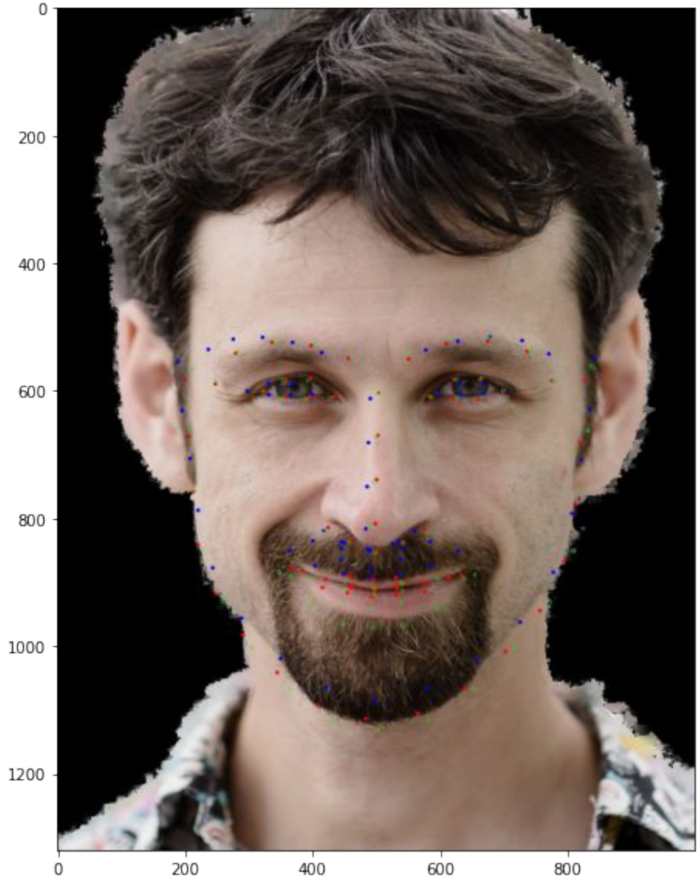


Example Image



Input Image



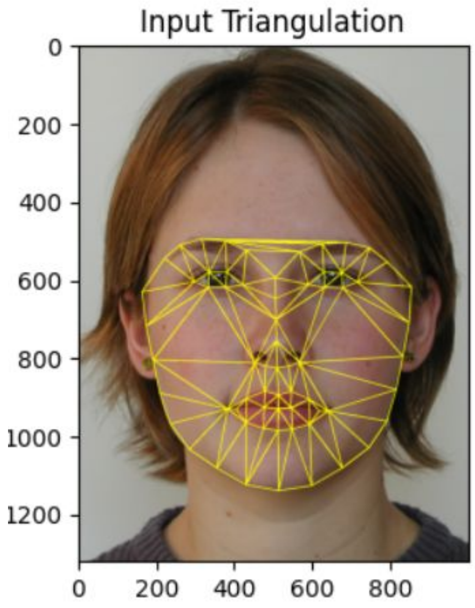


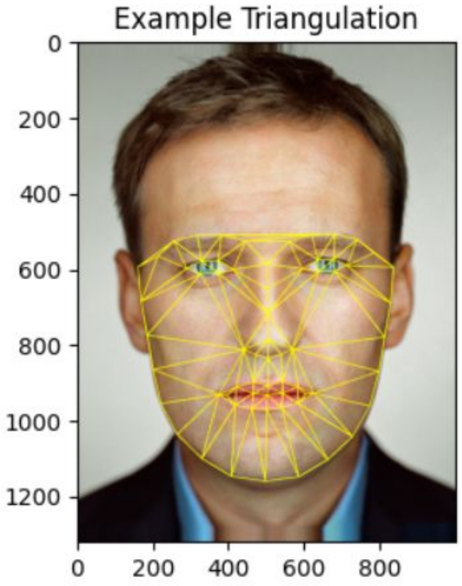
Comparison of 3 different techniques of landmark detection

Blue landmarks -> dataset landmarks
Green landmarks -> OpenCV
Red landmarks -> Dilib

Triangulation Outputs

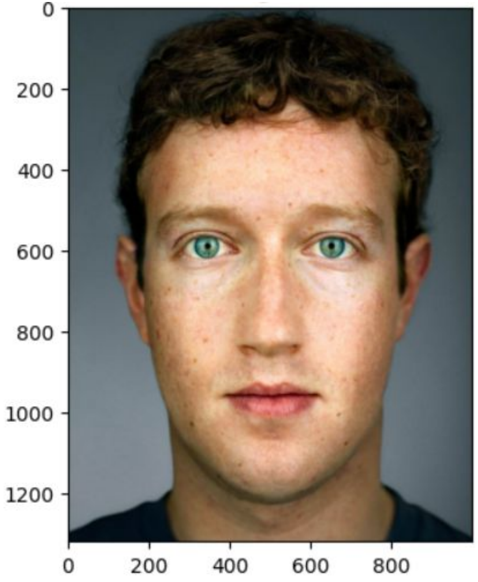
Below are the Delaunay triangulation outputs we got



