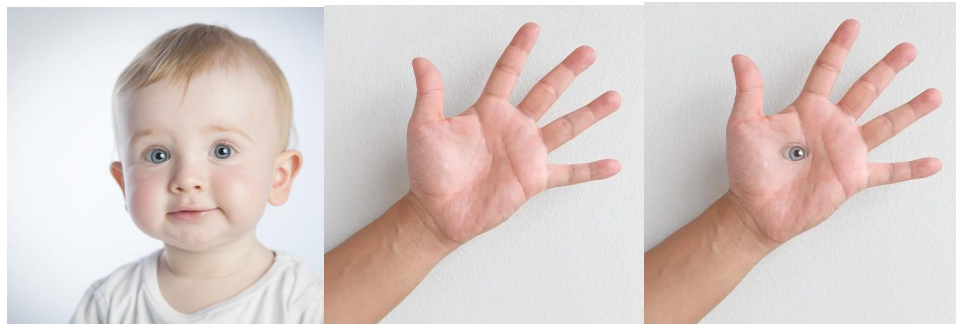


Image Blending Using Image Pyramids

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Steps Followed:

- I found images on and created binary mask images with Photoshop CC 2018.
- I read the two input images and the mask image with MATLAB's imread function.
- I defined a depth variable which determines the pyramid level.
- I built Laplacian pyramids of the two input images with laplacianpyr function. Notice that this function calls gausspyr function.
- I built the Gaussian pyramid for binary mask image with gausspyr function.
- Then I combined the pyramids by calling the combine function. This function calculates the sum of the multiplications of each Laplacian image with a mask and its complements. The formula is as follow:

$$LS\{i\} = GR\{i\} . * LA\{i\} + (1 - GR\{i\}) . * LB\{i\} ;$$

- Finally, I reconstructed the final image from the blended Laplacian pyramid. I used collapse function to do this. Now, I was able to combine two images successfully.

NOTE: Montage function produces an empty display image if the size of the list 5. It could be seen during the report. Additionally, figures coming from montage function are always listed from 1 to the highest level. (left to right then down).

Input Images:

a) Balls Experiment



Football Image



Baseball Image

b) Eye in Hand Experiment



Baby Image



Hand Image

c) Twin Brothers Experiment



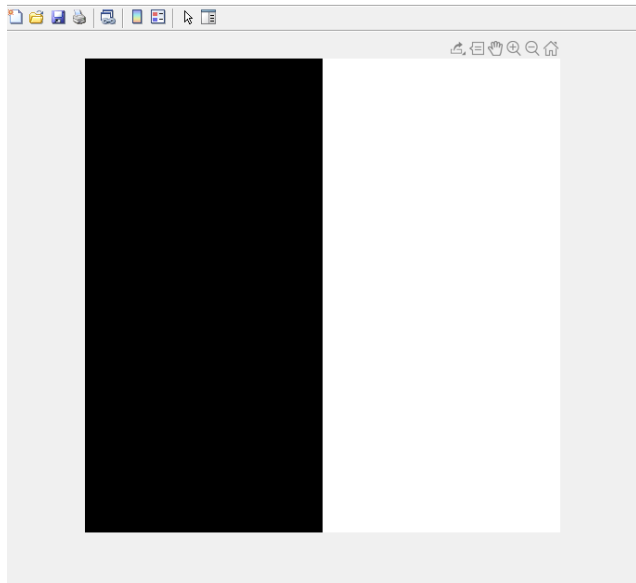
Image of myself (Eren)



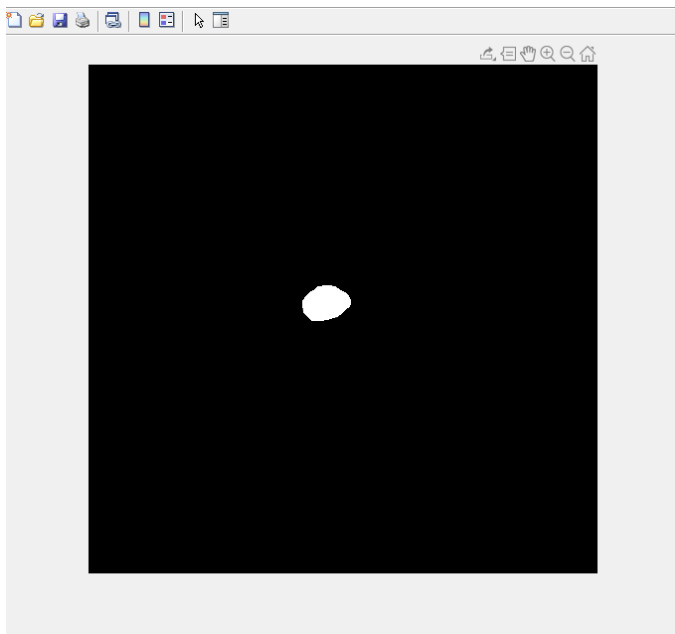
Image of my brother (Emre)

