COMPUTER VISION (CAP5415)-PA-1 REPORT

CANNY EDGE DETECTION

Step 1: Firstly, we need to read a gray scale image from the given dataset ‘Berkeley Segmentation Dataset’ and that image is stored in a matrix named ‘I’. In addition, I created a definition to take the input URL automatically without any manual intervention.

Step2: I have used the kernel length as 7 i.e.., from (-3 to +3) and it is iterated with every position w.r.t gaussian filter

1D gaussian distribution is stated as follows:

$$G(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{\frac{-x^2}{2\sigma^2}}$$

Step 3: Here, I performed convolution of 2Dimensional input image along with 1Dimensional Gaussian kernel in both the x and y directions. Named them as Ix and Iy (Iy is transpose of Ix).

Step 4: I’ve used the gaussian derivative formulae as listed below to get the gaussian derivative G(x) which is in X axis direction and applied the transpose of G(x) to get G(y) (where G(y) is gaussian derivative in Y axis direction).

$$G'(x) = \frac{-x}{\sqrt{2\pi\sigma^3}} e^{\frac{-x^2}{2\sigma^2}}$$

Step 5: Convoluted I(X) and G(X) and named it as (I_X). Similarly convoluted I(y) and G(y) and named it as (I_Y) {I used the transpose of X to get the I_Y}.

Step 6: I calculated the magnitude of the gradient of each pixel in X and Y direction to detect the edges in an image.

$$M(x, y) = \sqrt{G'(x)^2 + G'(y)^2}$$

Step 7: Magnitude, direction and angle is calculated according to each pixel in order to create a Non-Maximum suppression function to identify local maxima containing highest gradient magnitude along the edges by classifying true/ false edges.

Suppressing the noise direction is calculated using below formulae:

$$\theta_{x,y} = arctan\left(G'(x), G'(y)\right)$$

Step 8: Here we used thresholding to identify strong edges and marked them as 1 and weak edges as 0. Where highest value is given as (20% of maximum pixel value) and lowest value (7% of maximum pixel value). Stored the final output image as hysteresis threshold which indeed handled noise and improvising the detected edges quality.

CONCLUSION:

To encapsulate, I took 3 standard deviations/ sigma (0.5,2,4) for my training input images out of which I found that, the lowest sigma value (0.5) handled noise and improvised the detected edges quality. So, I convey that lowest sigma value gave me the best result.

Output Images:

Image 1

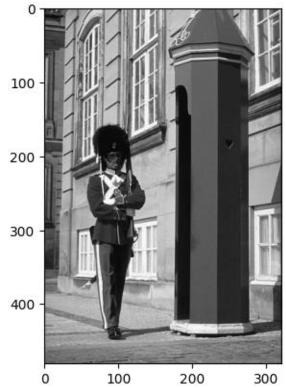
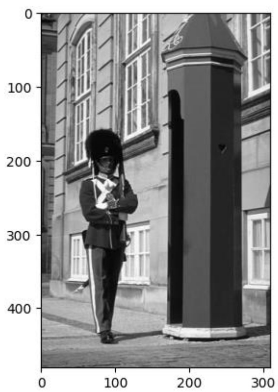
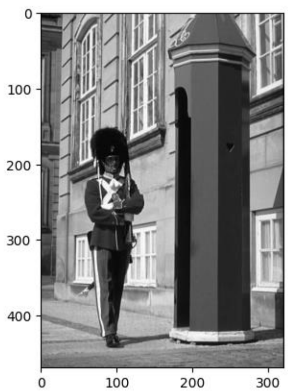


