ASSIGNMENT COMPUTER VISION - SUBHASHREE RADHAKRISHNAN

Note: I would further be improvising, explaining more on the results for extra credits, will be giving additional results and be submitting before Friday. If some improvisations are required for the extras already mentioned in the report please notify before Friday and I would work on them.

1.Hybrid Images

Favourite Result:

My favourite result is the hybrid image of Einstein and Marylin. I chose the filter size to be 30 in both the cases. I low pass filtered Einstein and high pass filtered marlin by subtracting the low frequency image from the original image. For the low pass filter I chose the sigma to be 3 and high pass filter sigma to be 5. The results are as shown below.

The concept for choosing the sigma and hsize:

A greater sigma value results in more blurring. Hence I picked middle small value as 3 for Einstein image. A greater sigma value for low pass filter results in a prominent high frequency image which is obtained by subtracting low passed image from original image. Since Marilyn is already prominent I chose a low value as 5. (I am lesser low frequencies from original image).

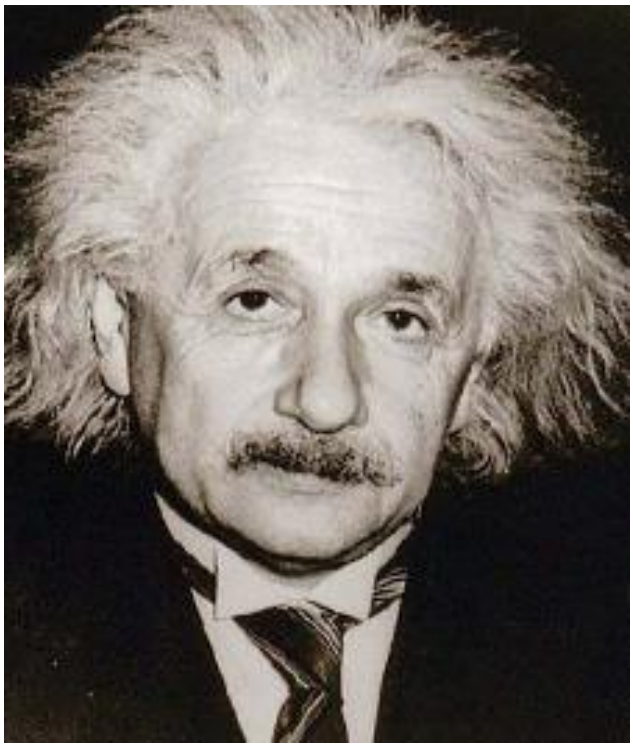


Image of Einstein

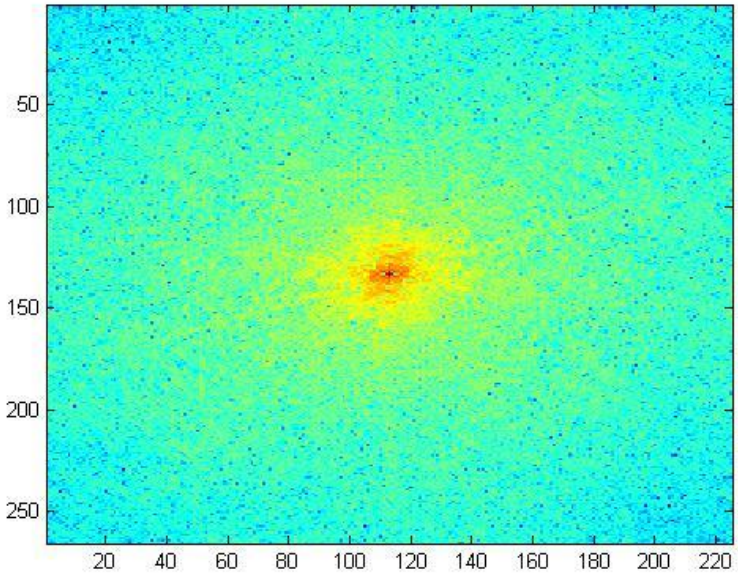
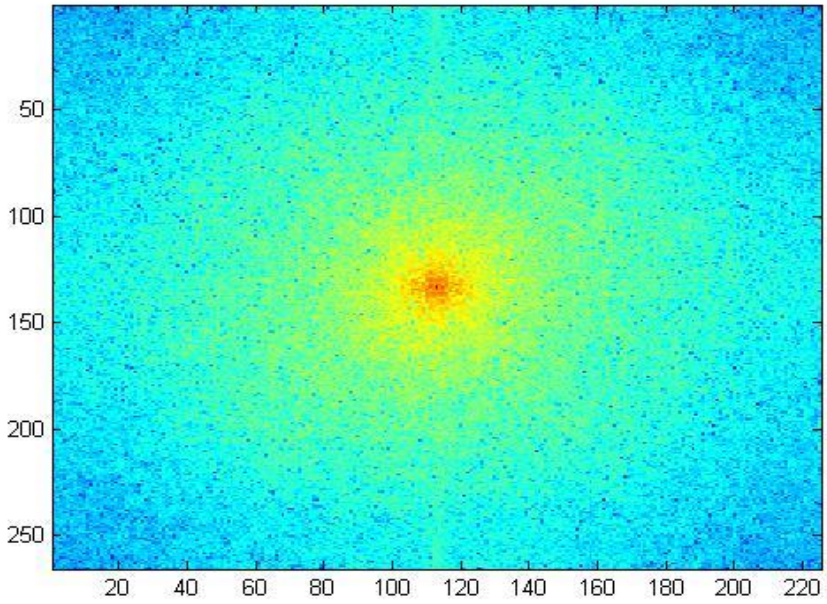


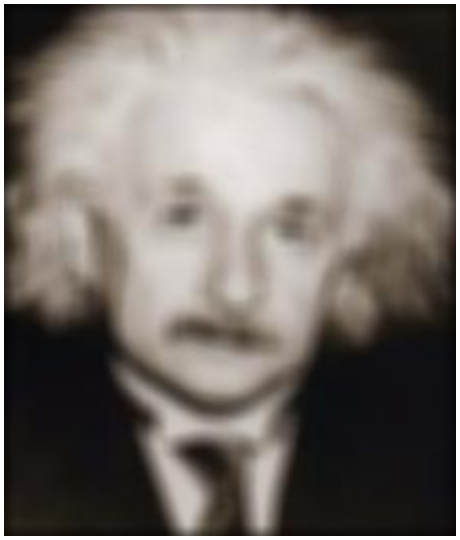
Image of log mag of fft of Einstein

Image of Marilyn

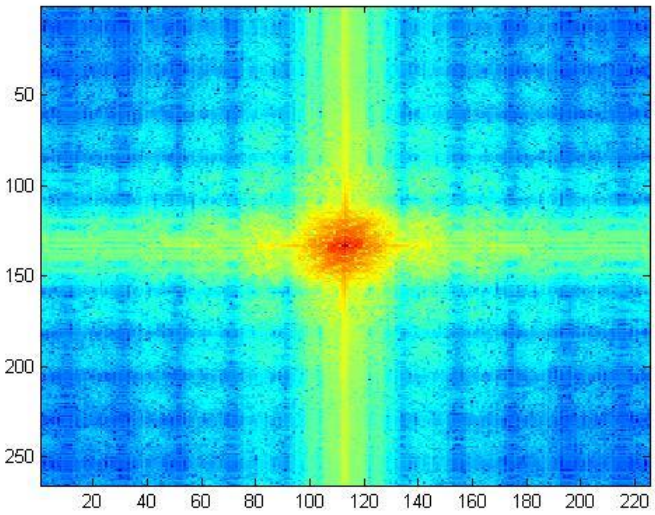


fft log magnitude of Marilyn

Above show the original image of Einstein and marylin and the log magnitude fft respectively. As it can be inferred from the fft image, the low frequencies and the high frequencies are equally distributed about the x and y axis.



