COMPUTER VISION

PROJECT-1

HYBRID IMAGE PROCESSING

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1 INTRODUCTION

A hybrid image is an image that is perceived in one of two different ways, depending on viewing distance, based on the way humans process visual input. A technique for creating hybrid images exhibiting this optical illusion was developed by Aude Oliva of MIT and Philippe G. Schyns of University of Glasgow, a method originally proposed by Schyns and Oliva in 1994. Hybrid images combine the low spatial frequencies of one picture with the high spatial frequencies of another picture, producing an image with an interpretation that changes with viewing distance. Here we discussed the way of making an hybrid image from two image of similar dimensions.

2 ALGORITHM

The basic idea behind this making of an hybrid image(H),from two images(I1 and I2), is to change the contrast of those two images and then to merge them.So we take two images-

(a) Dog (b) Cat

Figure 1: Original images we will be using

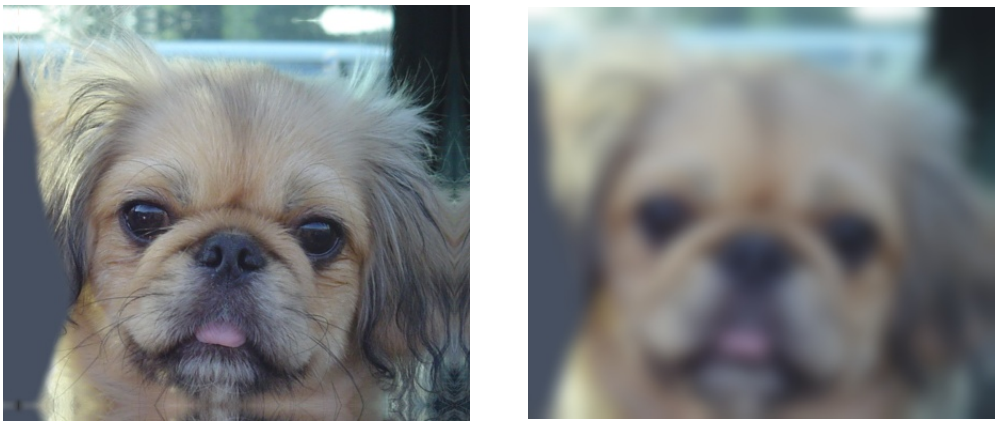
Now we describe the algorithm step by step below-

2.1 blurring the first image:

at first , we chose one image(Dog) to be viewed from longer distance and try to blur it(i.e , lowering the contrast).To do this, first, we do padding(to avoid shrinking during convolution) to the image ,then, we take one gaussian filter(G) and apply convolution on that image(I1).

$$C1 = I1 * G,\ [C1 = low\ frequency\ component\ of\ I1]$$

Result of this respective operation is-



(a) Padded image (b) low freq. component(C1)

Figure 2: Steps of applying gaussian filter

2.2 sharpening the second image:

And now we pick the second image(Cat) to be viewed from nearby and increase the contrast(i.e, sharpen the image). To do this we first take the lower frequency component(i.e, blur the image) of that image.Then subtract it from the original image to get the high frequency component(C2).

$$C2 = I2 - I2 * G,\ [C2 = high\ frequency\ component\ of\ I2]$$

Result is as shown below-

(a) Original image

(b) Padded image

(c) Low freq. component

(d) high freq. component

Figure 3: Steps of applying gaussian filter

2.3 Making of Hybrid Image:

Now we add this two components(high freq. component of the cat image and the low freq. component of the dog image) of the respective images. And while adding we have to take care of the pixel values.We have to clip the pixel values in between 0 to 1(or 0 to 255).To do this we can add the absolute value of the pixel with minimum intensity to every other pixel(it clips the minimum pixel intensity to 0), and then we can divide all the pixel values with the highest pixel intensity of that image(it clips the highest pixel intensity to 1 or 255).Result of this particular step and the visualization illusion what it creates is shown below-