Fig.1 Original image

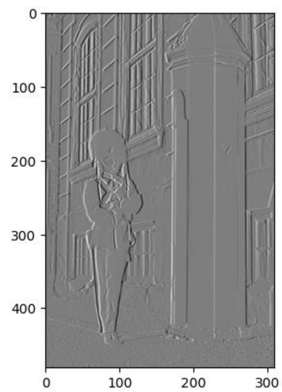
Sigma = 0.5



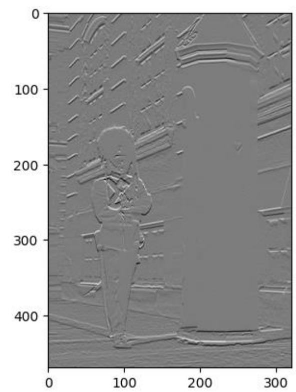
Ix



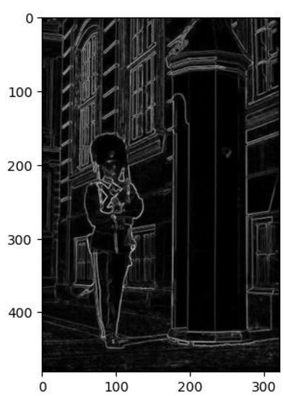
Iy



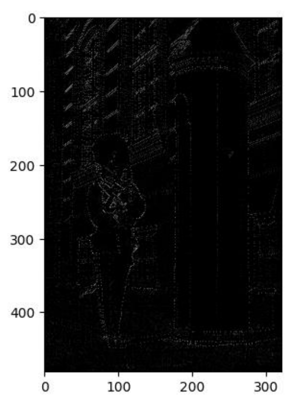
Ix_Prime



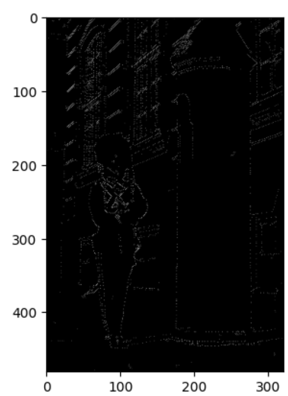
Iy_Prime



Magnitude

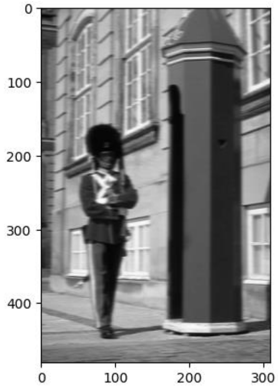


NonMax_Suppression

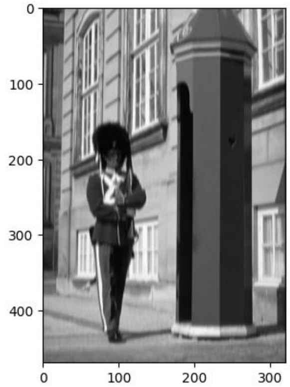


Hysterisis_Threshold

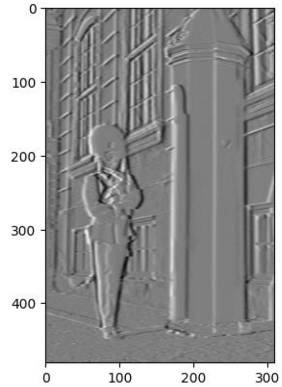
Sigma = 2



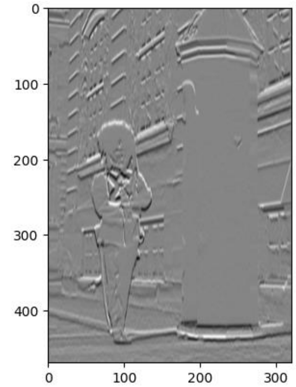
Ix



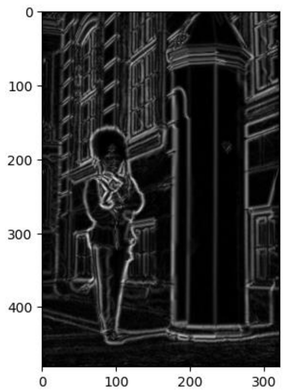
Iy



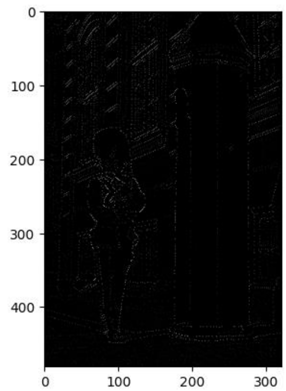
Ix_Prime



