<u>Digital Image Analysis COL783</u>
<u>Assignment 2</u>

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Part I: Image Morphing

Implement image morphing using triangle method as discussed in the class. The featuere correspndendence can be done using off-the-shelf code or manually. You may use Delaunay triangulation to generate the triangle mesh of the featuer points.

- ➔ We take two facial images (Source and Target) to perform morphing using mapping of correspondence feature points and interpolate them to a complete wrapping the task.

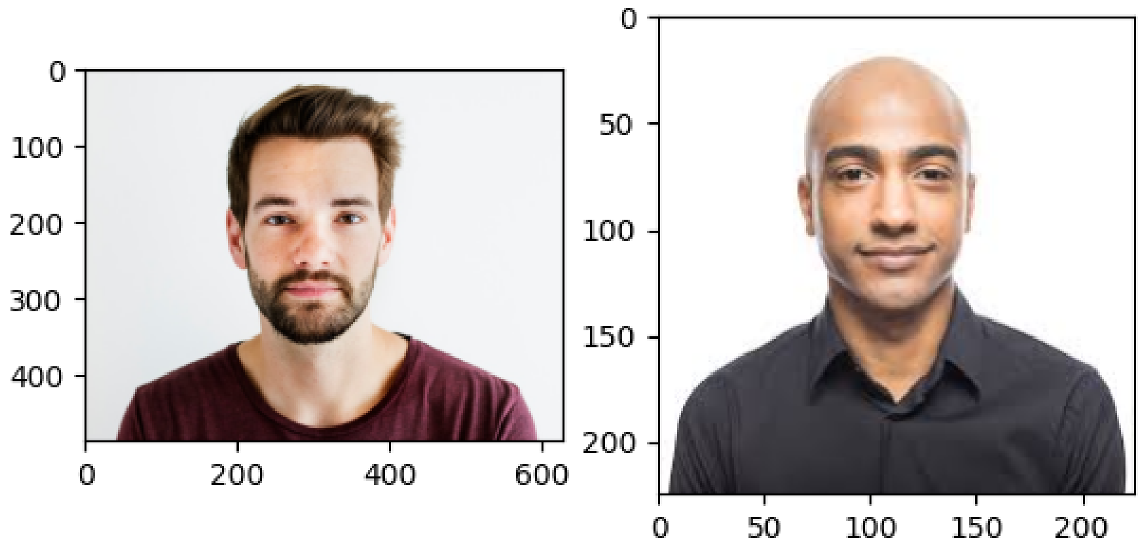


Fig.1: Two photographs selected for morphing

- ➔ To map the corresponding feature, we make both images same size. Here (200x200) as shown below.

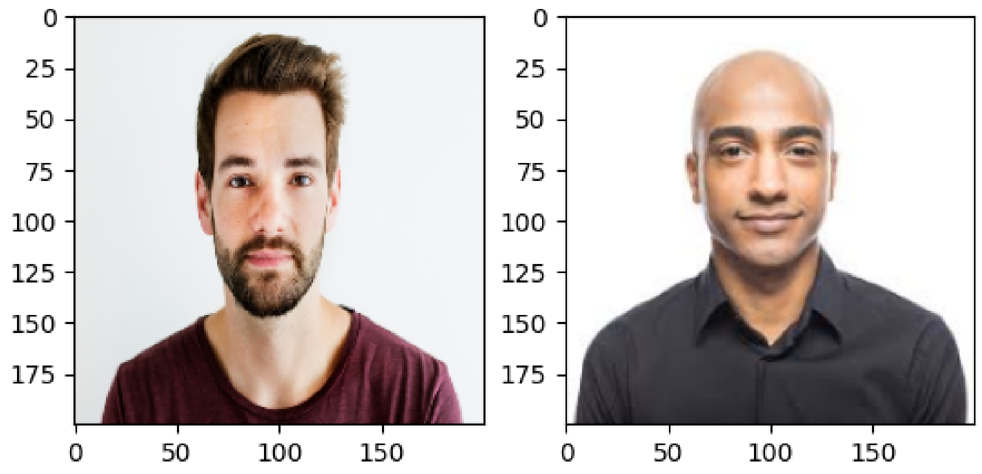


Fig.2: Make the size same of both photographs

➔ Now we need to extract the feature points in both the images. For this we have used dlib library for feature correspondence which gives us 68 different features points in both images. The feature points are marked for both images as show below.

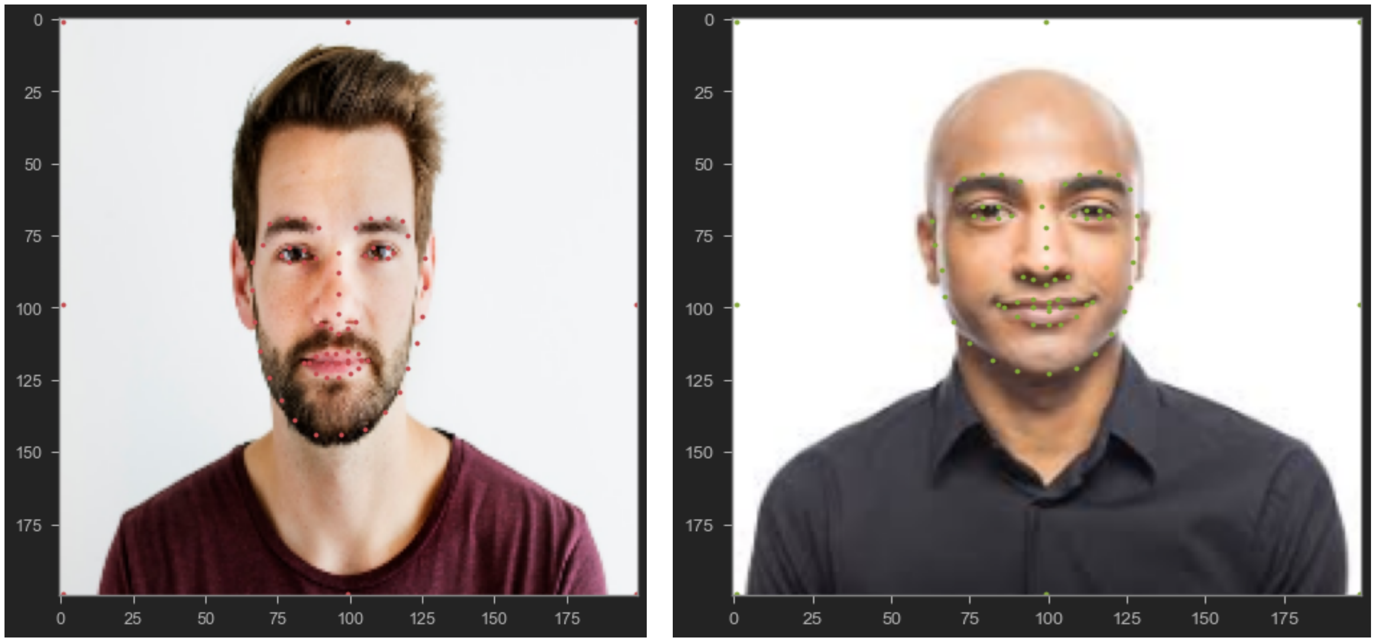


Fig.3: Generation of feature marks

➔ Now we make delaunay triangle for each set of corresponding feature points which we used for localise affine transform process. Delaunay triangulation is done using the image processing library, OpenCV and obtained Delaunay triangles for the marked feature points, as show below.