Mask Images

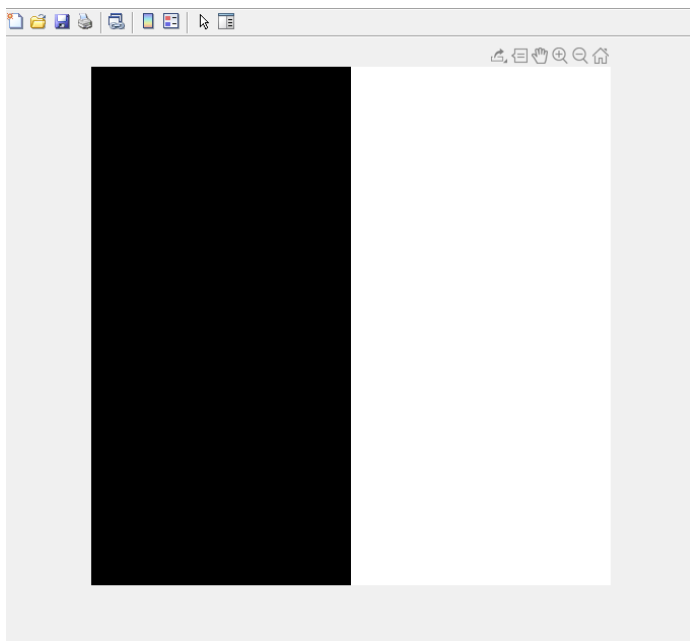
a) Balls Experiment



b) Eye in Hand Experiment



c) Twin Brothers Experiment

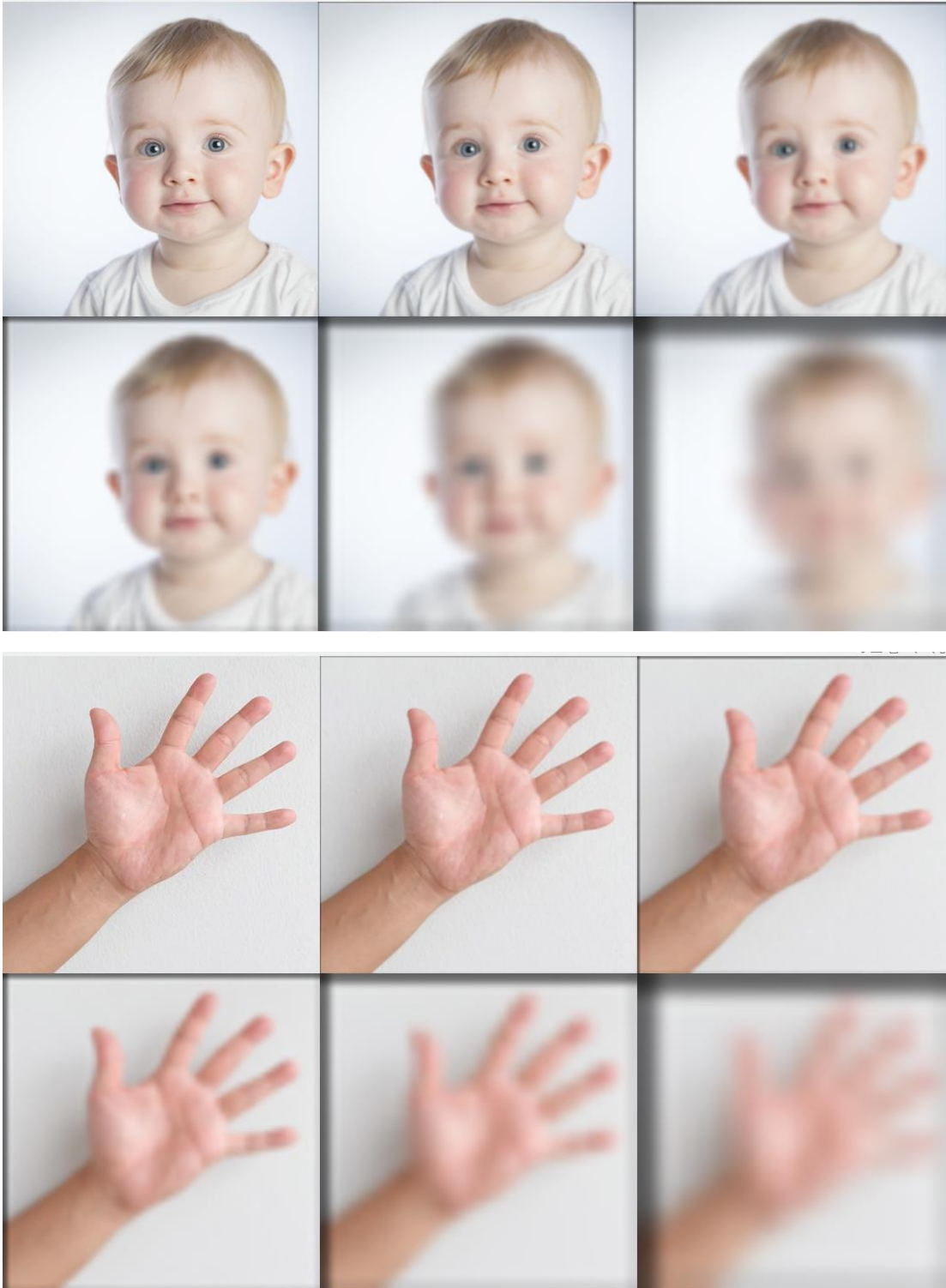


Results of when gaussPyr is called inside lapPyr:

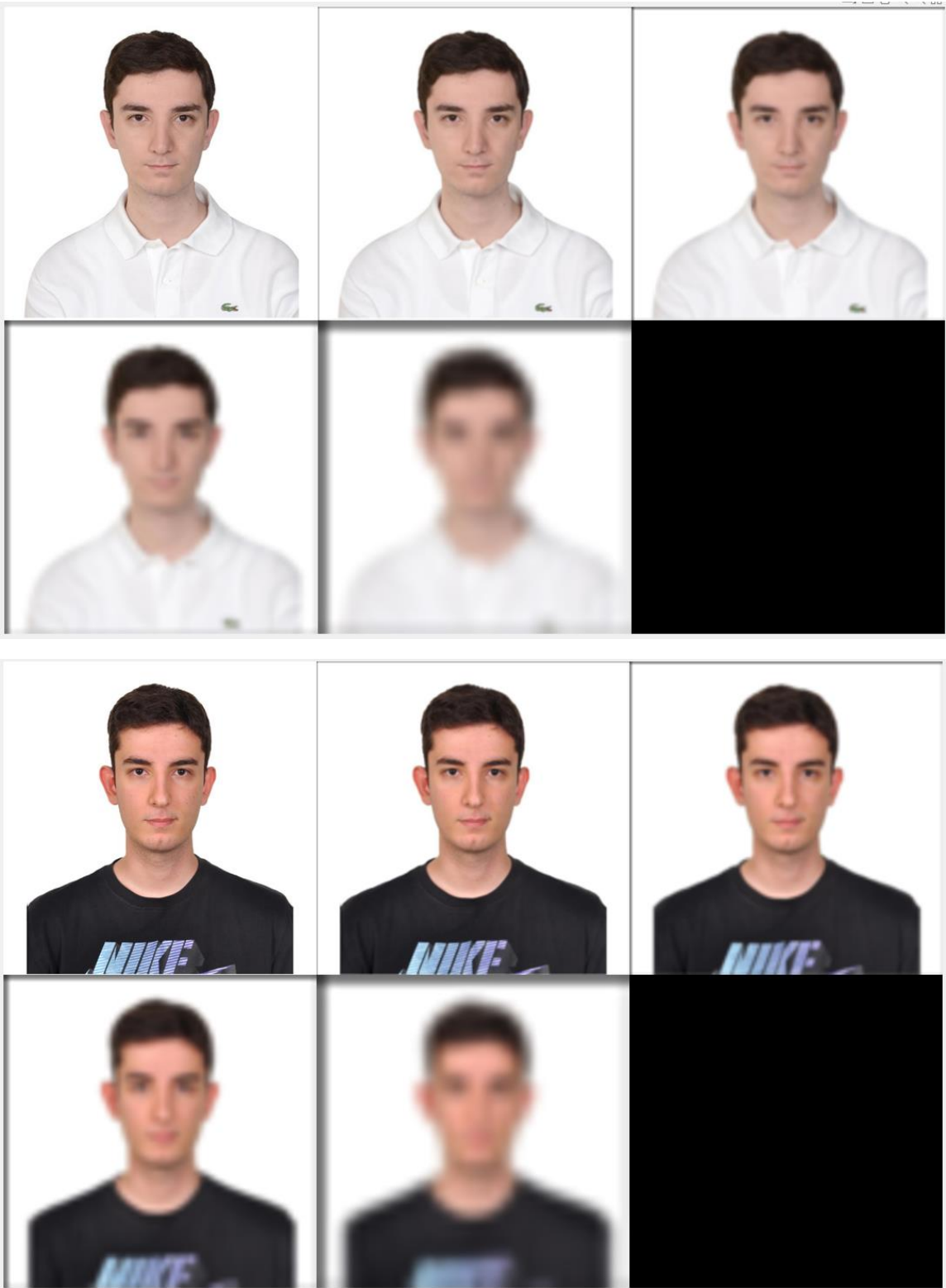
a) Pyramid Level = 4



b) Pyramid Level = 6



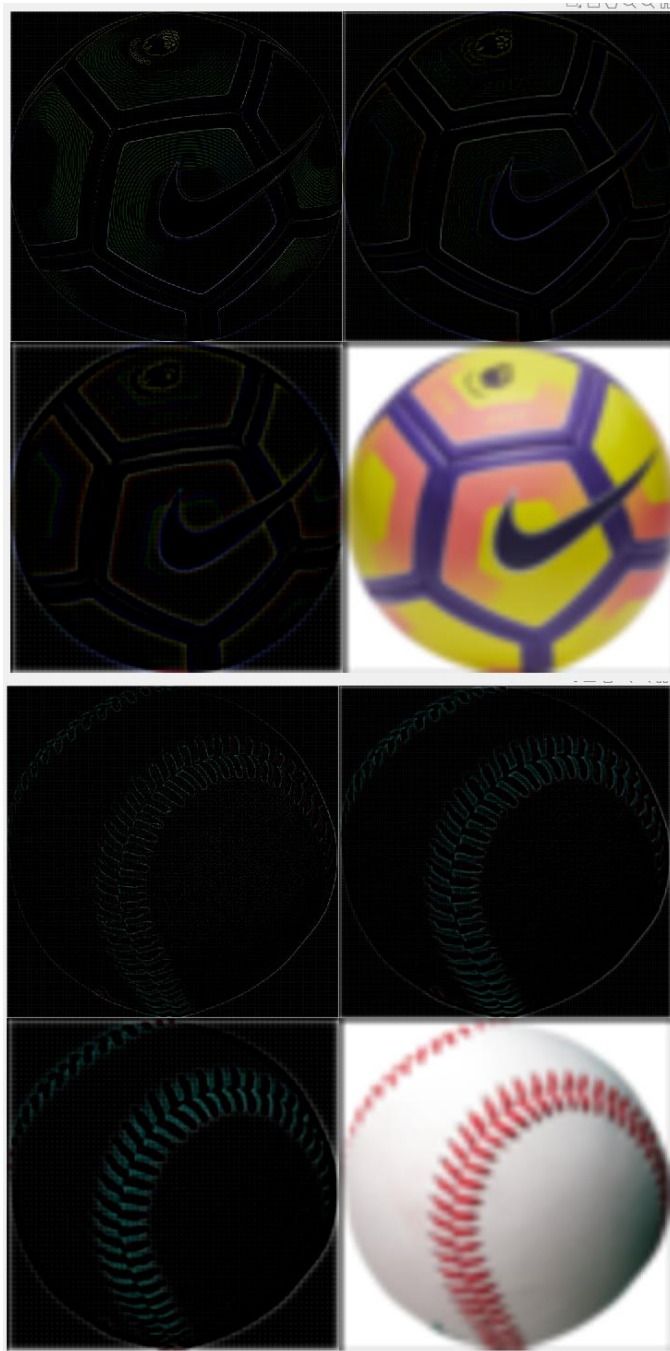
c) Pyramid Level = 5



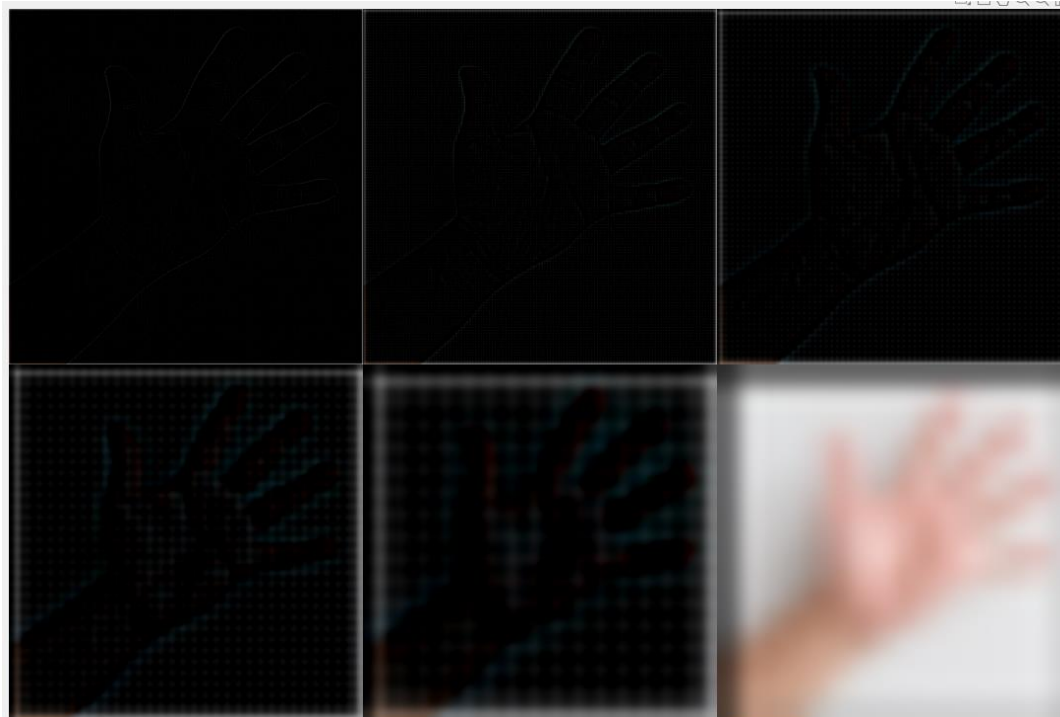
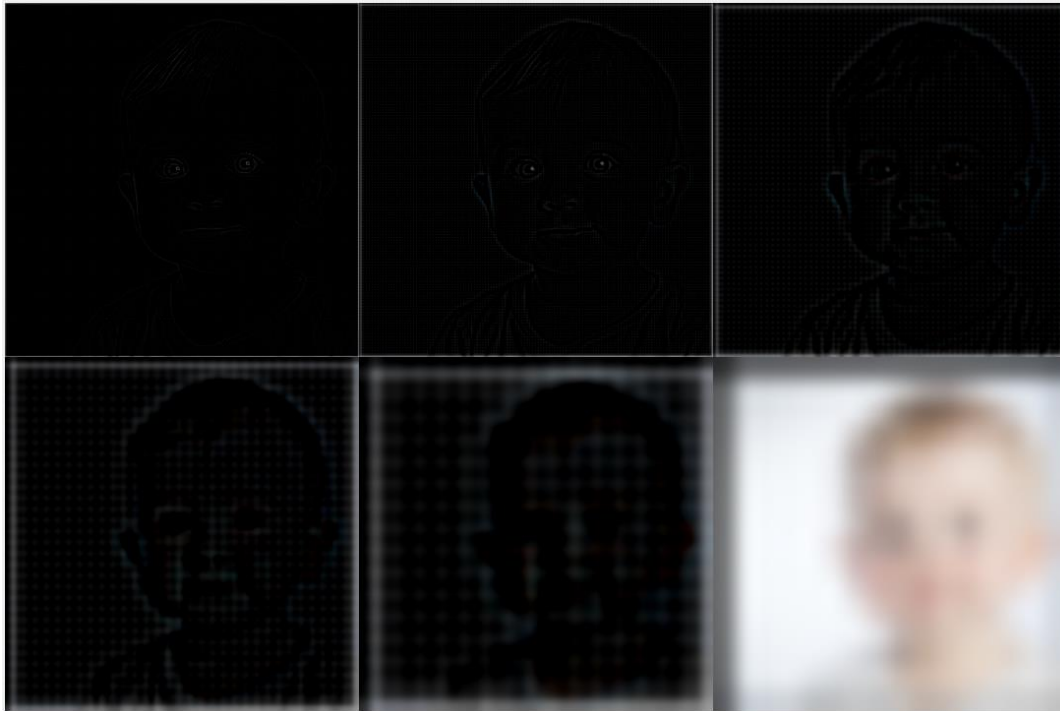
The outputs on page 5, page 6 and page 7 are created by using MATLAB's montage function. This function helps to display multiple images. Here the outputs show each level of the gaussian pyramids (from 1 to depth) which is called inside lappyrmaid function. Images get blurred because the size images shrink like 512x512, 256x256, 128x128 and so on. Yet, in the figures, the size seems similar because of the montage function.