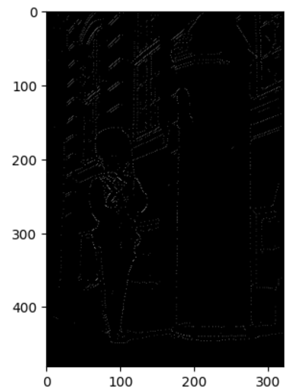
Iy_Prime



Magnitude

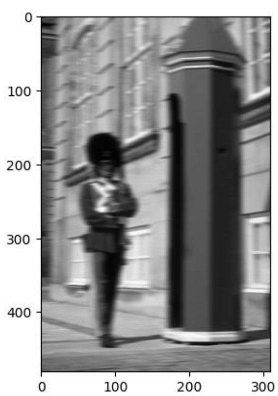


NonMax_Suppression

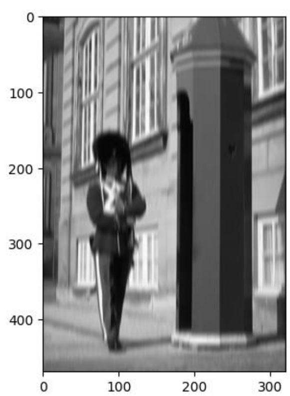


Hysterisis_Threshold

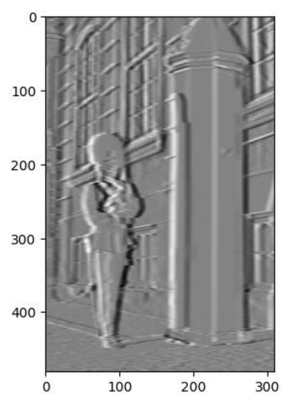
Sigma = 4



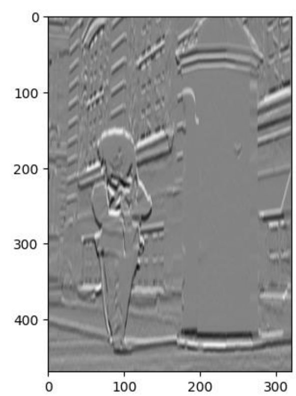
Ix



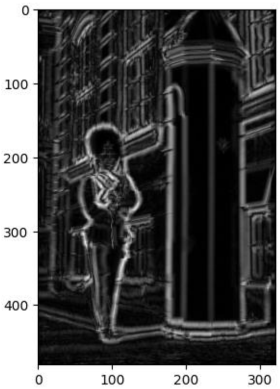
Iy



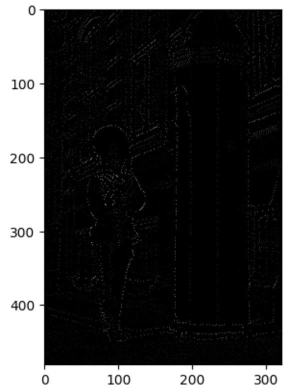
Ix_Prime



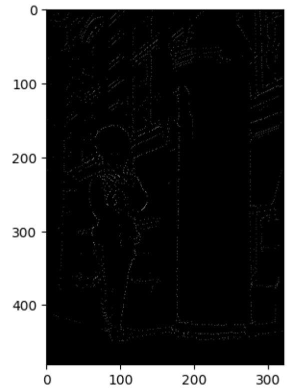
Iy_Prime



Magnitude



NonMax_Suppression



Hysterisis_Threshold

Image 2

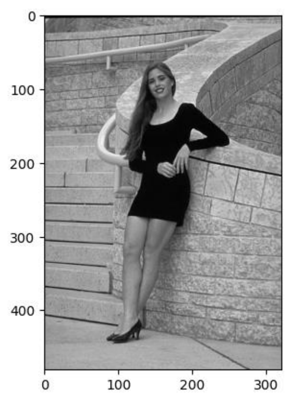
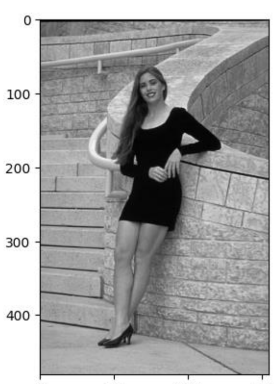
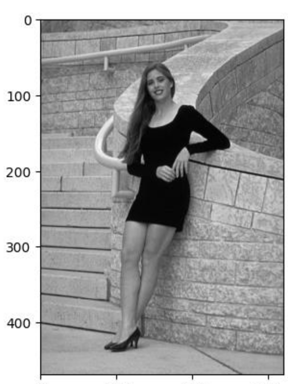