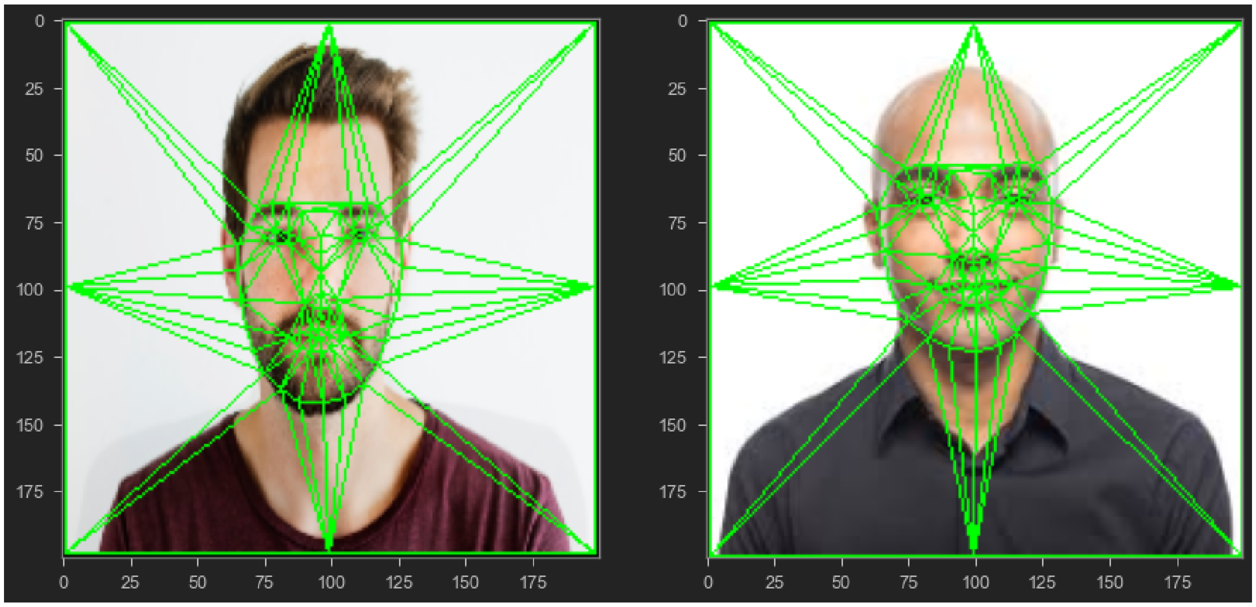


Fig 4 : Dealuanay Trianagle representation for both images

➔ Mapping the Delaunay tringles to perform affine transform(warping). Both the warped images cross-dissolved. Finally, the result of dissolving came up with a morphed image as shown below.

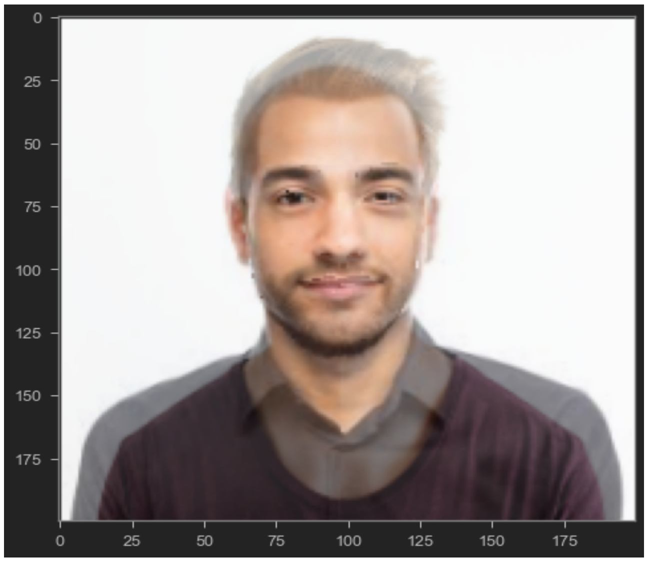
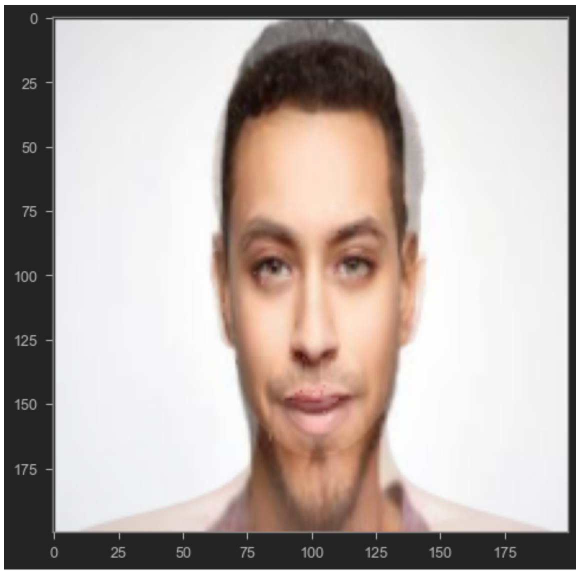


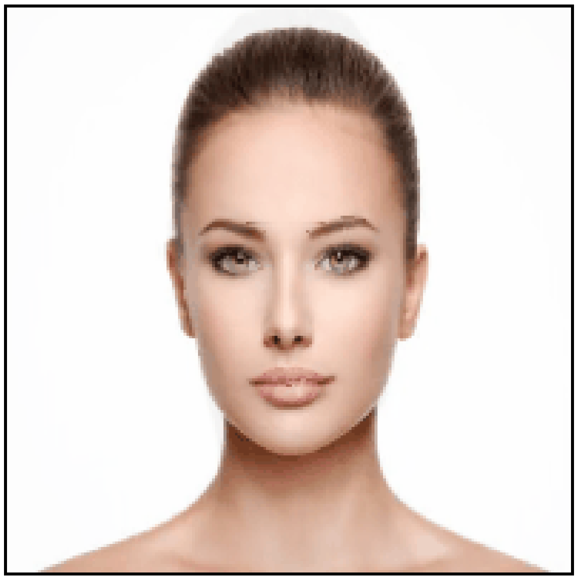
Fig.5: Morphed intermediate image

Gif.1: Fluid transformation from one image to another(Morphing)