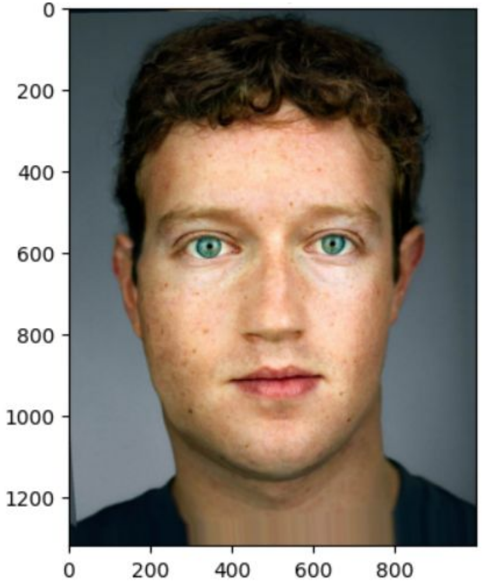


Warped Outputs

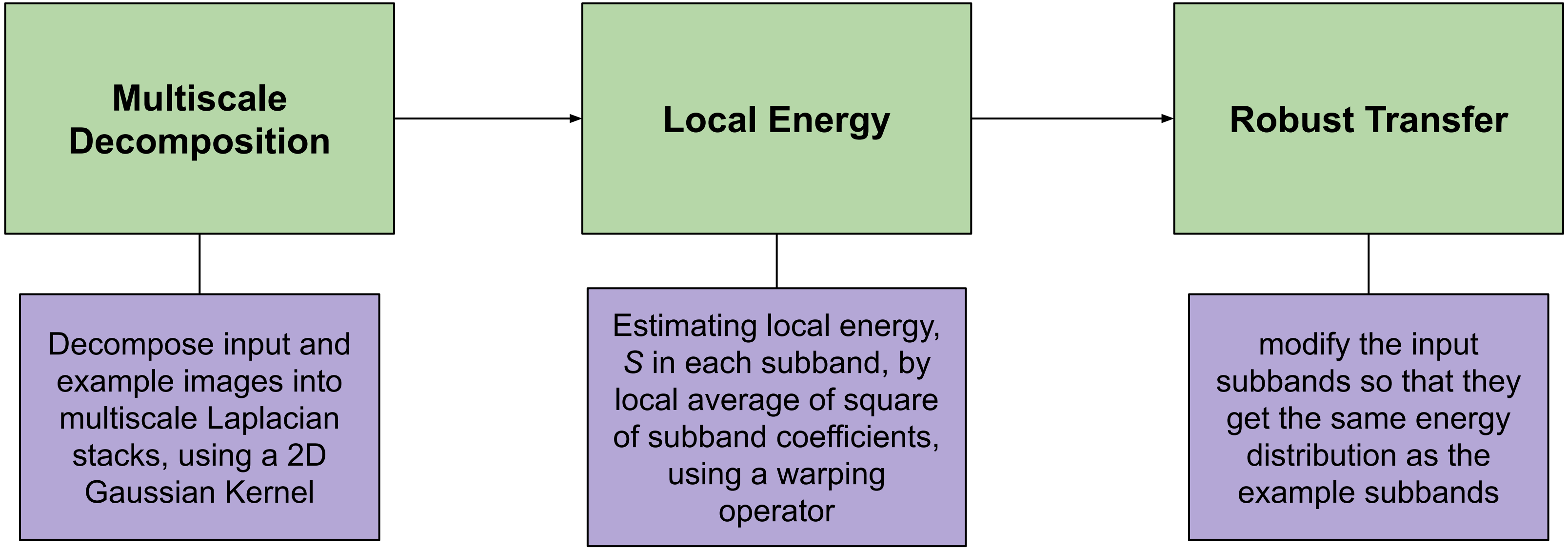
Original



Warped

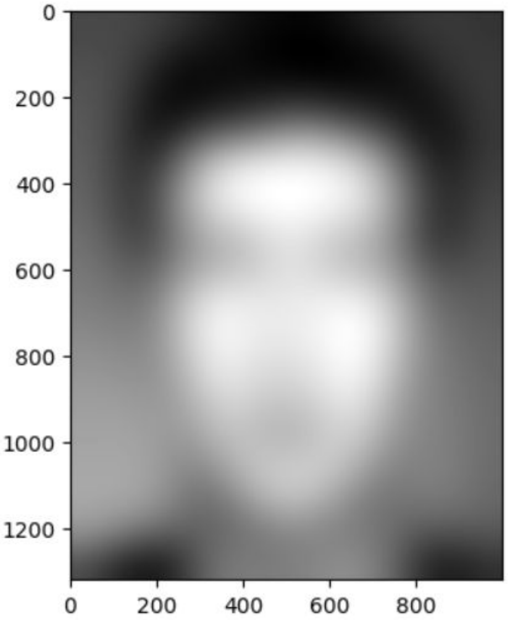


Multiscale Approach

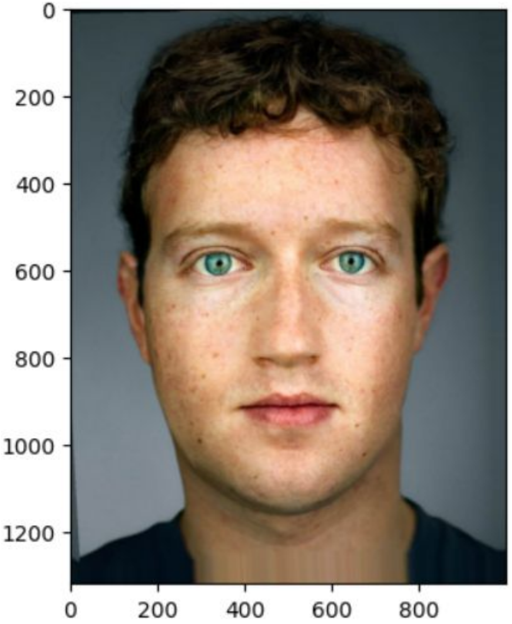


Residual Image Output

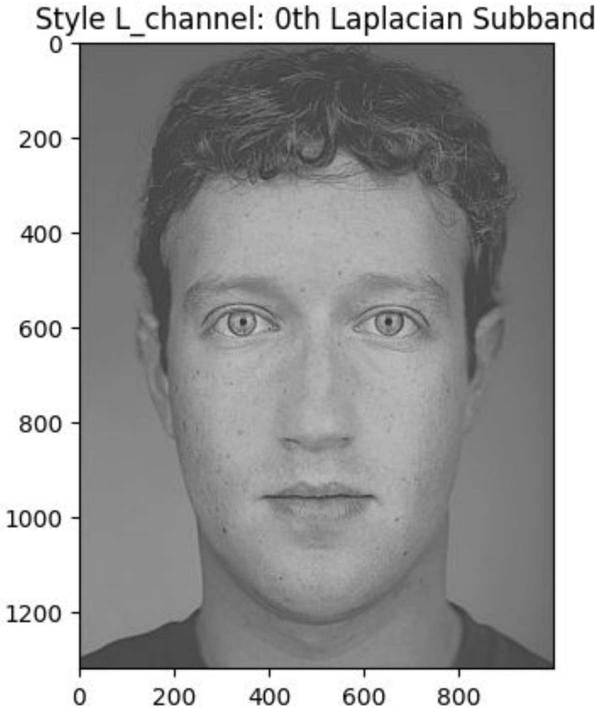
$$R[I] = I \otimes G(2^n)$$ with n levels