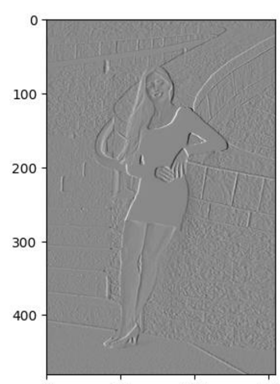
Fig.2 original



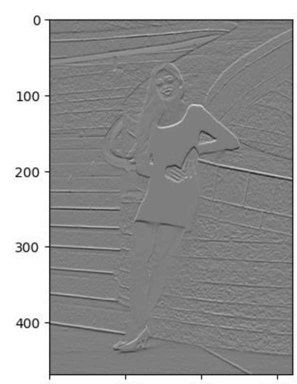
Ix



Iy



Ix_Prime



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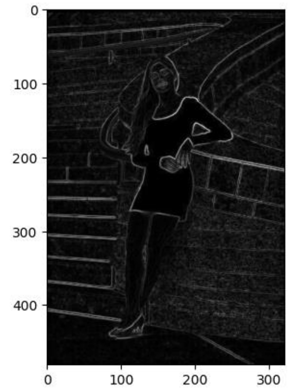
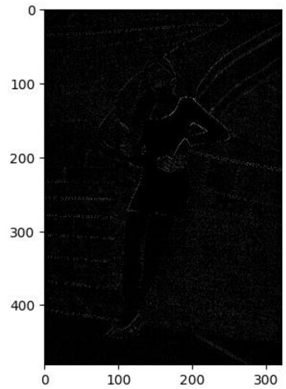
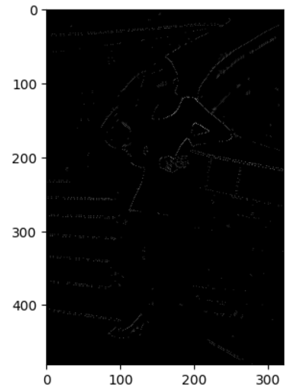