Results of Step 1 (Generating Laplacian Pyramids for Input Images):

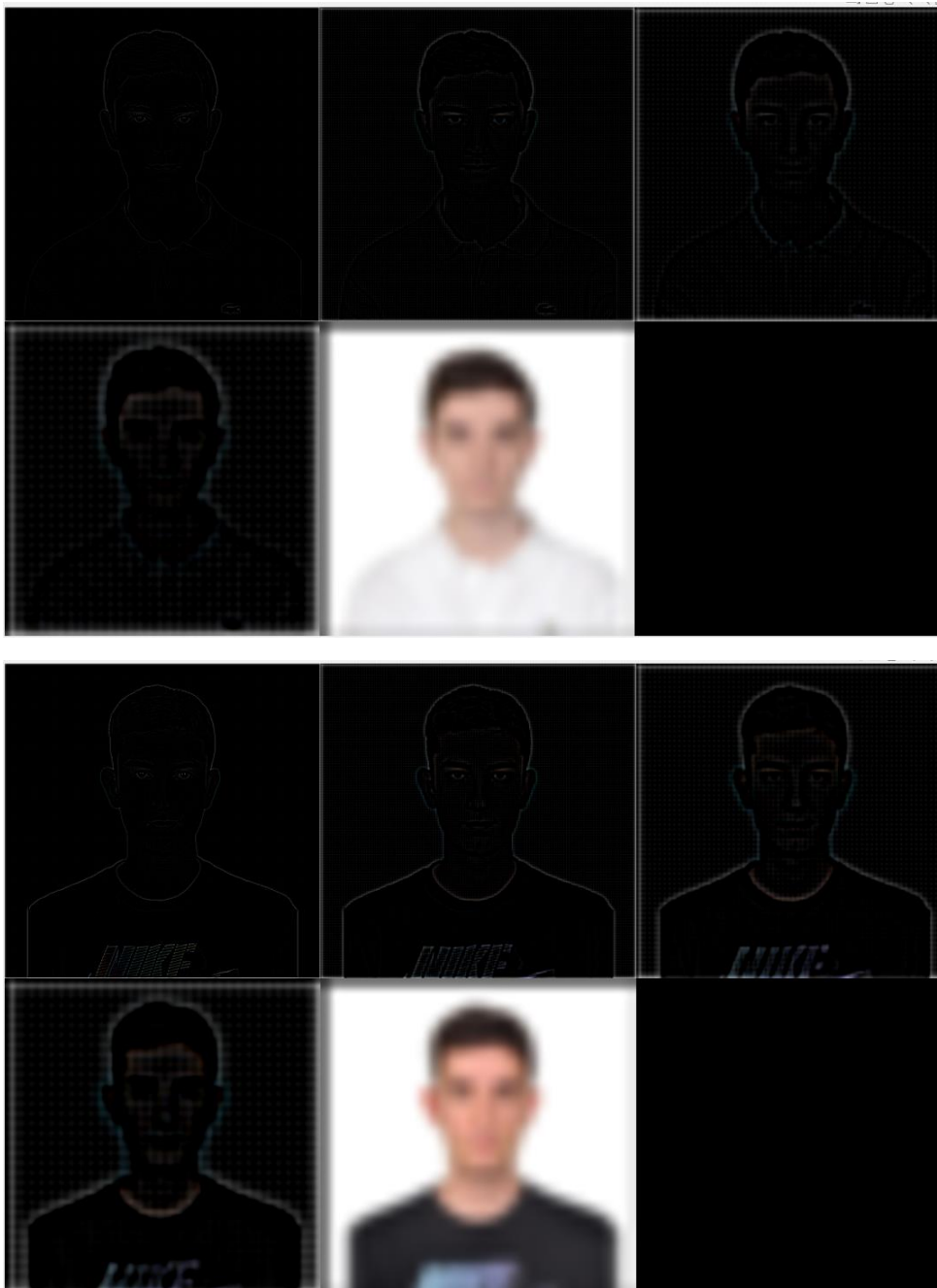
a) Pyramid Level = 4



b) Pyramid Level = 6



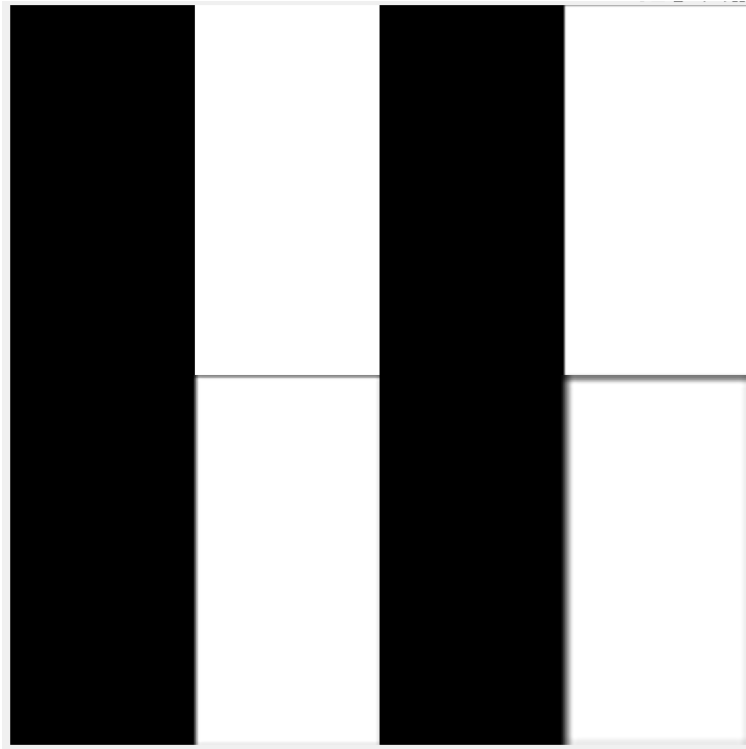
c) Pyramid Level = 5



These results show that the laplacian pyramid computes the difference between the upsampled Gaussian pyramid level and the Gaussian pyramid level. By dividing the picture into various isotropic spatial frequency bands, the Laplacian pyramid provides an extra level of analysis compared to the Gaussian pyramid.

Results of Step 2 (Generating Gaussian Pyramids for Mask Images)