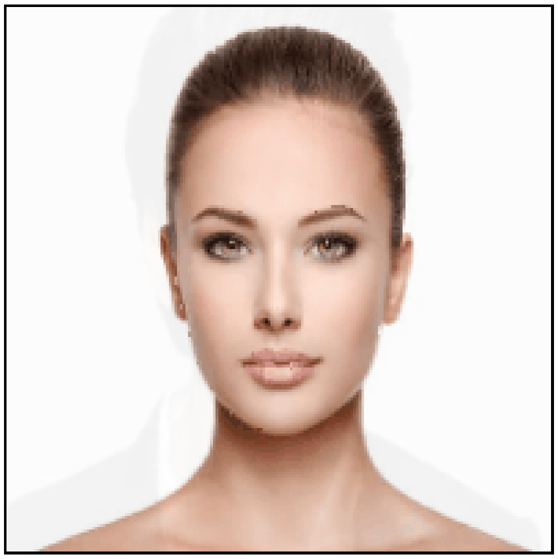
➔ **Other examples:**



Morphed Image



Transformation from one image to another(Morphing)



Morphed Image

Transformation from one image to another(Morphing)

Part II: Image Pyramid

Implement image pyramid (Gaussian and Laplacian) as discussed in the class. Demonstrate its applications a) in the context of image morphing b) in the context of image blending. The two papers (paper 1 and paper 2) for the references are available. Paper 1 provides general understanding of image pyramid and shows its different applications. Paper 2 elaborates on the image blending for stiching two images.

- **In the context of image blending**

➔ The task is to add two images (image1 and image 2). If we directly add first half of the left image and the second half of right image then we will get clearly visible boundary between them. Frist made the same size of both images

Fig.6: Two photographs selected for morphing using Image pyramid

➔ Gaussian pyramid of first image generated (blurring the image then subsampling then again upsampling)

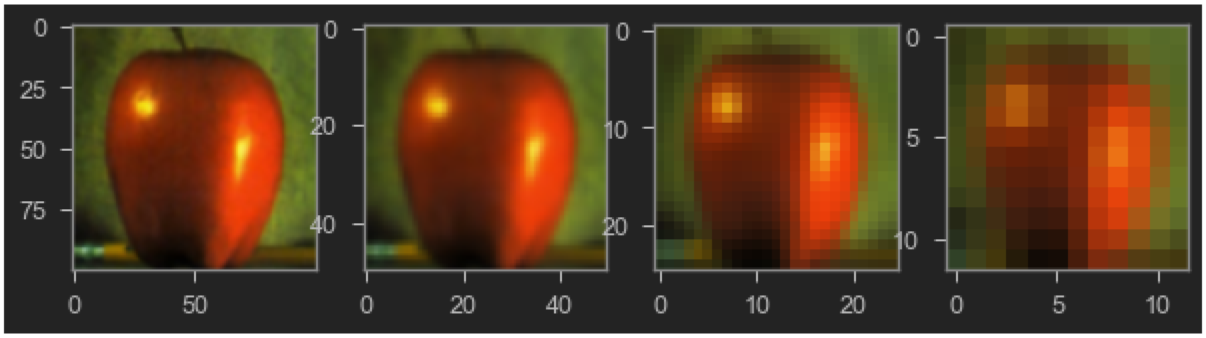


Fig.7:Gaussian pyramid of image 1

➔ Laplacian pyramid of the first image generated by taking the difference of the original image and upsampled gaussian image.