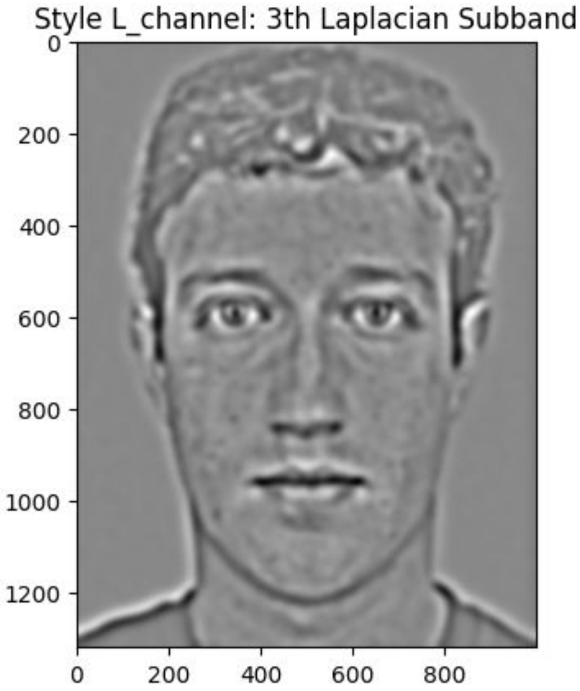


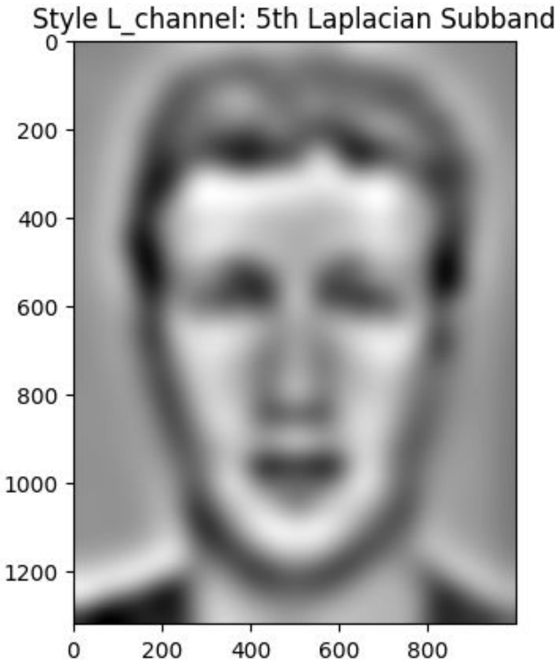
Warped Image Output



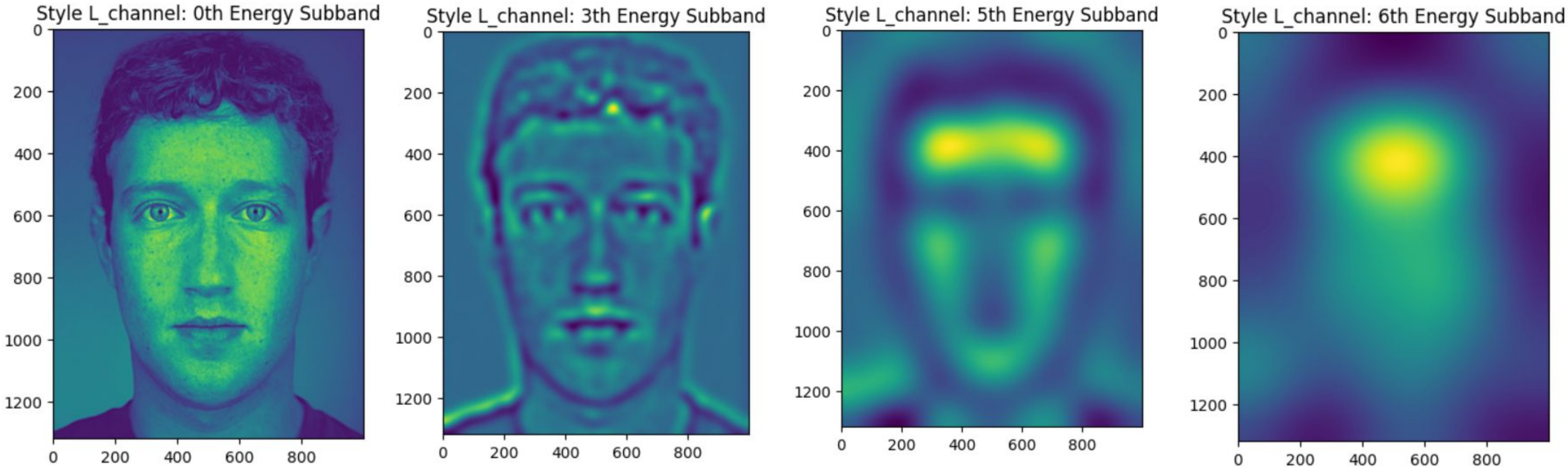
Multiscale Laplacian Stacks







Local Energy Subbands



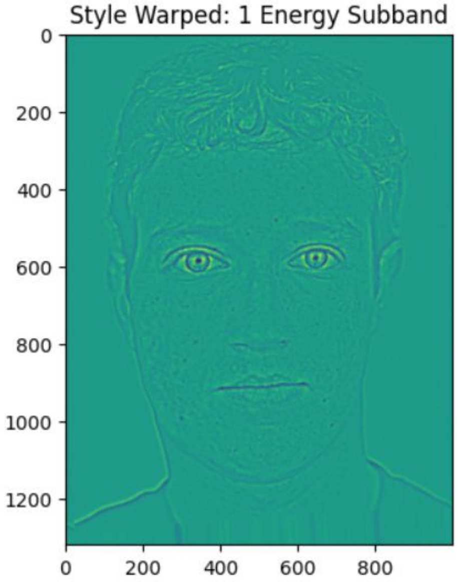
Energy Maps

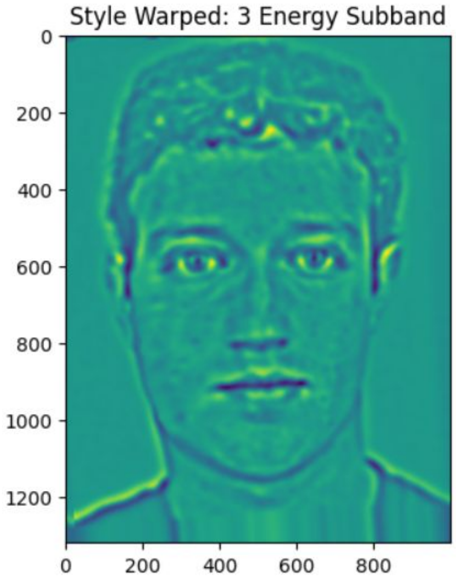
$$S_\ell[I] = L_\ell^2[I] \otimes G(2^{\ell+1})$$

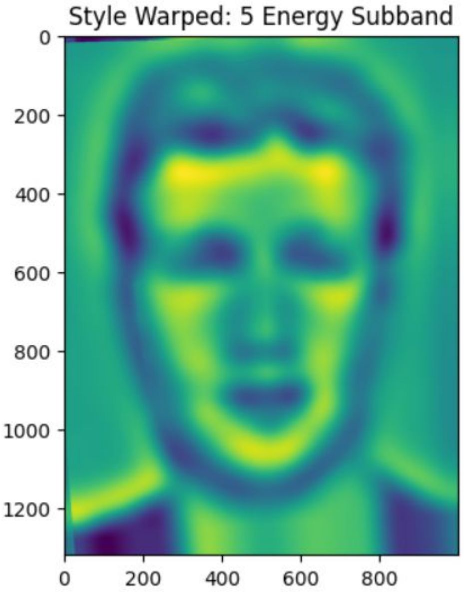
$$\tilde{S}_\ell[E] = W(S_\ell[E])$$

Computing local energy for both images using the given equation, which allows to capture the frequency profiles in the images. These energy maps get the strengths in lighting and color