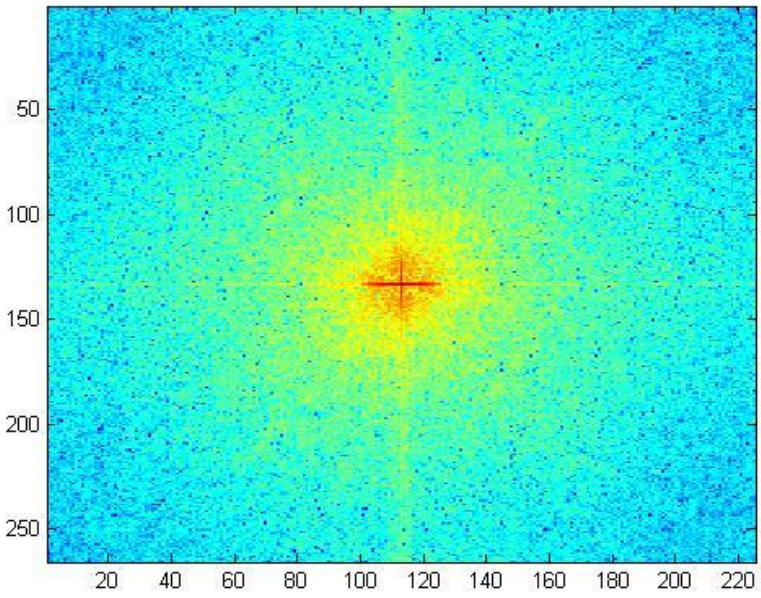
Low frequency Image



fft low frequency image

The above image gives the low frequency image of Einstein after Gaussian filter and the right image gives the fft mag. The concentration is at the centre forming a blob indicating concentration of low frequencies.

High frequency Image



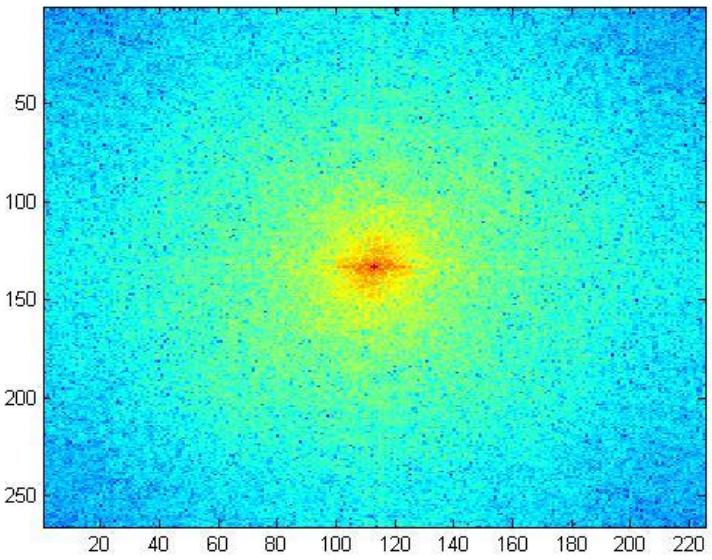
FFT mag High frequency

The above represents the high frequency image of Marilyn and fft magnitude of the same. Since the image has higher high frequencies the concentration is uniformly on the x and y axis away from center.

Hybrid Image

Vis starting from largest scale

The above image gives the hybrid image. The Marylin is more prominent from nearby as it was the high frequency image and as we move back, the Einstein image is visible as the hair becomes clearer. This is shown clearly in the vis image where the first image is Marilyn dominated and the last image has Einstein prominent.



FFT Mag of hybrid

The fft of hybrid image has a mix of high and low frequencies which are distributed along the two axes away from center.