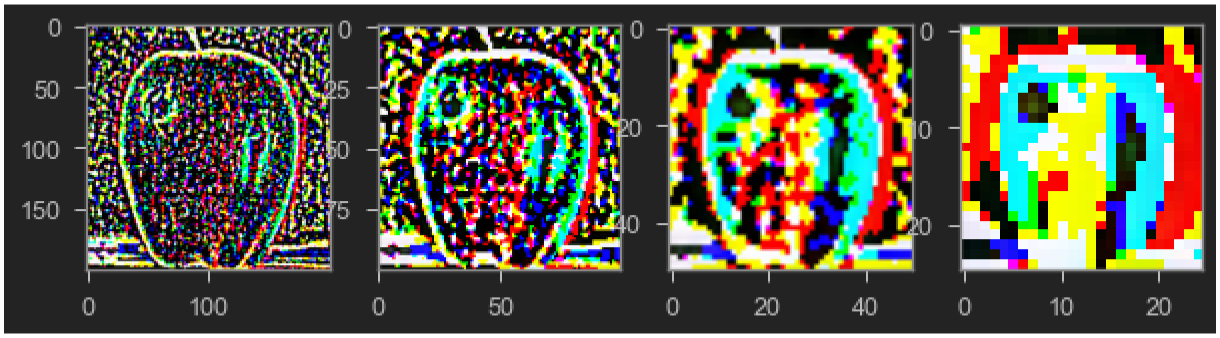


Fig.8: Laplacian pyramid of image 1

➔ The Gaussian pyramid of the second image generated

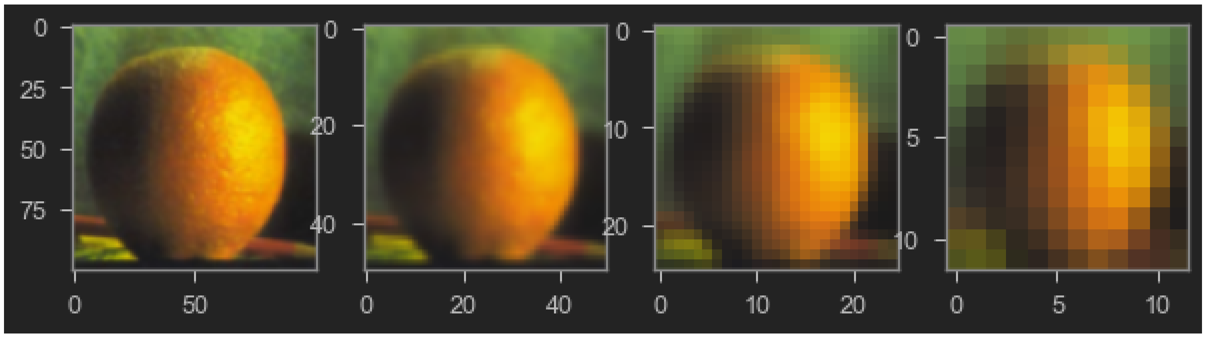


Fig.9: Gaussian pyramid of image 2

➔ The Laplacian pyramid of the second image generated

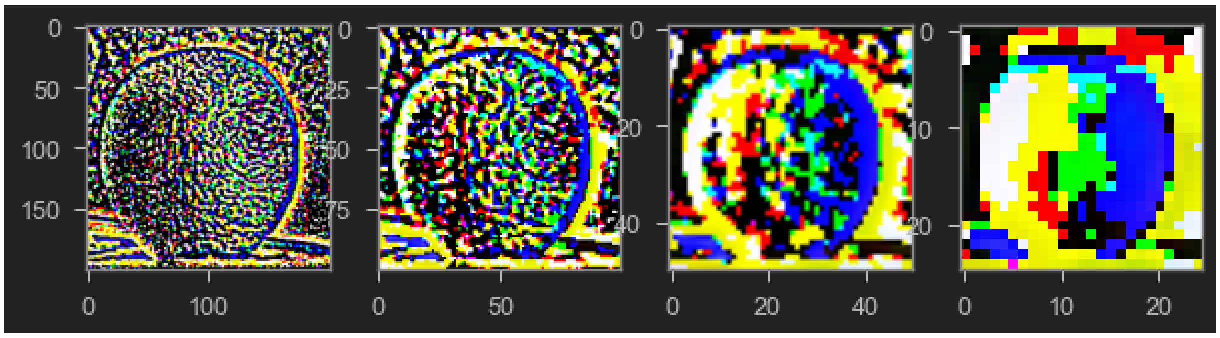


Fig.10: Laplacian pyramid of image 2

➔ Further made a binary mask (same size of images)

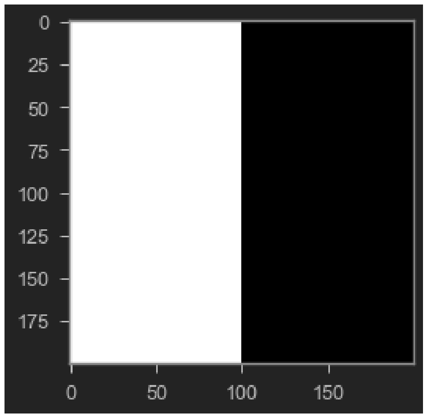


Fig.11: Binary mask of image size

➔ Further gaussian pyramid of that mask was generated. Mask pyramid is masked with first image pyramid and inverse of this mask is masked with second image pyramid. Both the masked result are then added together to get a final blended effect image.

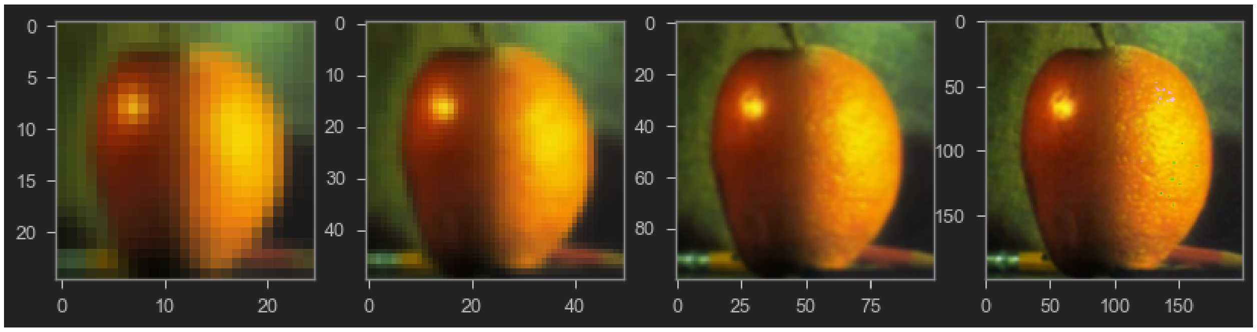


Fig.12: Blended image

- **<u>In the context of image morphing:</u>**

➔ Two images were selected for morphing and made the same size of both.

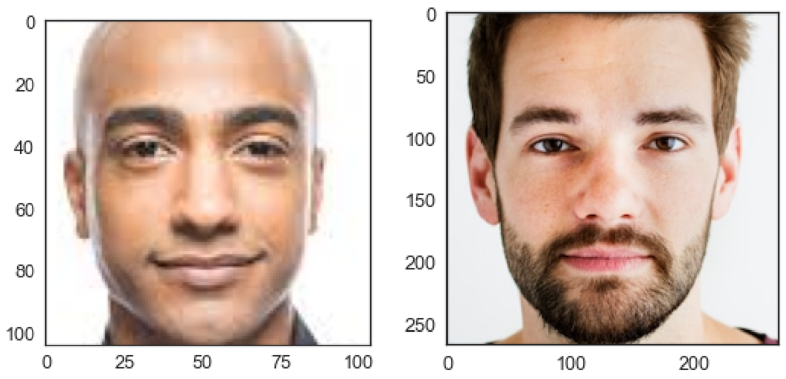


Fig.13: Two images selected for morphing using Image pyramid

➔ Gaussian pyramid of first image generated (blurring the image then subsampling then again upsampling)

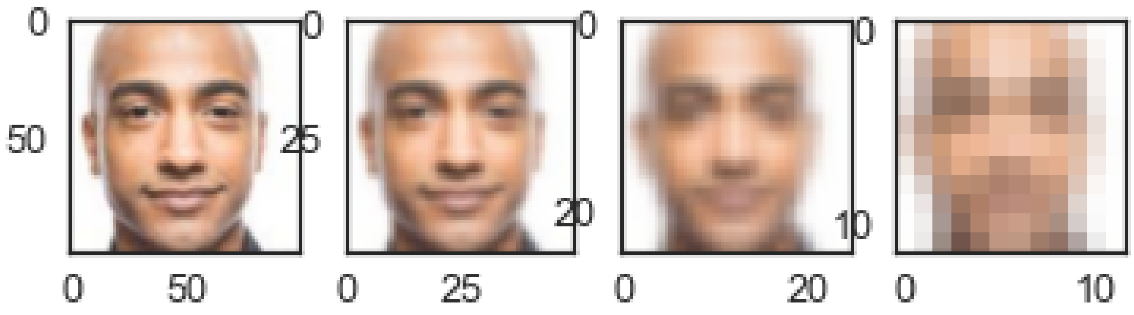


Fig.14: Gaussian pyramid of image 1

➔ Laplacian pyramid of the first image generated by taking the difference of original image and upsampled gaussian image.