Warped Style Local Energy Subband



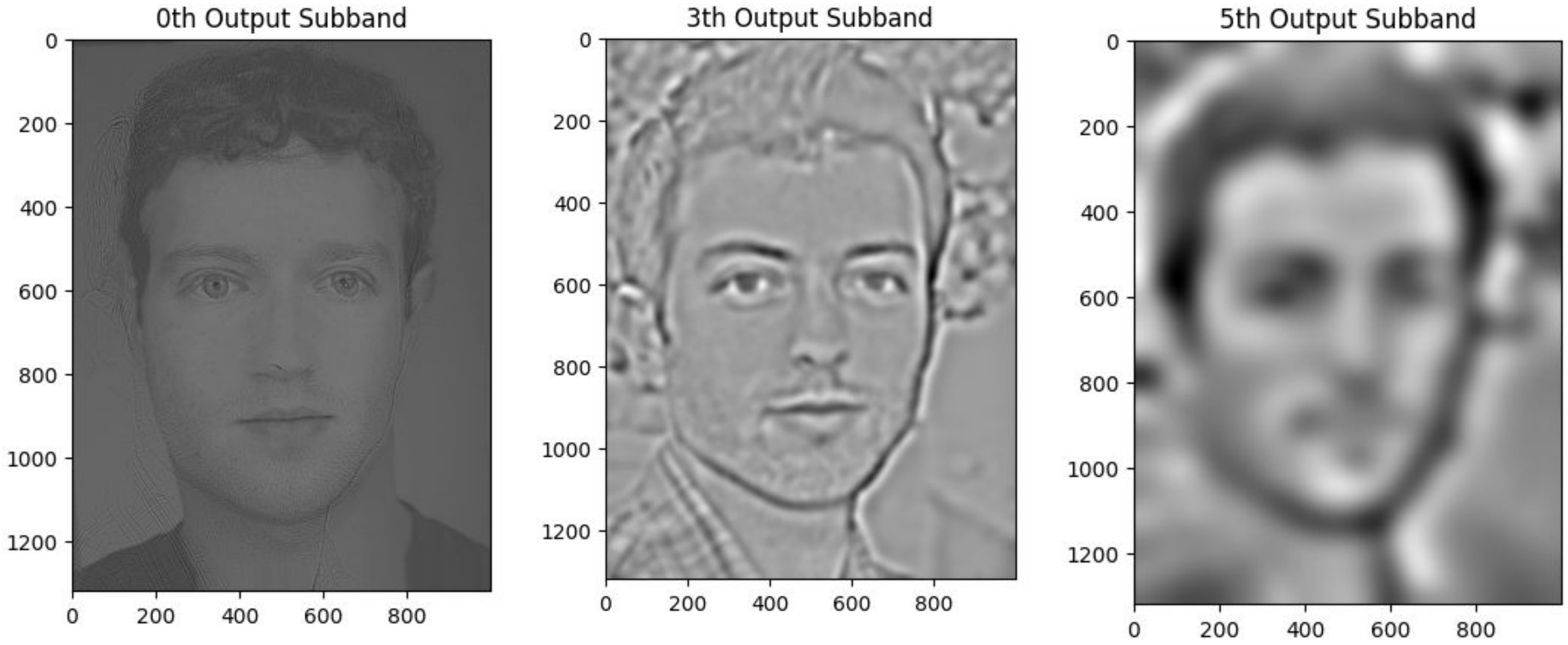




$\tilde{S}_\ell[E] = W(S_\ell[E])$ → Warping operator

$R[O] = W(R[E])$ → It gives Warped example residual

Robust Transfer

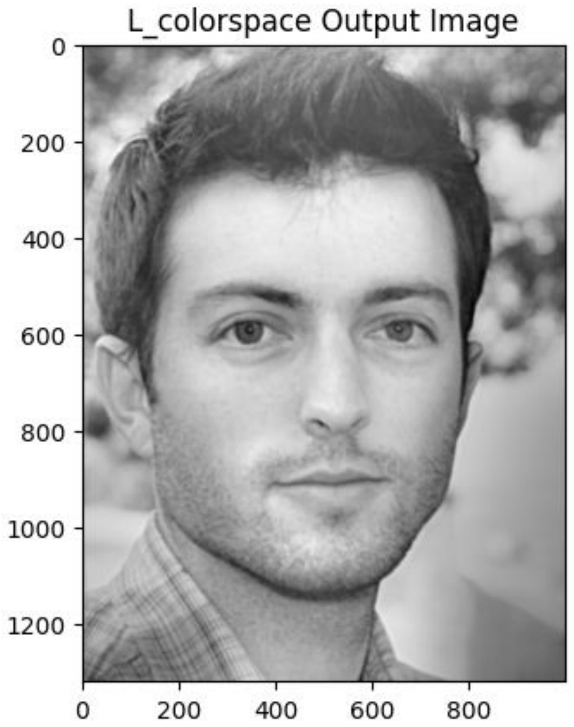


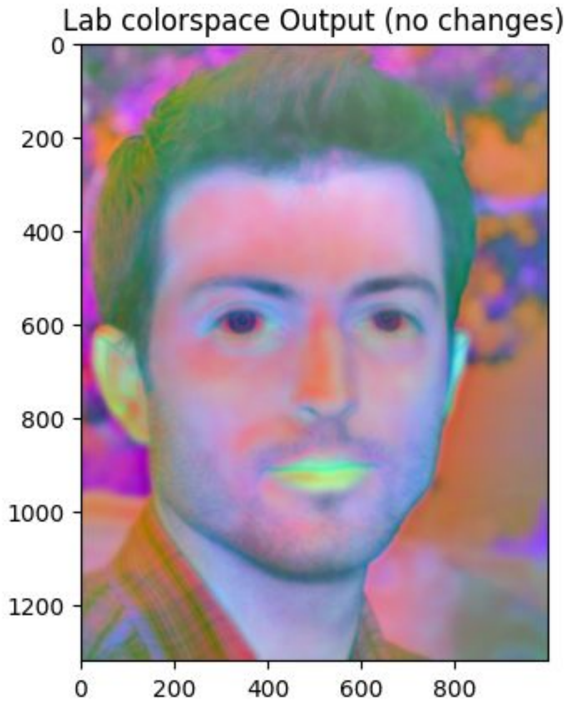
$$L_\ell[O] = L_\ell[I] \times \text{Gain}$$

$$\text{with Gain} = \sqrt{\frac{\tilde{S}_\ell[E]}{S_\ell[I] + \epsilon}}$$

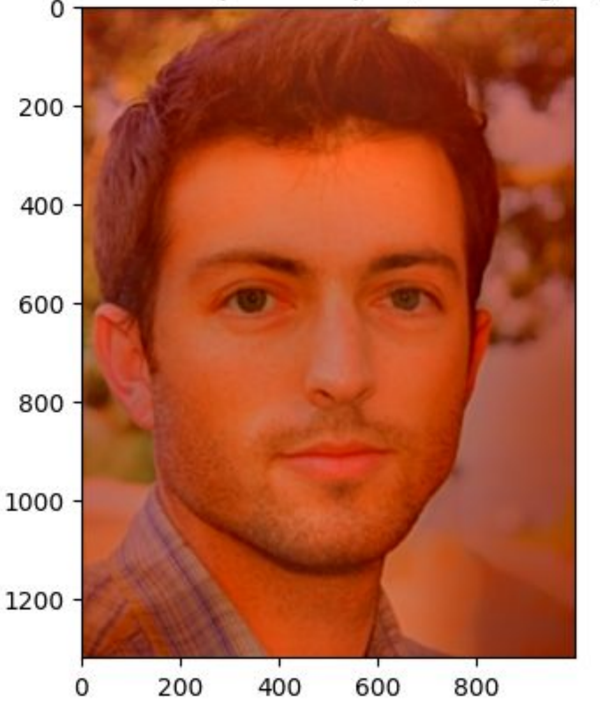
we modify the input subbands so that they get the same energy distribution as the example subband