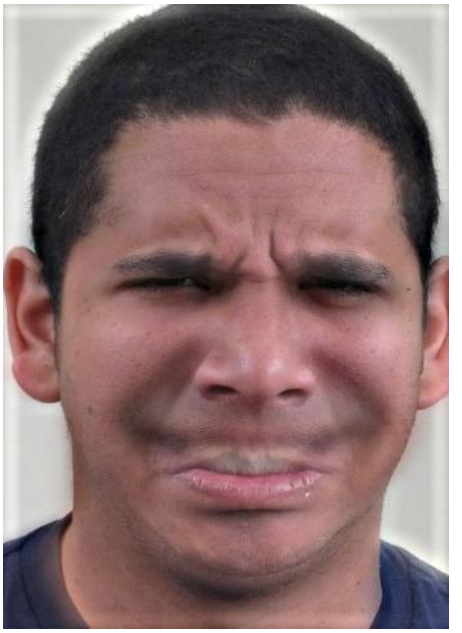
Extras:

1. Coloured:
   I did hybrid images by adding colour to the output. I also experimented change of expressions using hybrid images. I used 30 hsize for both high and low pass filters. I

used sigma of 8 for low pass of happy face and sigma of 16 for the high pass of sad face.

Image that is to be low passed

Image to be high passed



Hybrid Image

Vis image

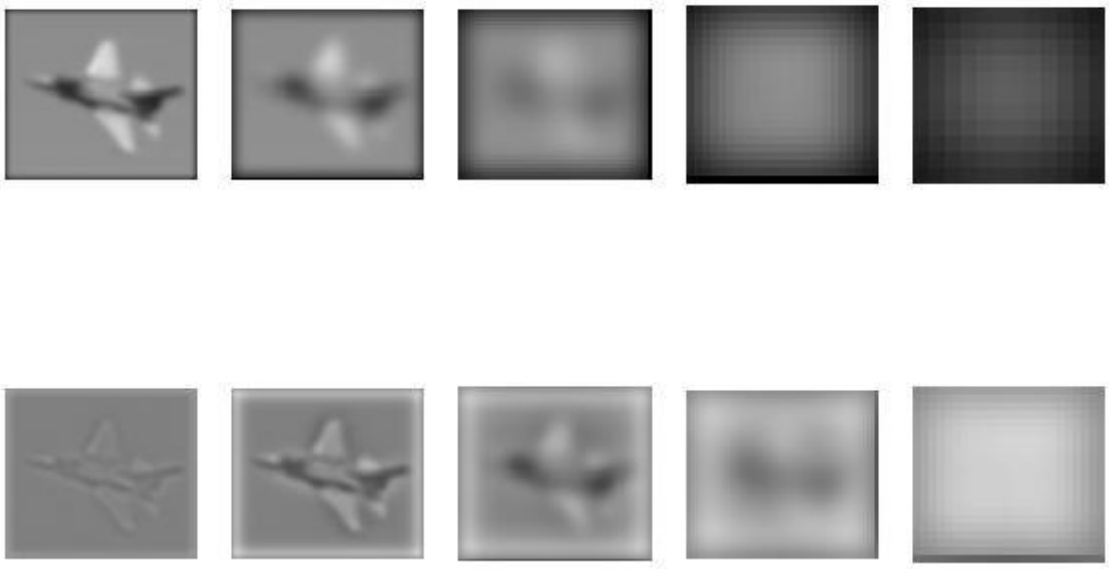
As it can be seen from the above image, the low frequency image which is happy is seen on the distant last image and sad low frequency image is found on the first closer image.