Figure 4: Resultant hybrid image pyramid

3 FEW MORE RESULTS:

3.1 Bicycle and Motorcycle:

(a) Motor-cycle

(b) Bicycle

Figure 5: original images

3.1.1 Using gaussian filter

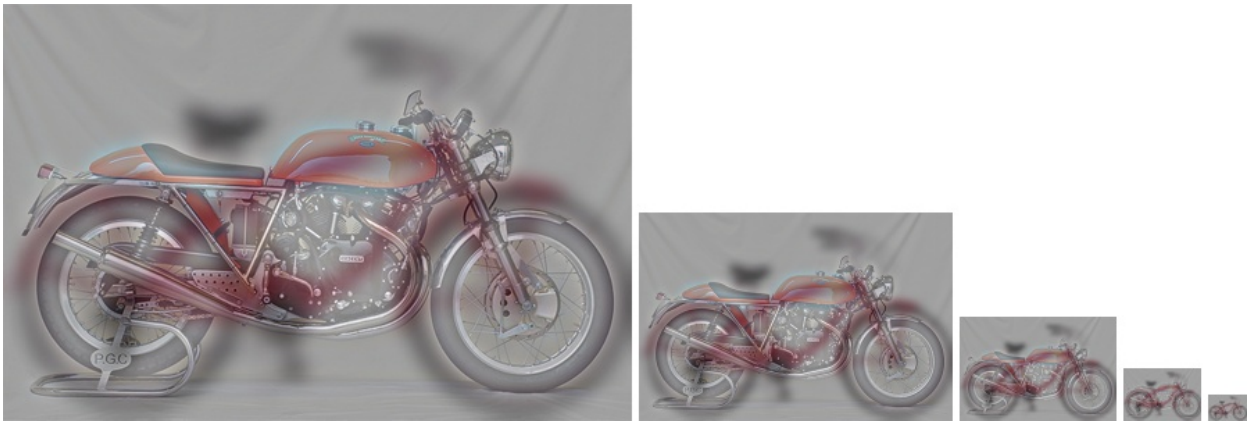


Figure 6: hybrid image pyramid(Gaussian with kernell-size=29*29 and sigma=7)

3.1.2 Using box filter

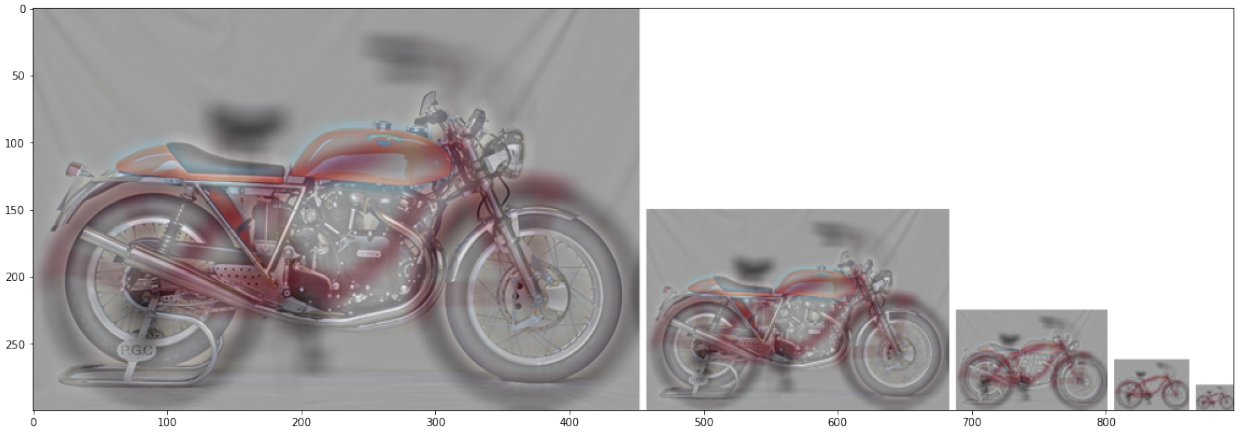
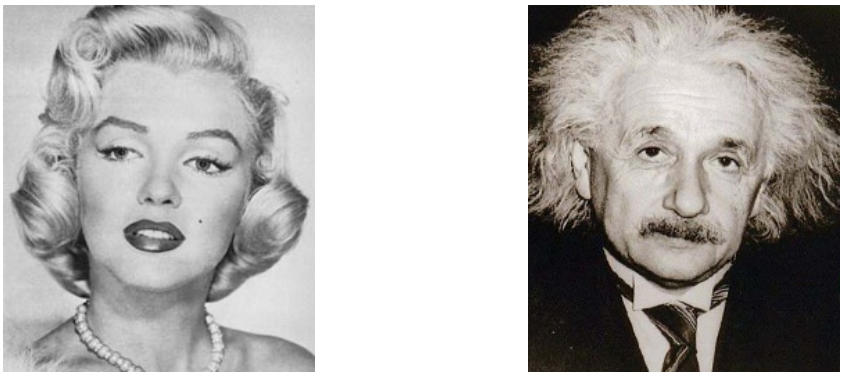