Magnitude

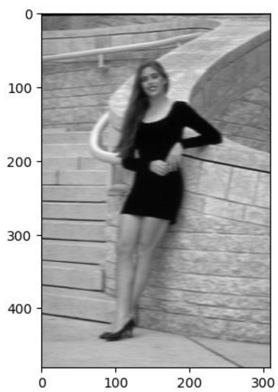


NonMax_Suppression

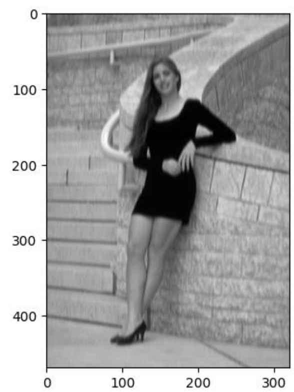


Hysterisis_Threshold

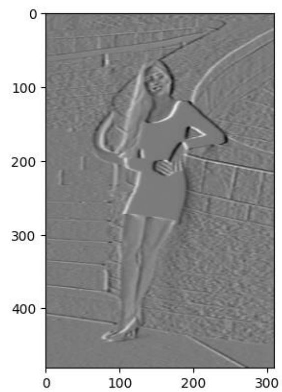
Sigma = 2



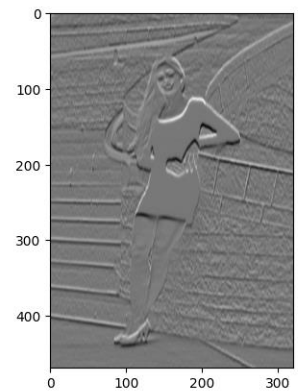
Ix



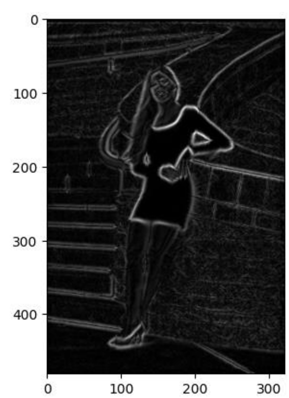
Iy



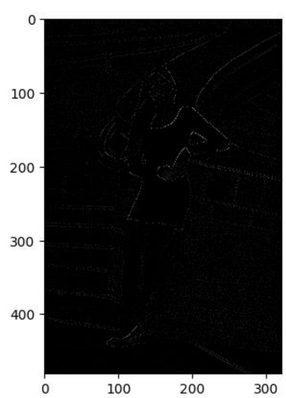
Ix_Prime



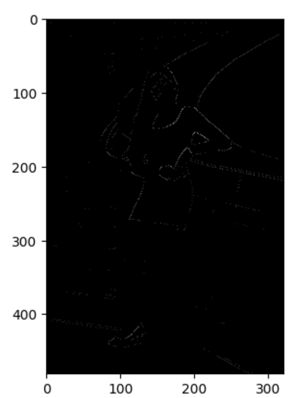
Iy_Prime



Magnitude

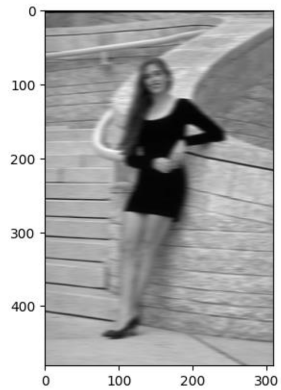


NonMax_Suppression

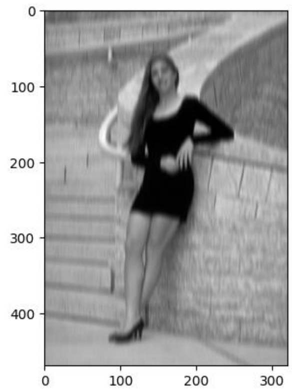


Hysterisis_Threshold

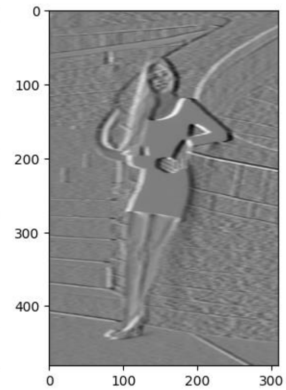
Sigma = 4



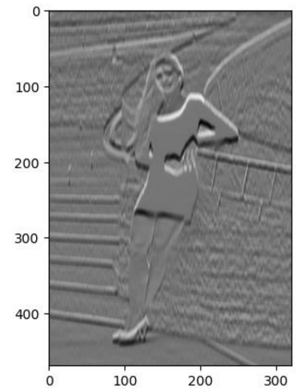
Ix



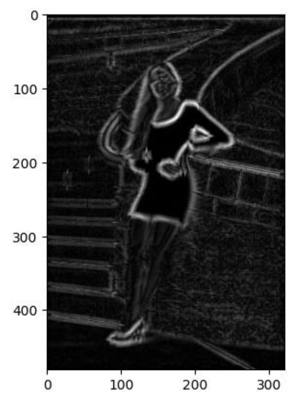