2. Laplacian and guassian pyramid for hybrid image

Laplacian and Gausian pyramid

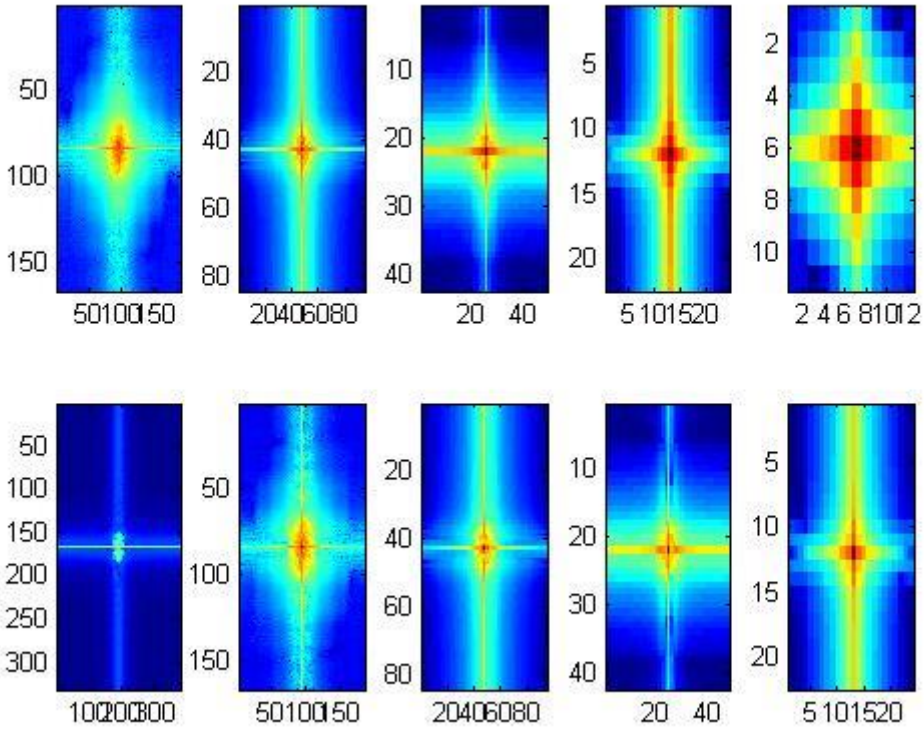
The proves that as we move from left to right the low frequency component increases due to blurring which is evident from the clarity of happy face (low pass filtered image) towards the right of pyramid. The first image in laplacian pyramid is appearing sad because comparatively it has lesser low frequency component as it's a difference of Gaussian filtered image from original image.

2. Pyramids



Laplacian and Gausian

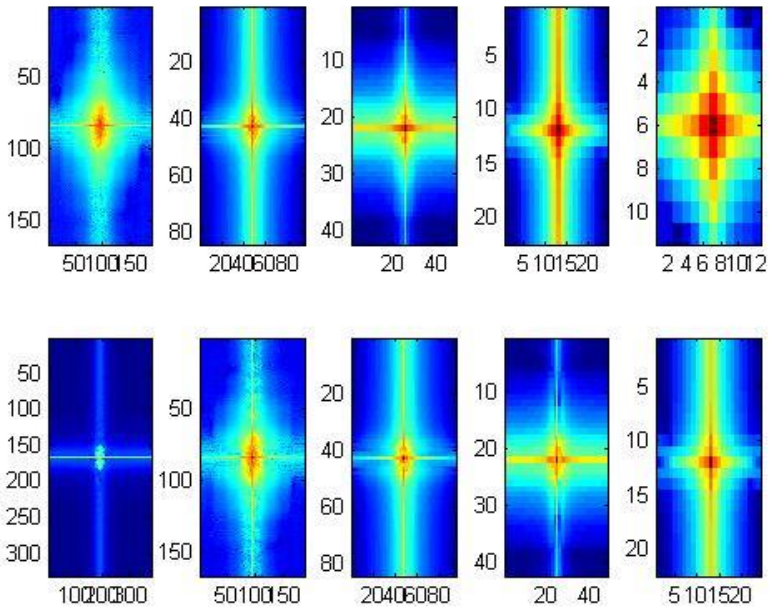
The above image gives the Gaussian and the laplacian pyramid. Gaussian pyramid is formed by smoothing the image and subsampling by 2 at every level. As it is seen in the image towards the right, the concentration of low frequencies increases in the image and it becomes blurred. The laplacian pyramid is a band pass pyramid which saves the information of difference in the resolution of different levels of Gaussian. This information is useful when we have to reconstruct the original image from the laplacian pyramid. Basically, it interpolates between the pixels with available resolution to reconstruct the original image.