Figure 7: hybrid image pyramid(Box with kernell-size=29*29)

3.2 Einstein and Marlyn:



(a) Marlyn (b) Einstein

Figure 8: original images

3.2.1 Using Gaussian filter:

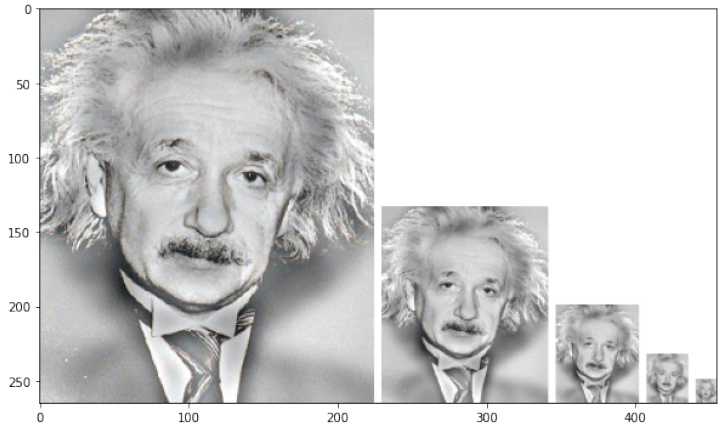


Figure 9: hybrid image pyramid(Gaussian with kernel-size=(29*29) and sigma=7)

3.2.2 Using Box filter:

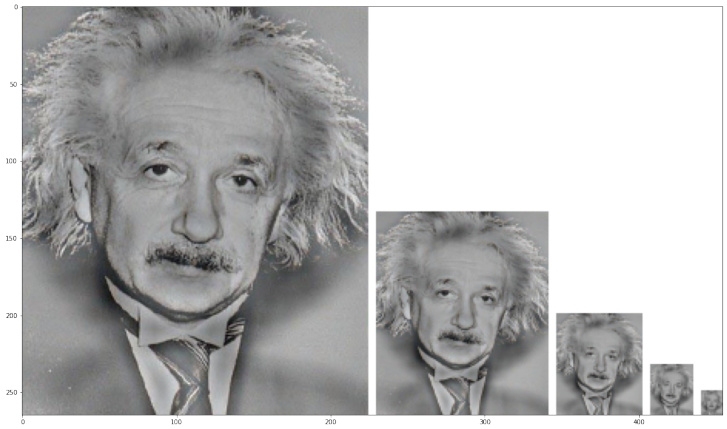


Figure 10: hybrid image pyramid(Box with kernel-size=(29*29))

4 OBSERVATION and CONCLUSION:

From the above images, it can be concluded that the hybrid image processing is dependent on the choice of a proper kernel(Gaussian or Box).In case of Gaussian it is dependent on the standard deviation of the kernel. The padding width is determined by the filter size. The influence of the values of the padding portion is not significant.

It is quite astonishing to observe that the running time of the direct method in which we convolve the image with a full 2D Gaussian filter is lesser in this project than the convolution with two separable 1D filter while using the 'cv2.getGaussianKernel' and 'my_imfilter'.But we get the opposite one. Whereas it is generally known that the approach of two separable 1D filter is faster than the direct method. But according to our expectations both the methods give the same output images.