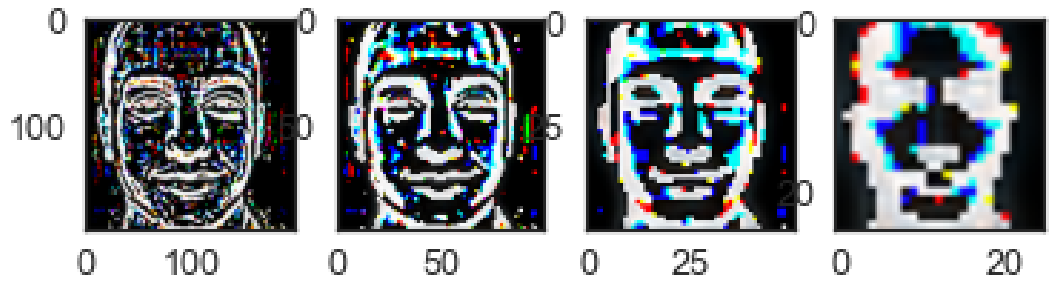


Fig.15: Laplacian pyramid of image1

➔ Gaussian pyramid of the second image generated (blurring the image then subsampling then again upsampling)

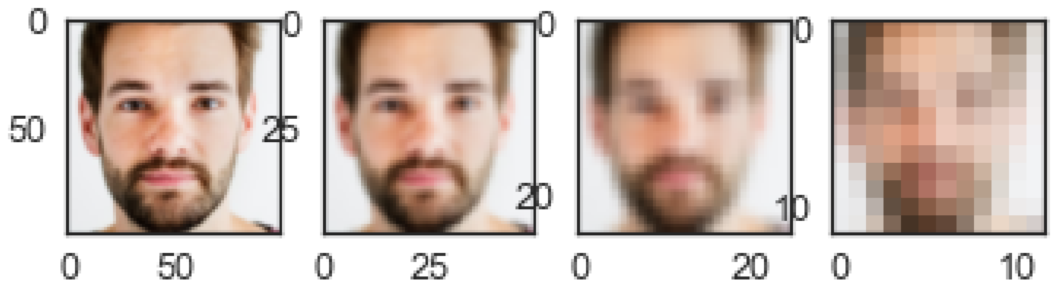


Fig.16: Gaussian pyramid of image2

➔ The Laplacian pyramid of the second image was generated by taking the original image's difference and upsampled gaussian image.

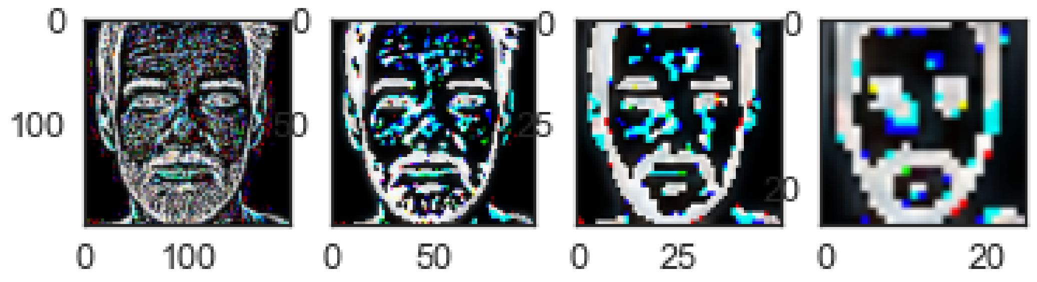


Fig.17: Laplacian pyramid of image 2

Gif.2: Morphing implementing image pyramid

Part III: Image Stylization

Implement the xDoG as described in the paper . Demonstrate its application on the Laplace pyramid and subsequently in image morphing.

Implementation of the xDoG

We take an image,and then smoothen the image using Gaussian filter with two values of sigma of ratio 1.6 to generate the Gaussian samples of the image. For the laplacian of the image, difference of gaussian of smaller sigma with the gaussian of larger sigma (**called Difference of Gaussian DOG**) was taken as shown below.

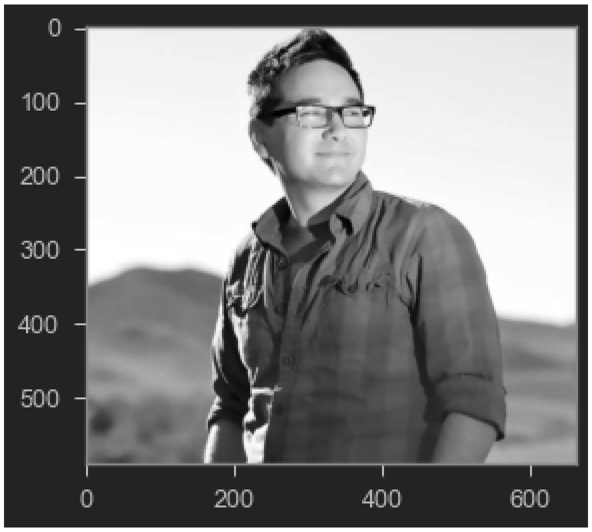
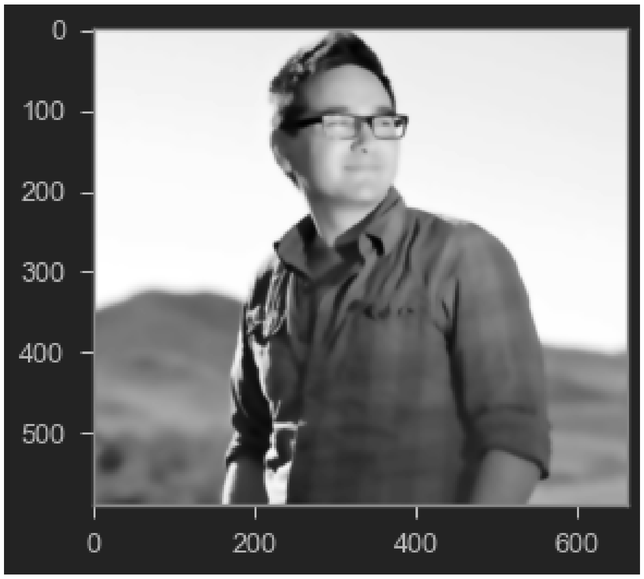


Fig.18 Original Image.