Aggregate Outputs

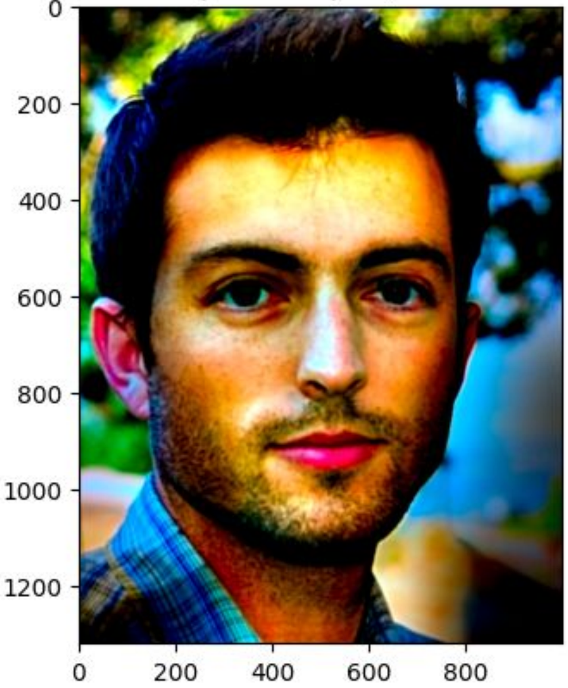


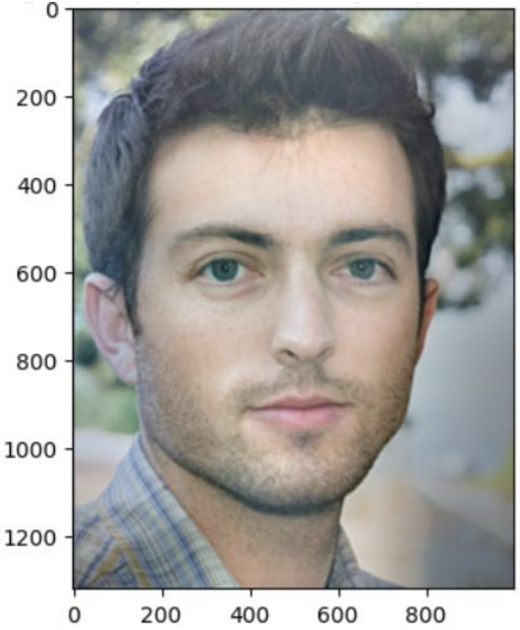


RGB Colorspace Output (no changes)



RGB Colorspace Output (shifted colors)

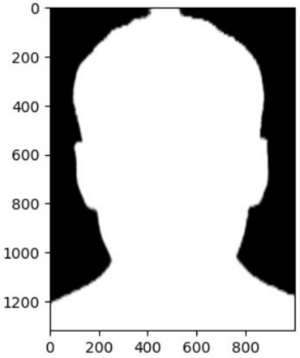




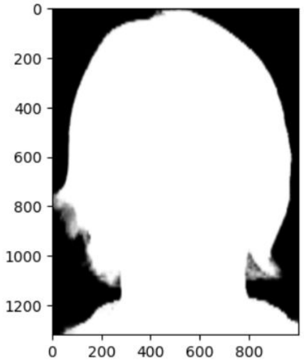
Output when algorithm is performed strictly on just RGB colorspace instead of LAB

Post Processing

Example Image

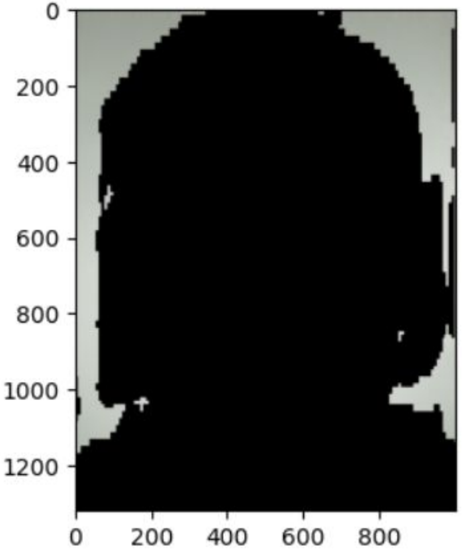


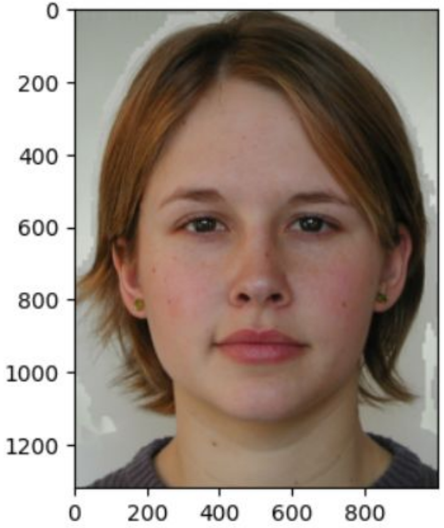
Input Image



Background - Replacing input background with example background

Get masks → get background → replace background → get imperfection
mask → image implanting

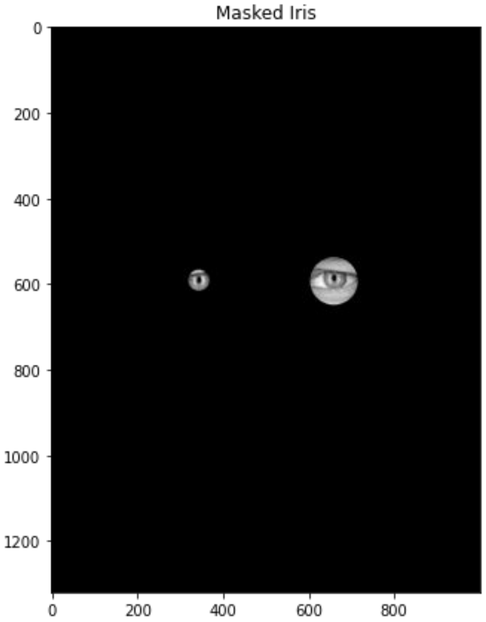




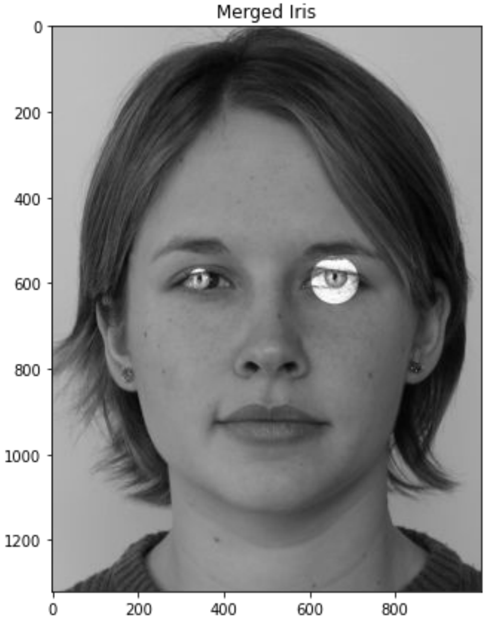
Post Processing

Eye Highlights (couldn't implement it fully) **-** Separating the specular reflection from the example eyeball and copy that onto input's eyes. This involved: -

iris location using circular arc detection → running a k-means algorithm for segmentation of iris, pupil and highlights → refining the reflection mask using alpha matting.