The first row is the fft representation of gausian pyramid. In the first image on the left, the distribution is uniform along x and y away from center. As the levels increase, since the low frequency component increases, the concentration is more towards the center.

Extras:

1. The Laplacian and Gaussian pyramid was constructed for coloured images. The features are clearer in this version than grayscale. An additional code snippet was used to ensure equal dimensions by padding zeros as the imresize did not work with 3D image.



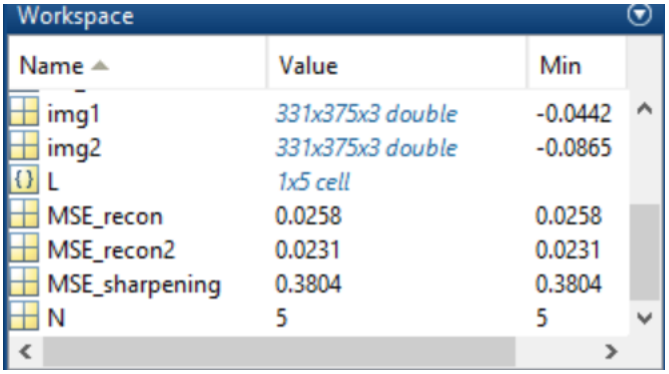
The frequency response is similar to the that for grayscale image.

2.Reconstruction of original image from Laplacian pyramid:

Reconstructed image from laplacian pyramid

Reconstructed image from laplacian pyramid where a level was scaled by 2

The Mean squared error for scaled reconstruction was found to be lesser than normal reconstruction. The error using reconstruction from laplacian pyramid was lesser than the error calculated by comparing the image obtained from sharpening image with original image.



MSE Recon= scaled laplacian

MSE= Sharpened image

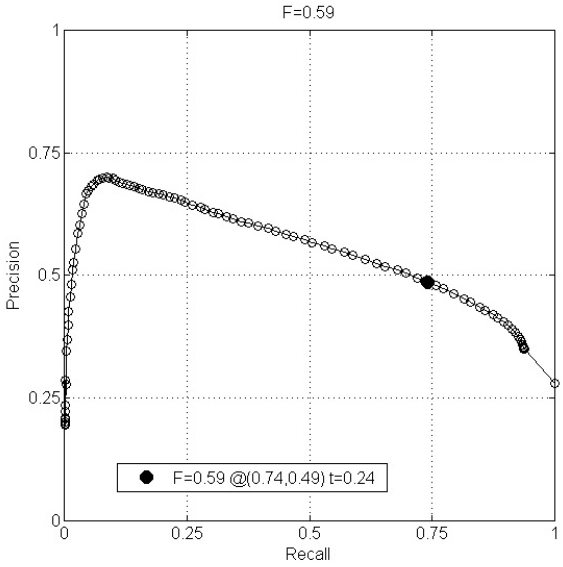
3. Edge Detection

Gradient:

Method:

Gradient magnitude function:

1. Constructed a Gaussian filter with sigma 2 which yielded the best result. Filtered the image with this low pass Gaussian filter to remove noises.
2. Designed a sobel filter and convolved with this filtered image to get the derivative along y direction. The derivative along x direction was done by taking the transpose of sobel filter.
3. The resulting filtered image was split into their respective r,g,b channels. The summation of L2 norm was calculated for the different channels. The channel corresponding to the maximum sum was chosen to calculate the orientation matrix using atan2(y/x).
4. The L2 norm was taken for all R,G,B together along x and y direction. The l2 norm of these 3 was returned as mag.