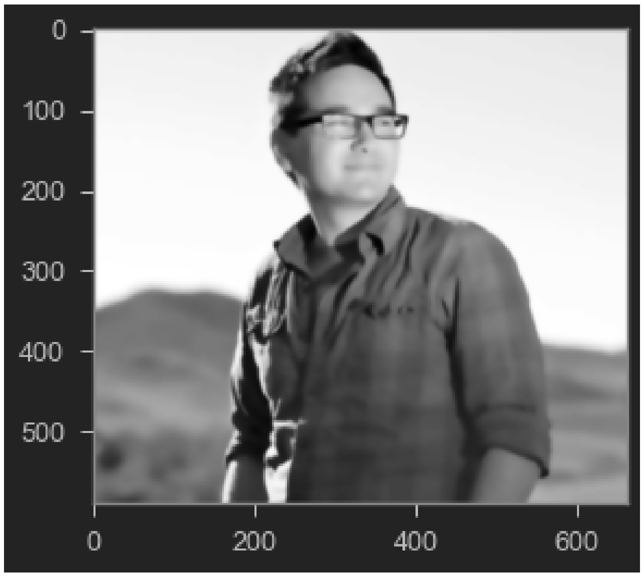


Fig 19: Gaussian Blurred image for σ = 0.8 ans 1.28

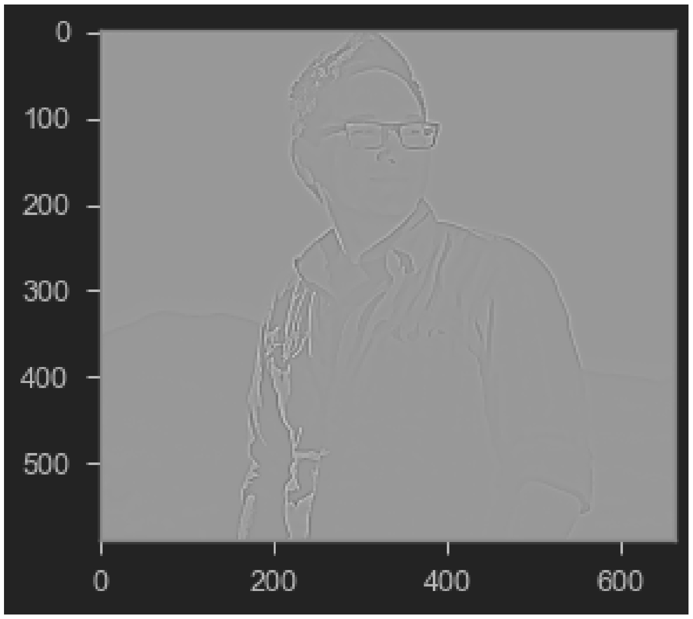


Fig 20 : Difference of Gaussian(DOG) image

➔ The DoG response is combined with the blur result in order to create a sharpened image

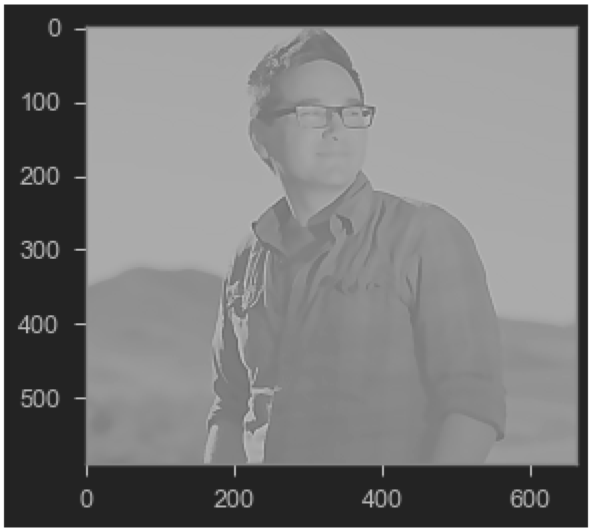
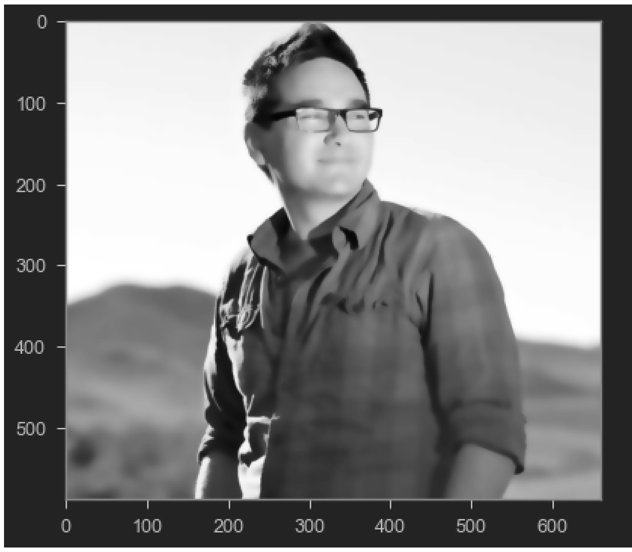


Fig.21: Generated image from DOG and Gaussian image.

➔ After summing the laplacian and gaussian images, thresholding is done.



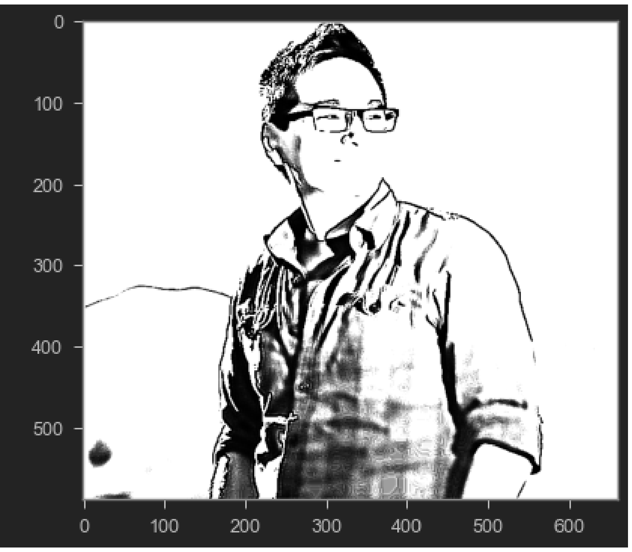
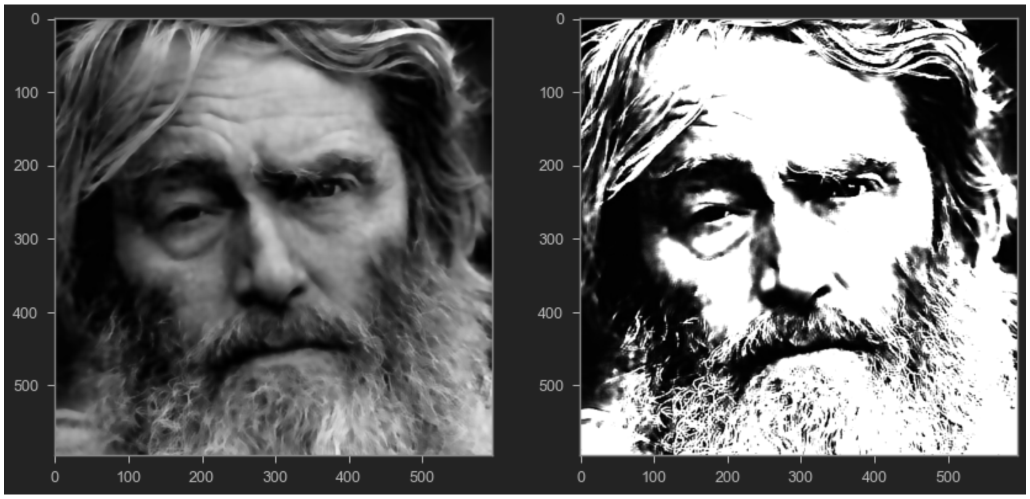