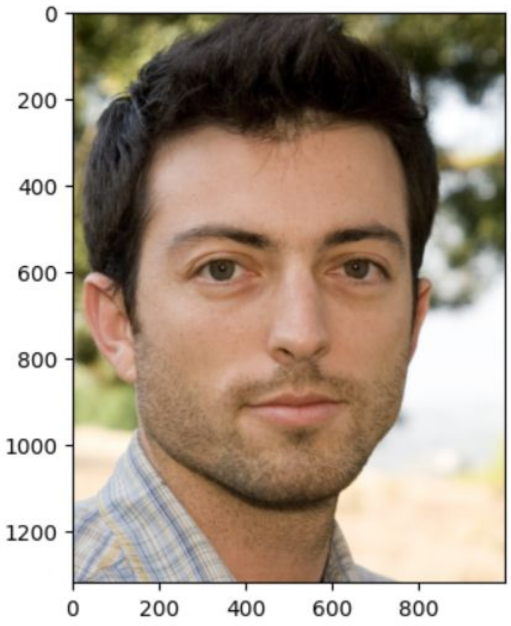


This is what we were able to achieve

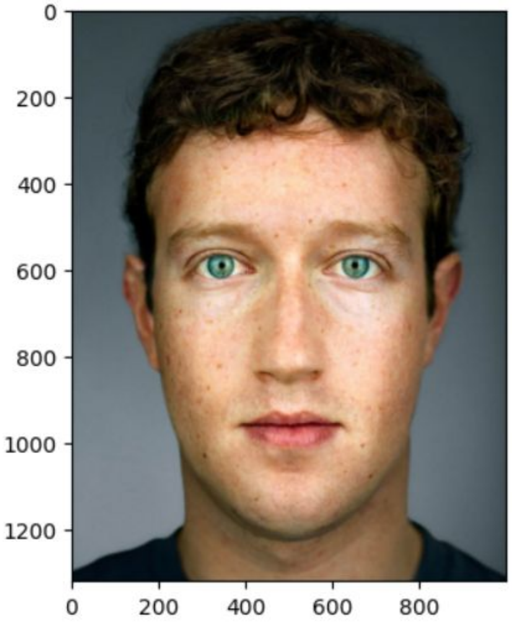


Final

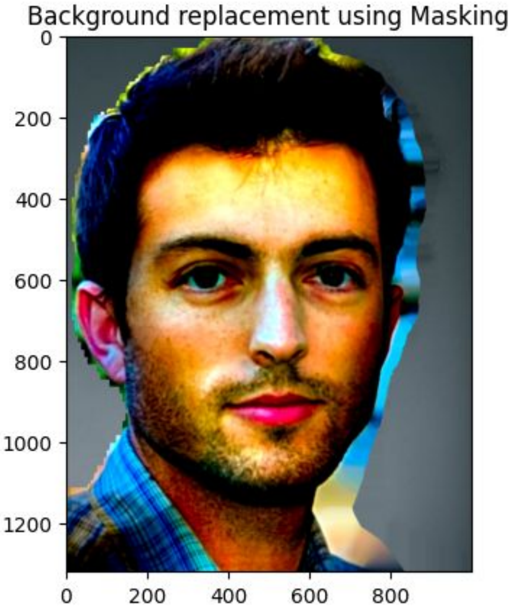
Input



Example

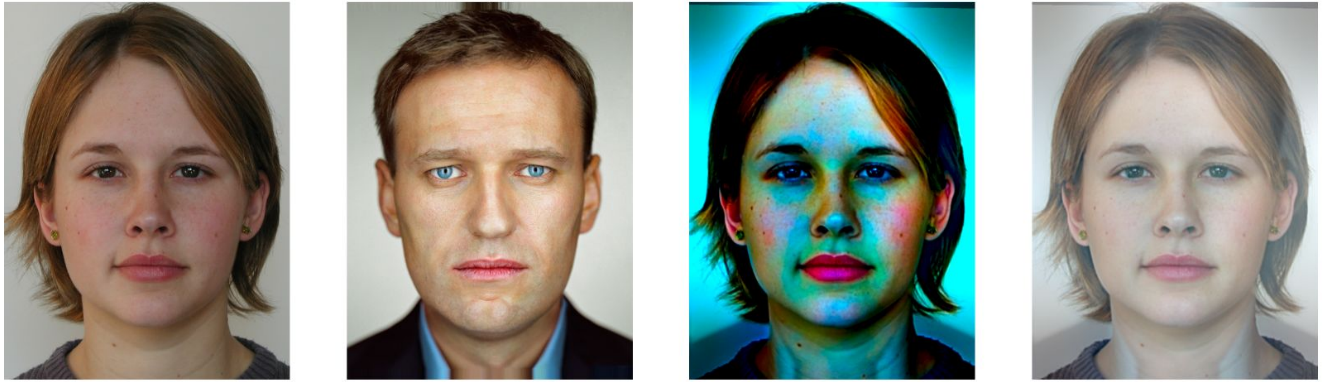


Output



Style Transfer

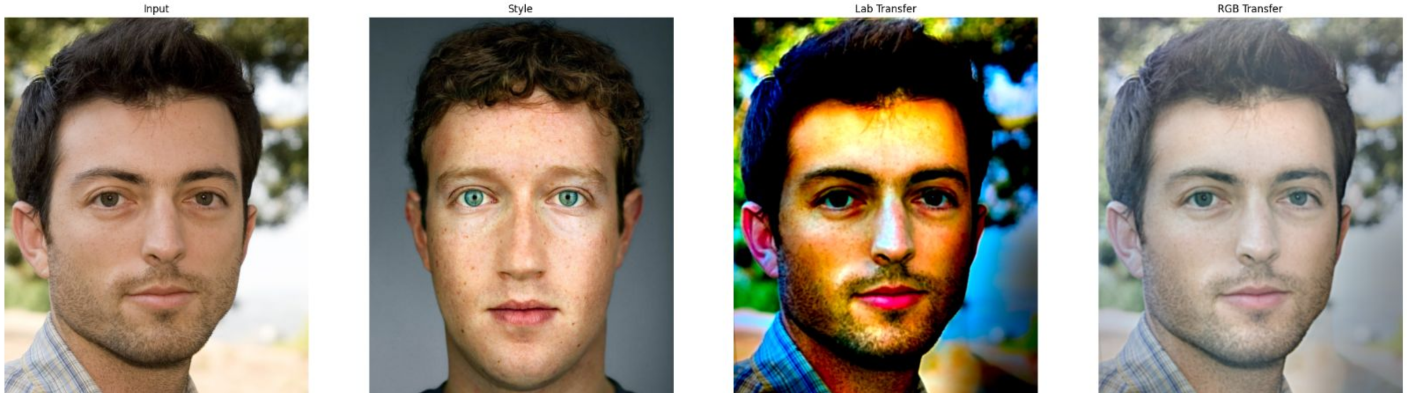
Input | Style | Lab Transfer | RGB Transfer