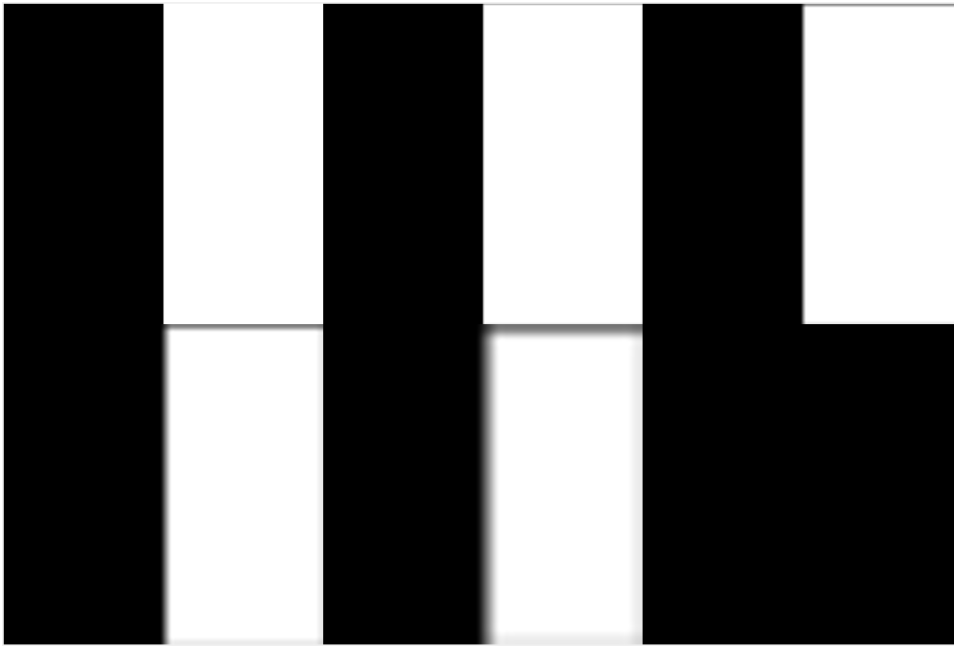
a) Balls Experiment



b) Eye in Hand Experiment



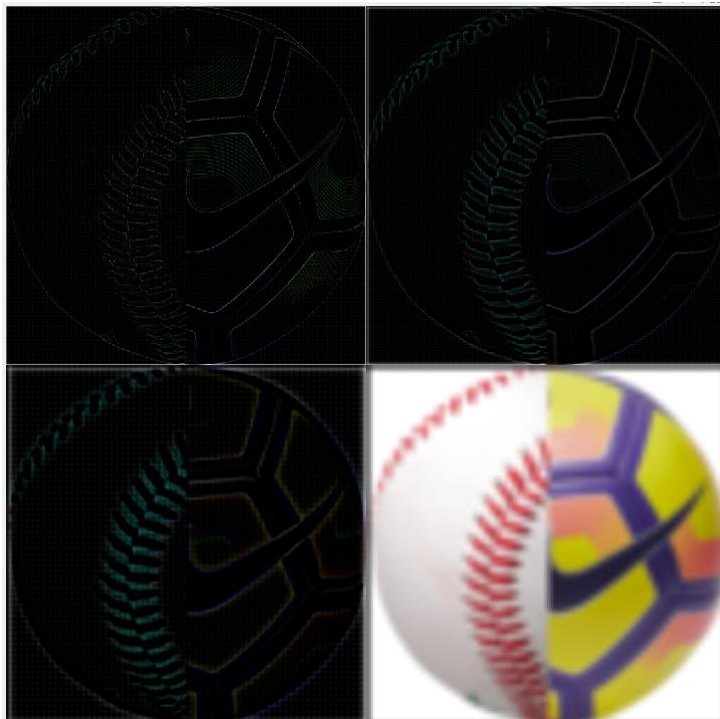
c) Twin Brothers Experiment



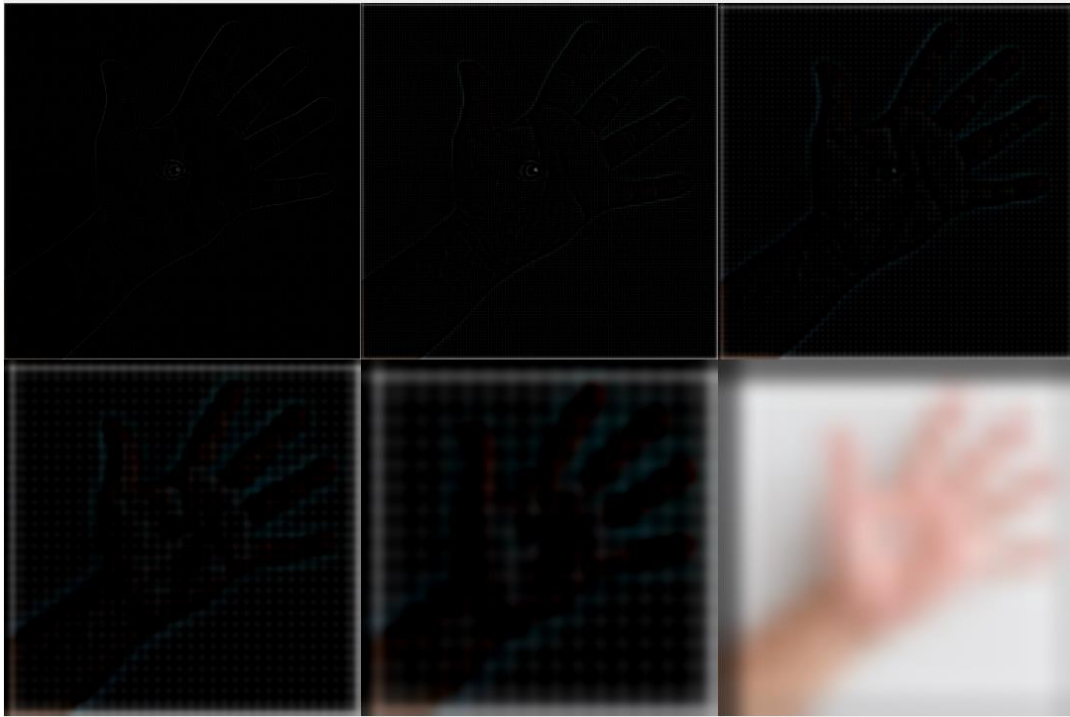
Results of step 2 show that the Gaussian pyramid blurs the edges of the binary mask since the binary masks get smaller this will help to obtain blend two images successfully. Basically, the gaussian pyramid search for an object on different spatial scales.

Results of Step 3 (Combining)