Fig.22: Sample image

Fig.23: xDoG Thresholding

- **<u>Another example:</u>**


Sample image *XDoG Thresholding*

- **Application on the Laplace pyramid and subsequently in image morphing**

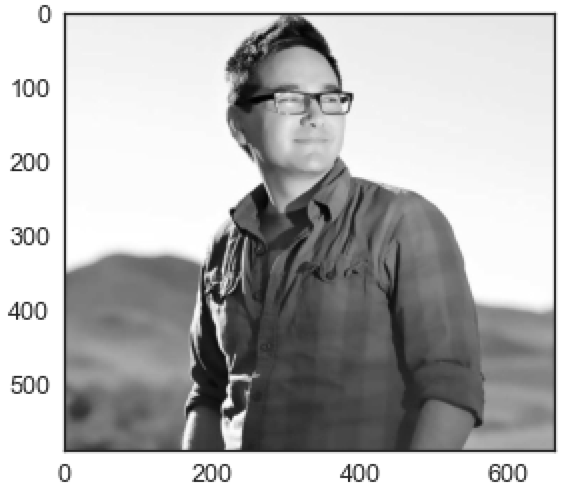


Fig.24: Sample photograph

➔ Gaussian pyramid of sample image generated.

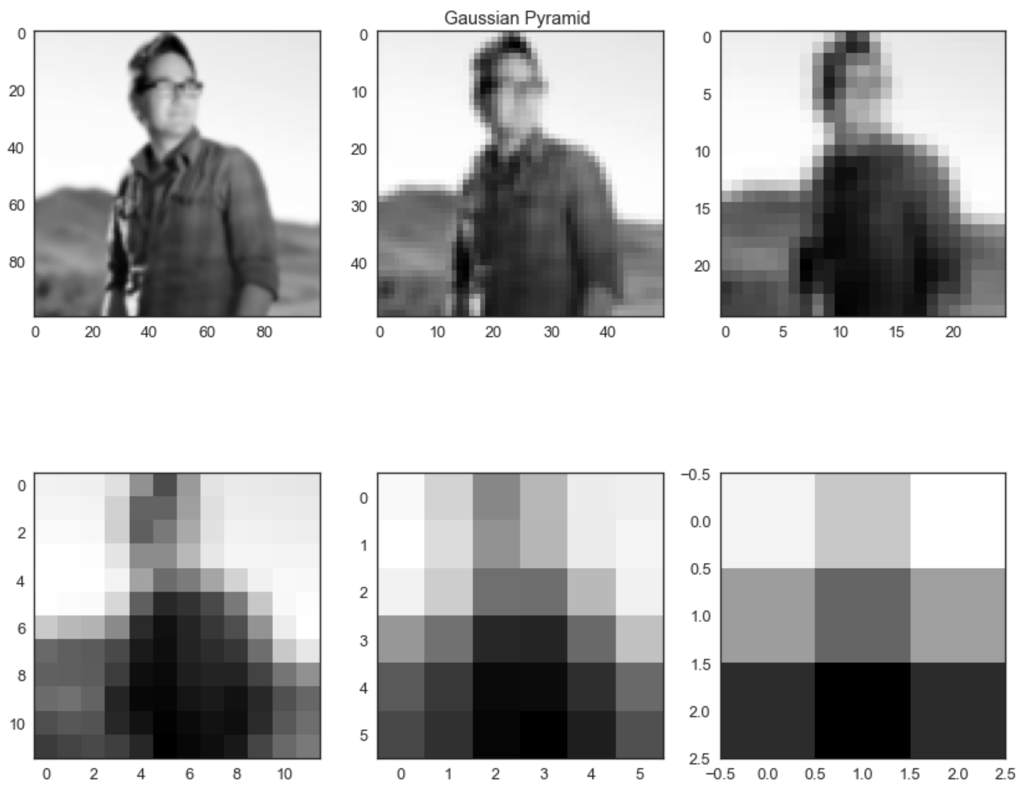


Fig.25: Gaussian pyramid of the image

➔ Difference of Gaussian (DOG) pyramid of sample image generated.

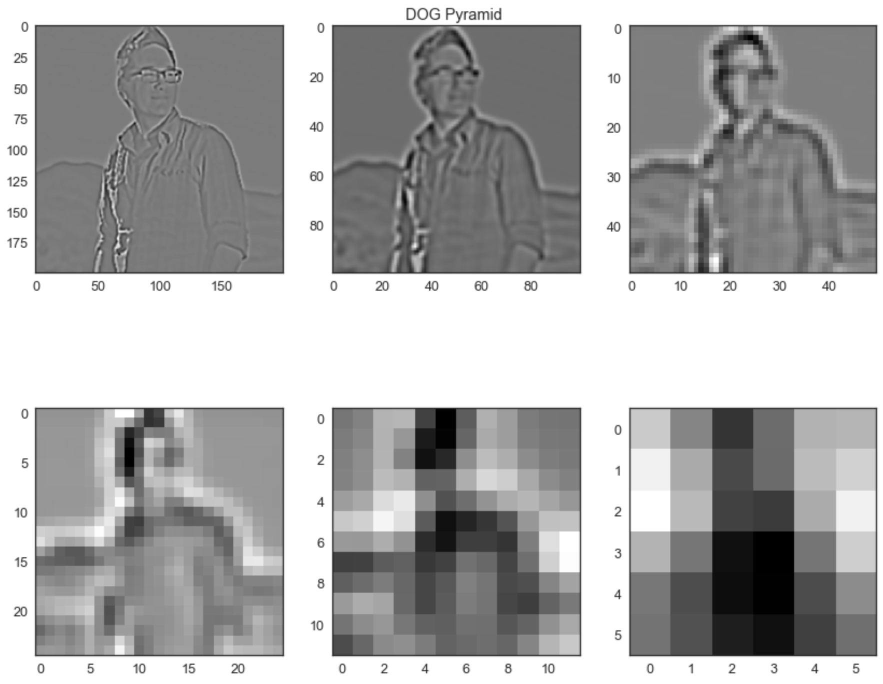


Fig.26: difference of gaussian pyramid of the sample image

➔ Image generated from the difference of gaussian and gaussian pyramids, by summing both of them(The DoG response is combined with the blur result in order to create a sharpened image).