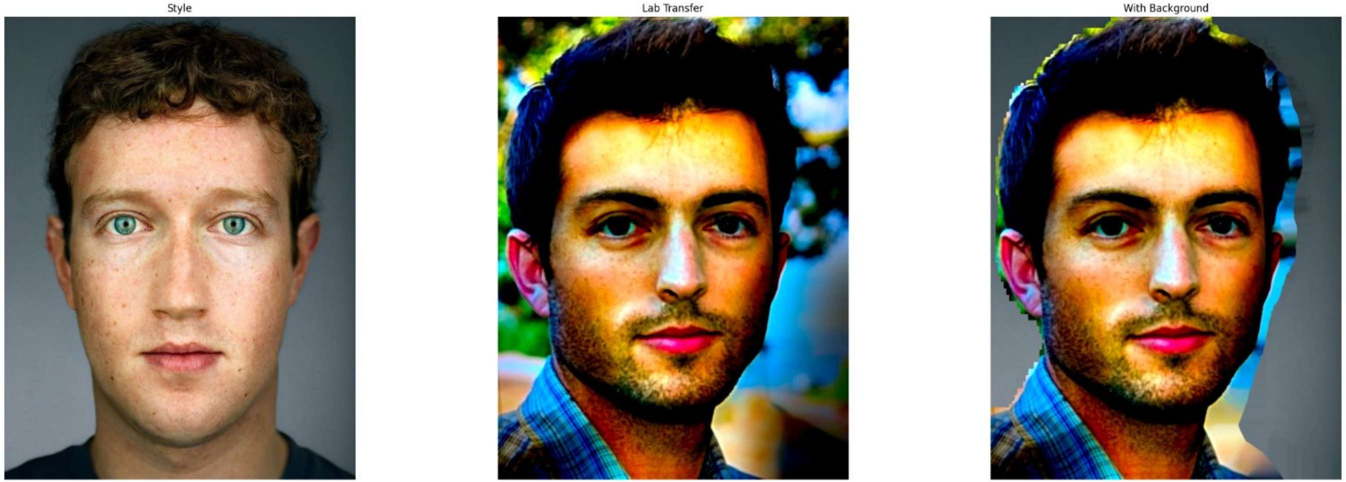
Adding Background Mask

Style | Lab Transfer | With Background

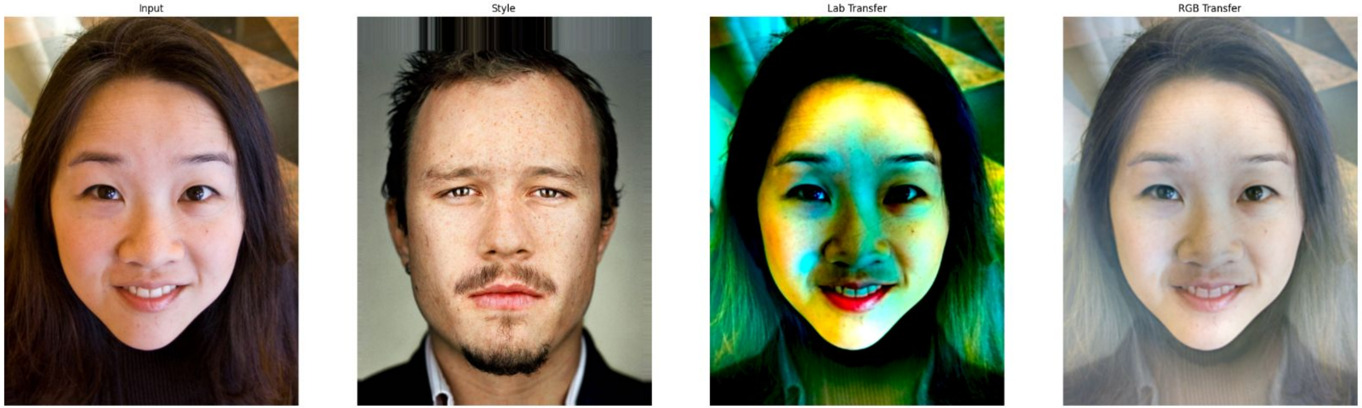
Style Transfer



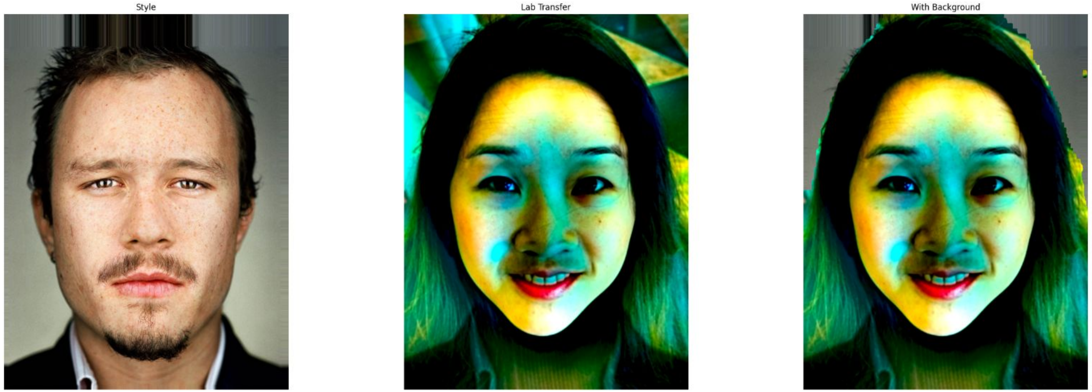
Adding Background Mask

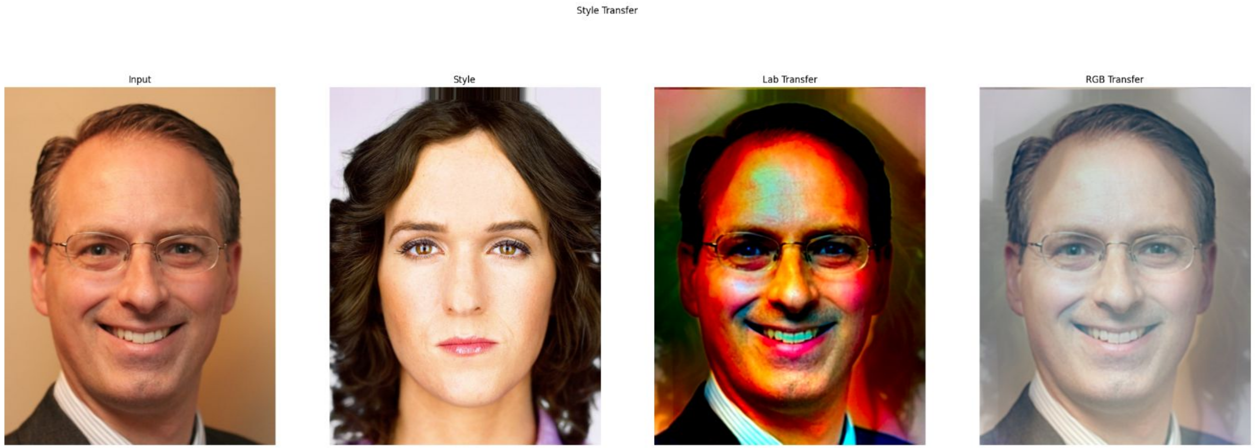


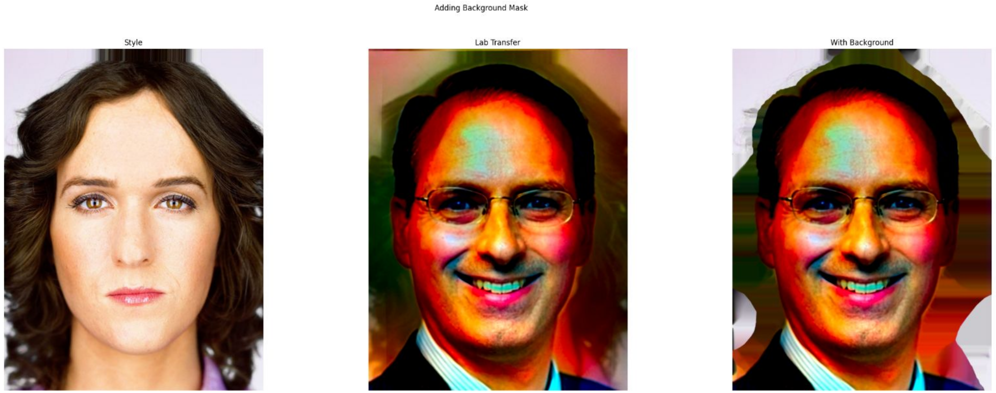
Style Transfer



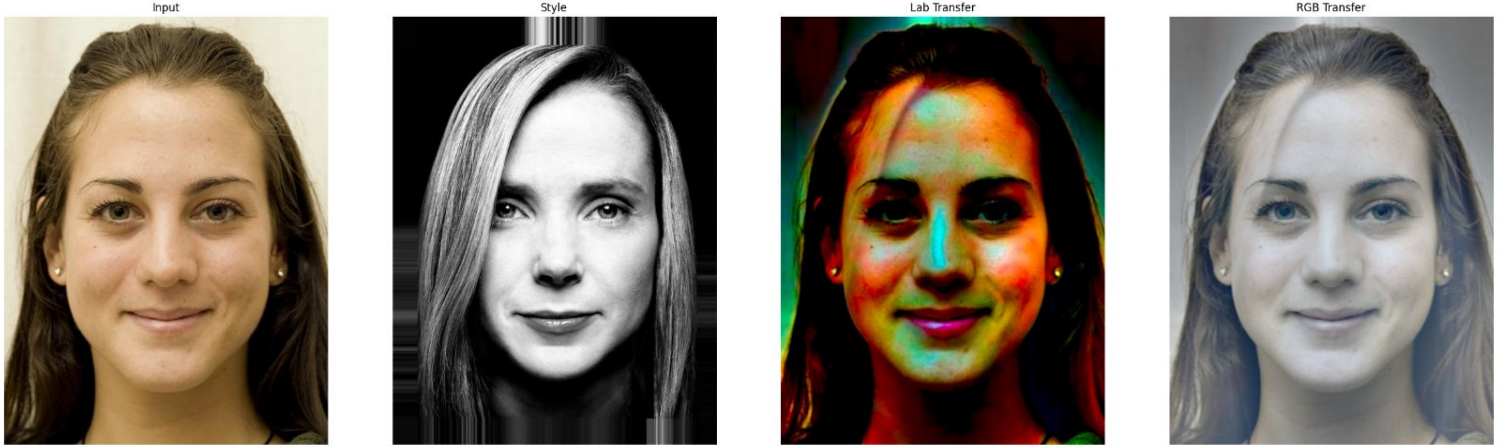
Adding Background Mask



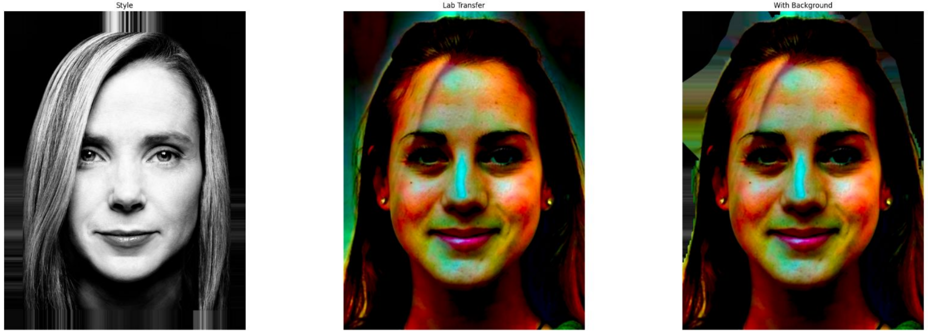

Style Transfer
Input
Style
Lab Transfer
RGB Transfer


Adding Background Mask
Style
Lab Transfer
With Background

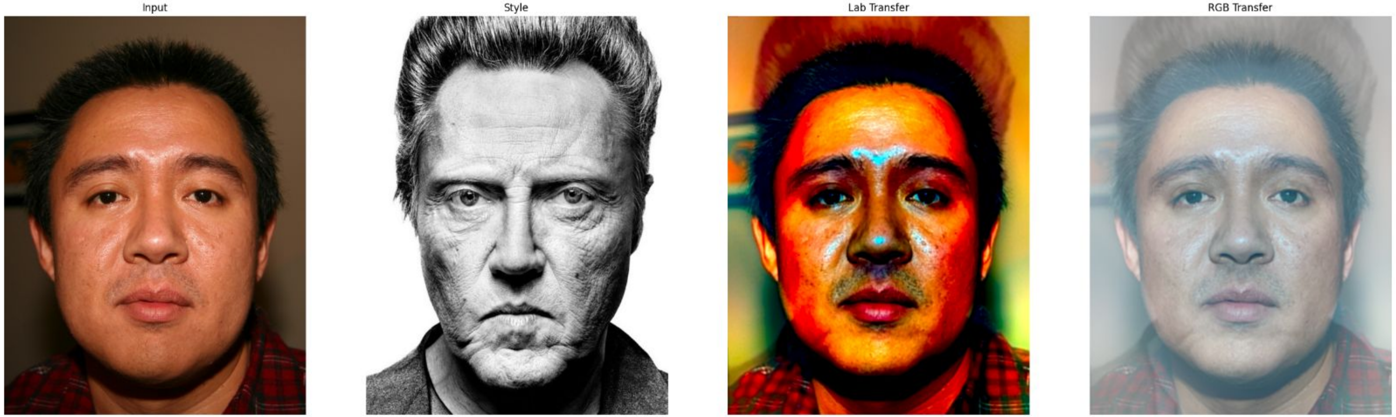
Style Transfer



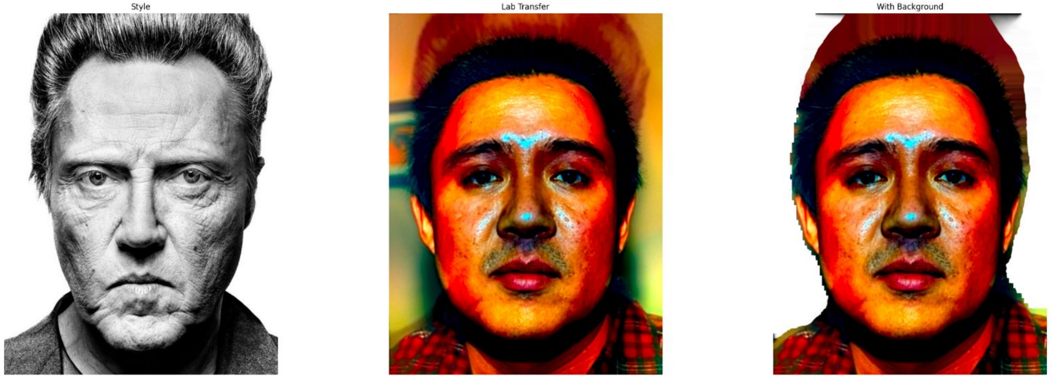
Adding Background Mask



Style Transfer



Adding Background Mask



Limitations

- Results of style transfer are affected since conversion from LAB to RGB colorspace is not done properly, but using the algorithm in RGB colorspace strictly gives us surprisingly good results
- Not able to get the complete background transfer from example to input when there is low contrast.
- Not able to eliminate hair features from style images properly
- Doesn’t work properly when huge difference in skin colors
- Low lighting doesn’t low style features to get eliminated easily

Contributions

Adhiraj Deshmukh - Paper readings, dense correspondence, energy maps (multiscale transfer), combining all outputs

Aparna Agarwal - Paper readings, laplacian stacks; energy maps (multiscale transfer), background (post processing)

Anjali Singh - Paper Readings, multiscale decomposition (multiscale transfer), background; Eye highlights (Post processing), ppt work

Deepthi Chandak - Paper readings, eye highlights, ppt work

Dataset

Link to the dataset: click here to download

Thank You :)