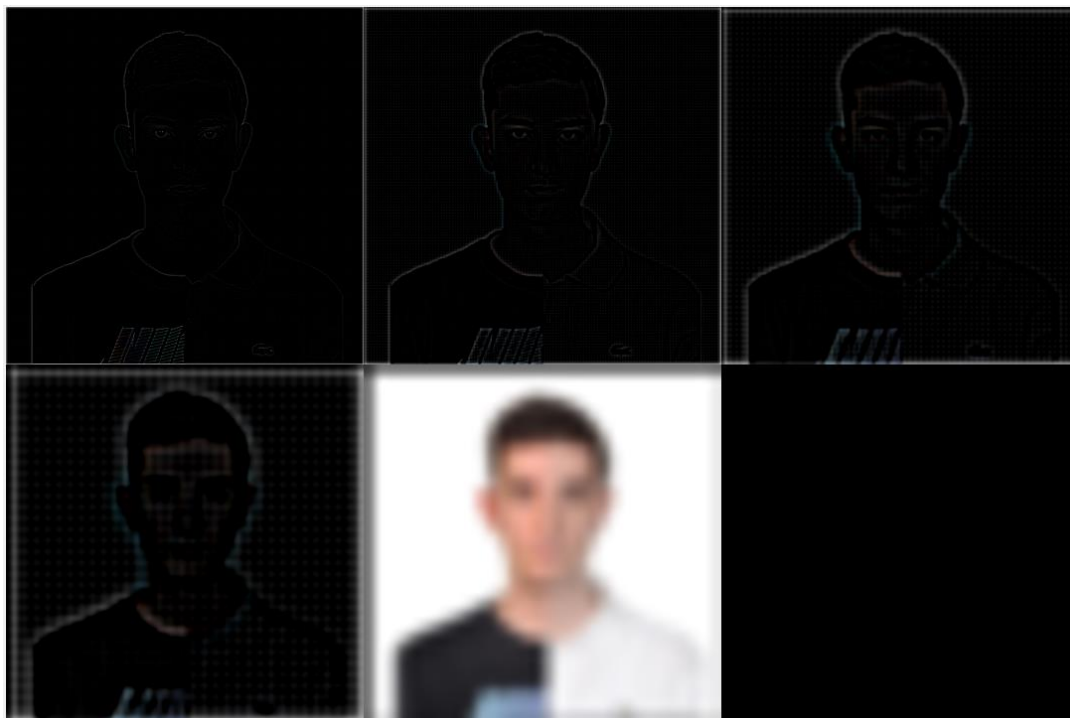
a) Balls Experiment



b) Eye in Hand Experiment



c) Twin Brothers Experiment



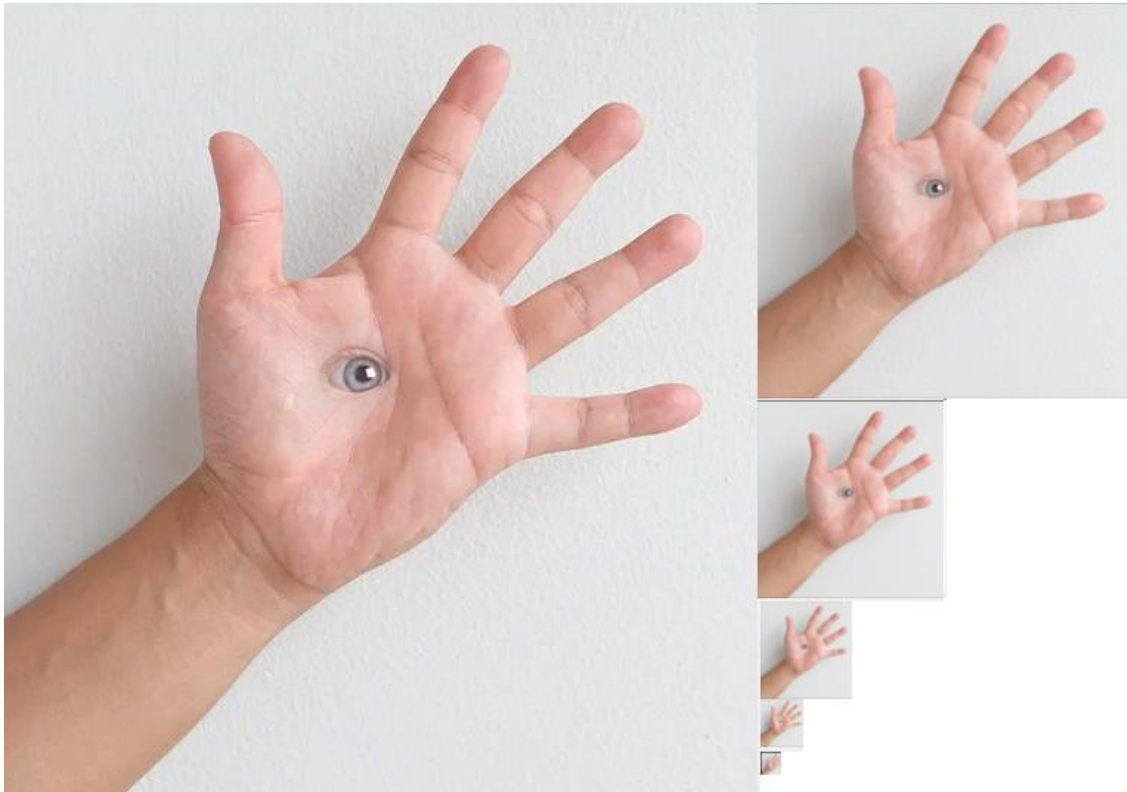
In this part, we calculate the formula of the sum of two images which are multiplied by mask image and its complement. When the iteration goes over the depth we get better combination results. Yet it still needs to be reconstructed.

Results of Step 4 (Collapsing)

a) Mixed Balls



b) Baby's Eye in Hand



c) Blended Brothers



For those images above, reconstruction is made from smaller images to bigger images since construction would be the vice versa operation of the pyramids.

Comparing Pyramid Levels

a) Blended Balls



Level = 1