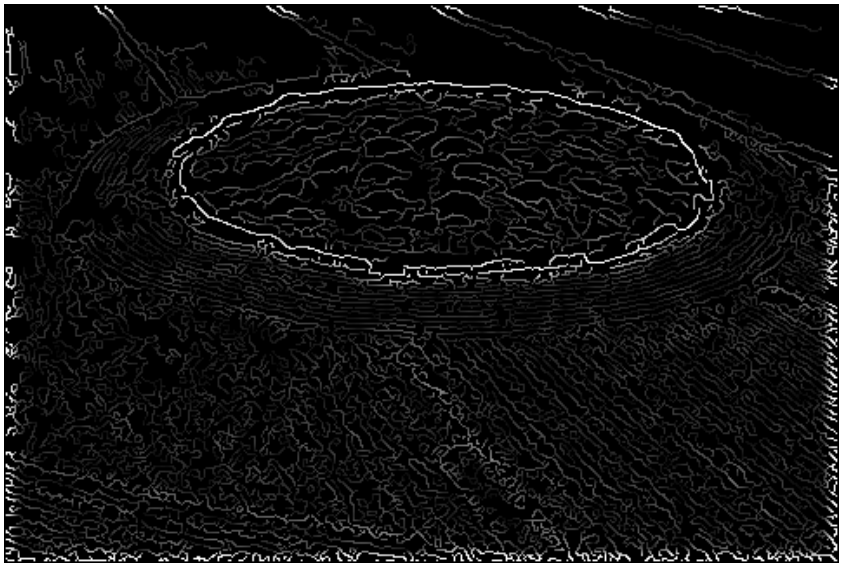


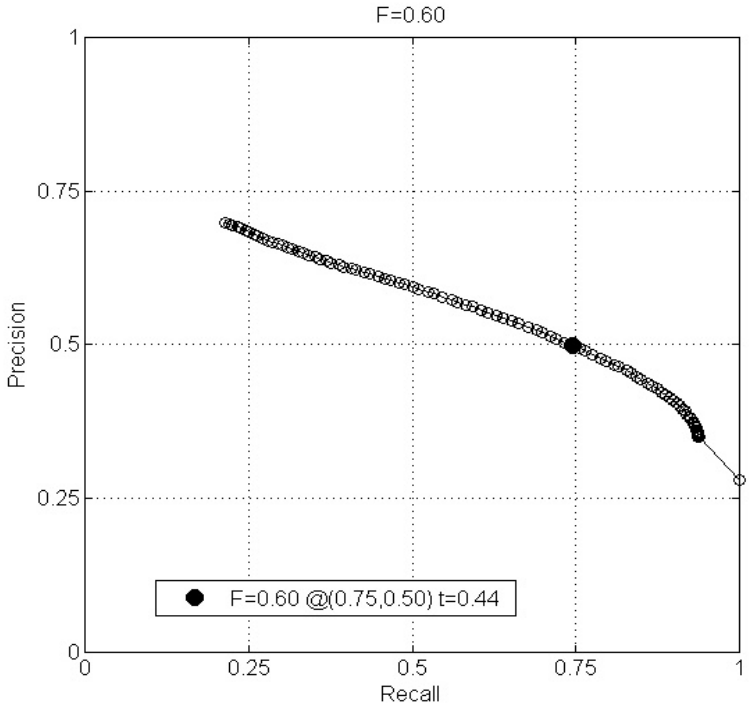
Sample Ouput of edge detector gradient

The edge gradient function calls gradient magnitude function. It calculates the binary edge matrix with the non-maxima suppression of canny edge. This is multiplied with the returned mag matrix from gradient magnitude to give the edge score. Since the canny edge returns a matrix of ones and zeros by comparing every pixel with surrounding 4 pixels(it makes those pixels whose gradient is lesser than a threshold as zero and the rest as 1). Thus by multiplying with these edges we ensure that the gradient is found only at strong edges.

The results are shown in the above two graphs. I got the fscore and avg fscore as (.59,.615).