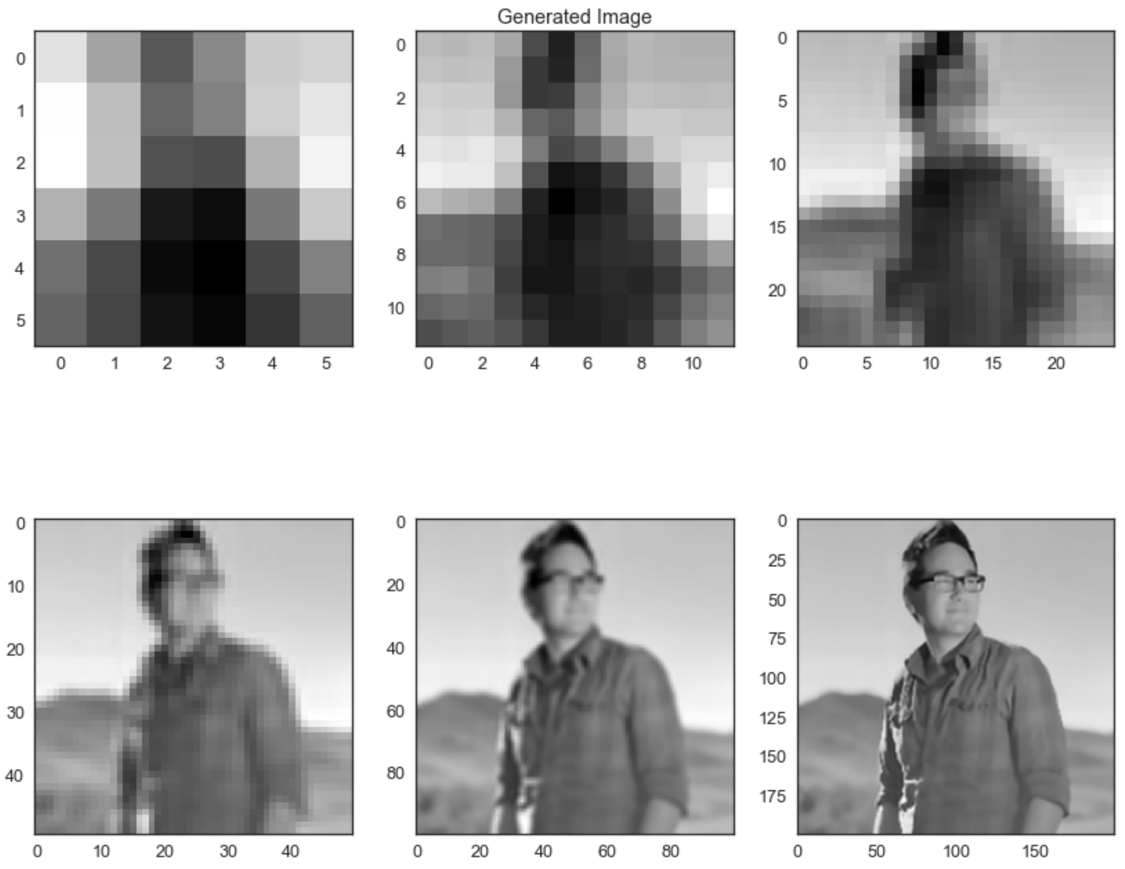


Fig.27: Image generation

➔ After sharpening the image, thresholding is implemented.

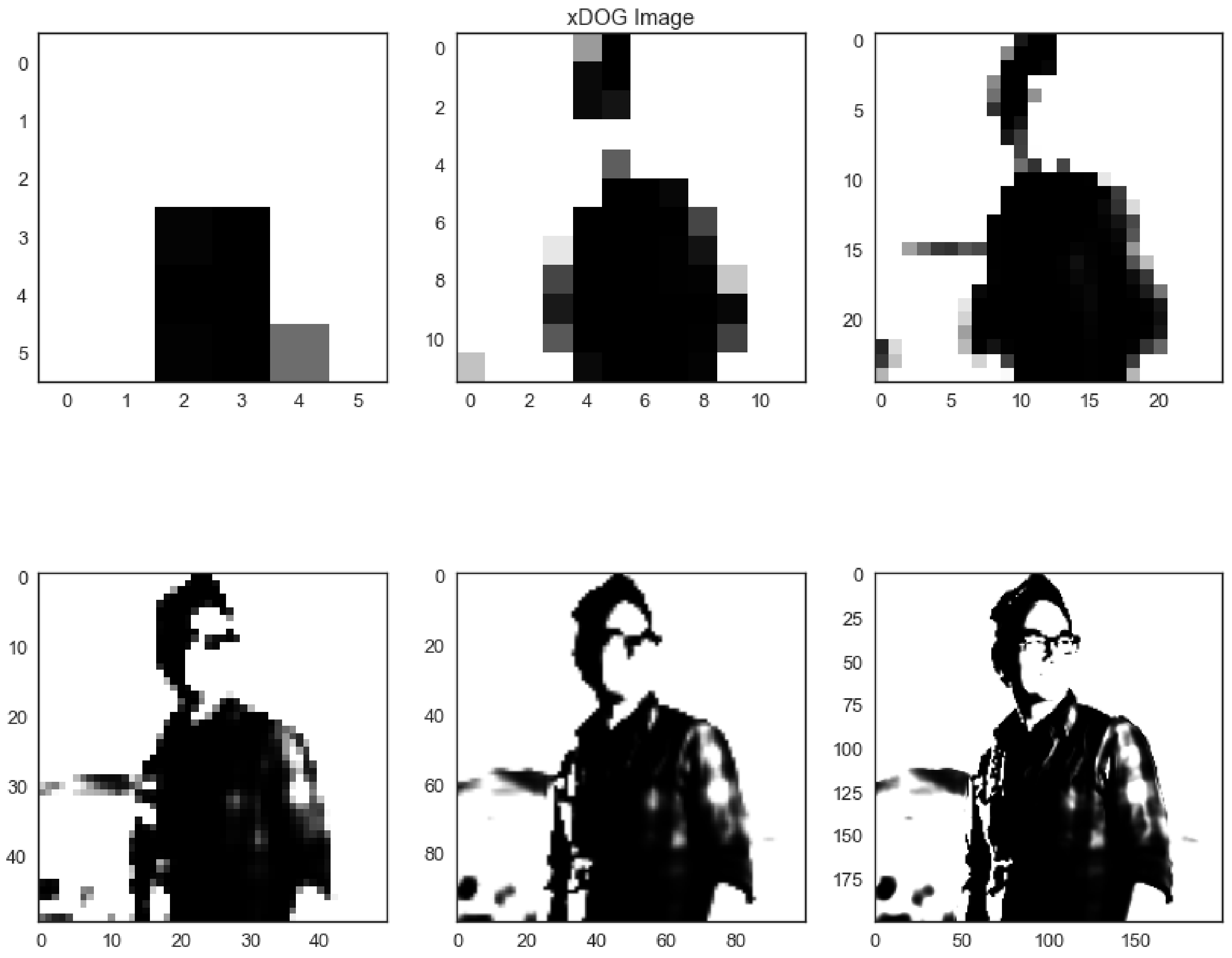


Fig.28: xDOG thresholding