Level = 2



Level = 3



Level = 4

b) Baby's Eye in Hand



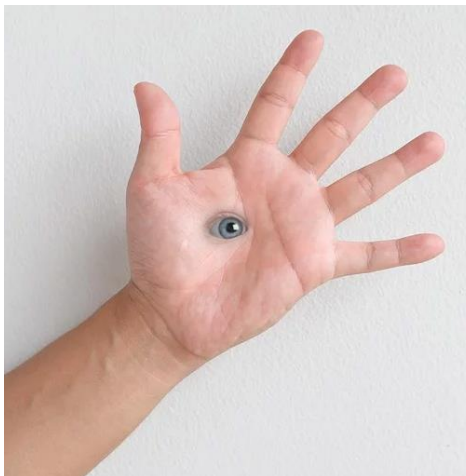
Level = 1



Level = 2



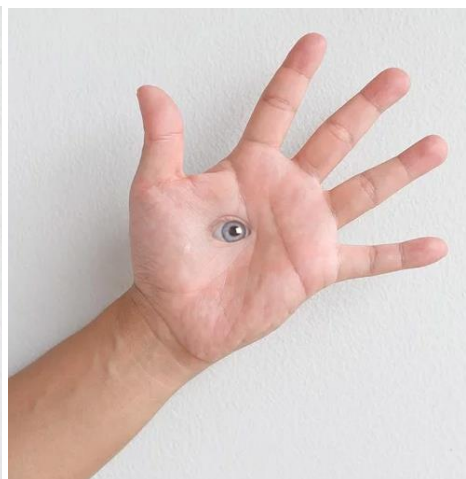
Level = 3



Level = 4



Level = 5



Level = 6

c) Blended Twins



Level = 1



Level = 2



Level = 3



Level = 4



Here on page 16, 17, and 18 we see that when we increase pyramid level the image results better. For example, on part b, for level 1 the eye look like does not belong to the hand, however the feeling of the belonging gets better when we increase the pyramid level. As a result, higher level gives better blended images. On lower levels, masks are obvious like it is cut and glued, but for higher levels pixels mixed very well.