Oriented





Method:

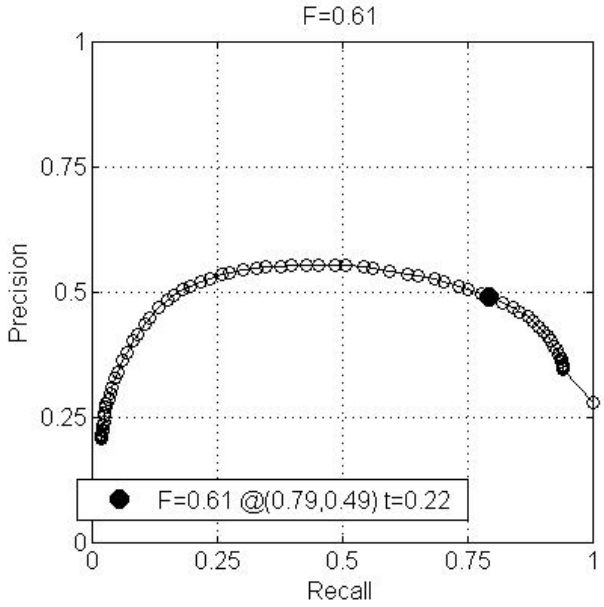
1. The Gaussian filter was constructed with sigma and hsize as .
2. This derivative of this gausian filter was calibrated by taking the sobel filter of Gaussian filter.
3. The Gaussian derivative filter was rotated for 8 orientations(angles starting from 0 to 180 equally divided).

4. The image was divided into 3 channels and was convolved with each of these oriented derivative Gaussian filter resulting in filteredr, filtered and filtered for every orientation.
5. The L2 norm was taken over filteredr,filtered,filteredb for every orientation resulting in R,G,B.
6. L2 norm was taken over R,G,B to give mag. Thus the response of all 4 filters were combined.
7. It resulted in increased F score of 0.60 and average f-score was 0.626.

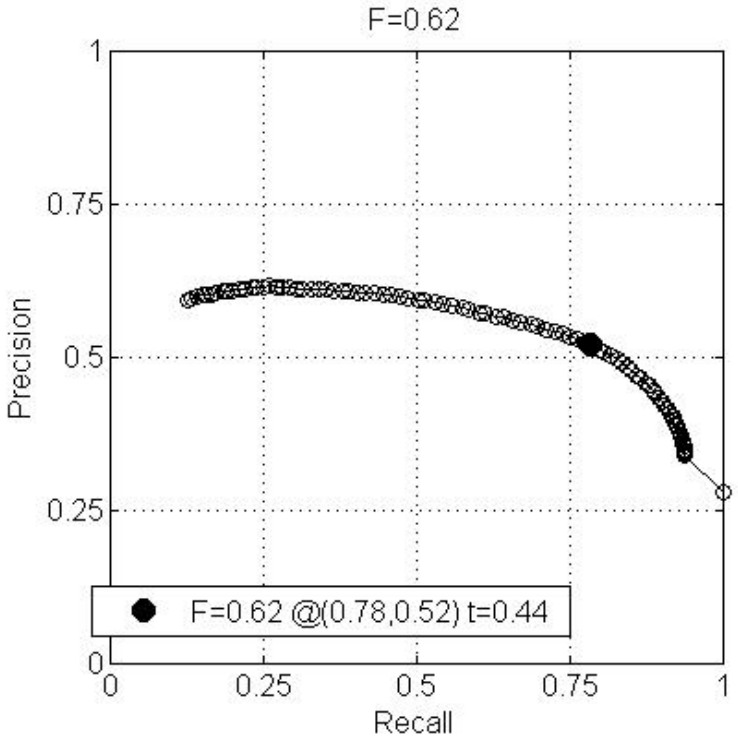
The tables are included as text file in the folder results.

Extras:

1. Changing colour space:
   The gradient calculation was performed in HSV space and the resulting overall fscore greater.
   Overall fscore=0.61



   The resulting fscore and fmax were greater.
2. Improvised the output of Orientation Filter:
   I changed the color space to hsv and used morphological transformation to the output of canny edge using the closing operator. It basically performs erosion after dialation which helps in enhancing the edges.



The overall f score was 0.62 and average fscore was 0.644

I have included the codes corresponding to this in \improved_result_withclosing folder. I am planning to use open operator with this result.