Iy



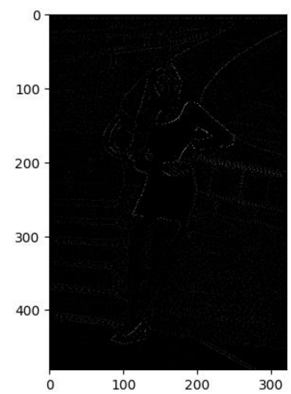
Ix_Prime



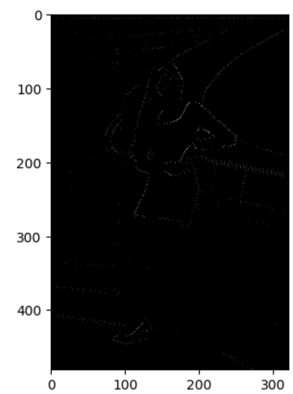
Iy_Prime



Magnitude



NonMax_Suppression



Hysterisis_Threshold

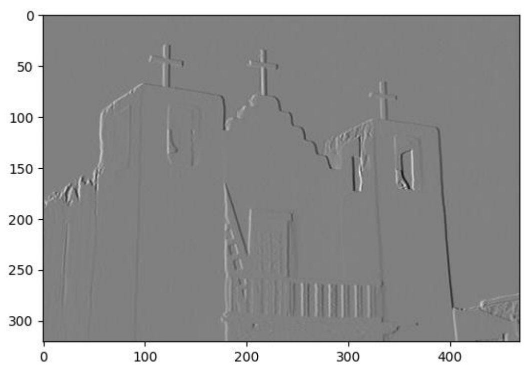
Image 3

Fig.3 Original

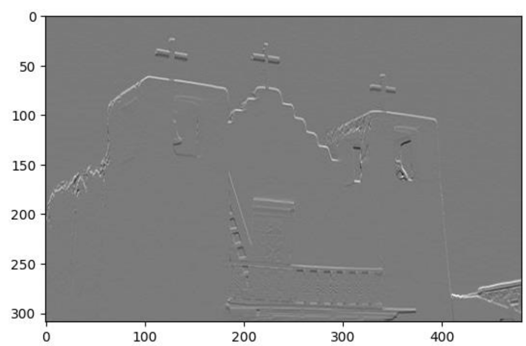
Sigma =0.5

Ix

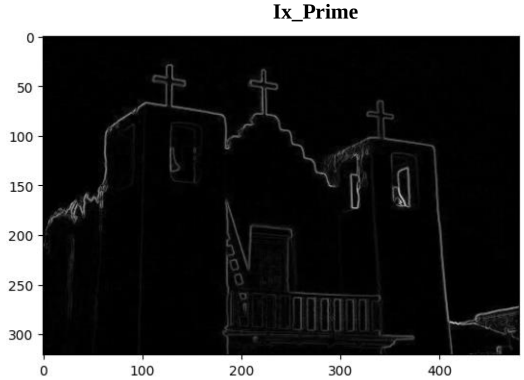
Iy



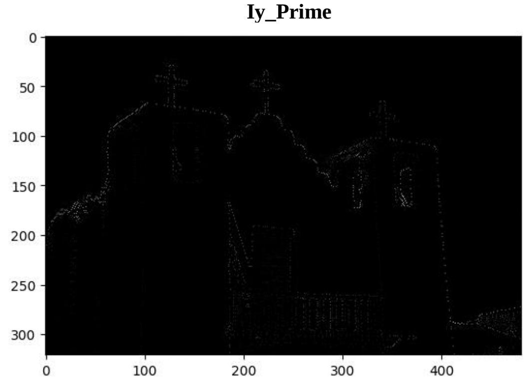
Ix_Prime



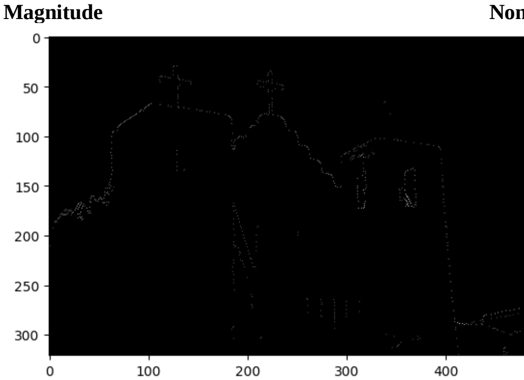
Iy_Prime



Magnitude

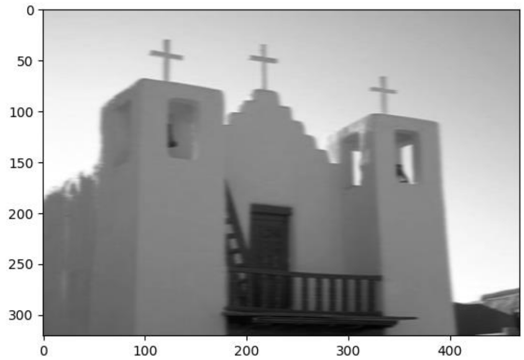


NonMax_Suppression



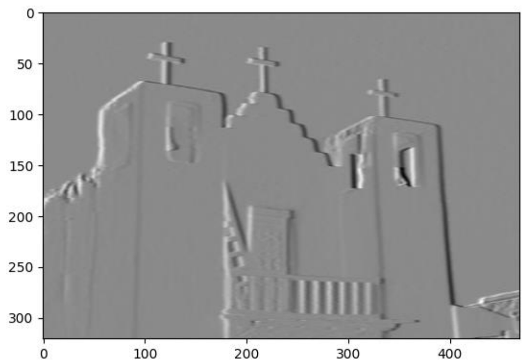
Hysterisis_Threshold

Sigma = 2

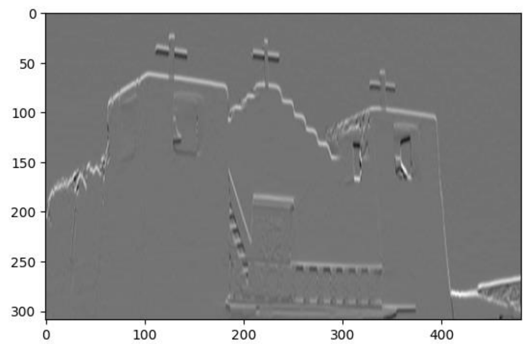


Ix

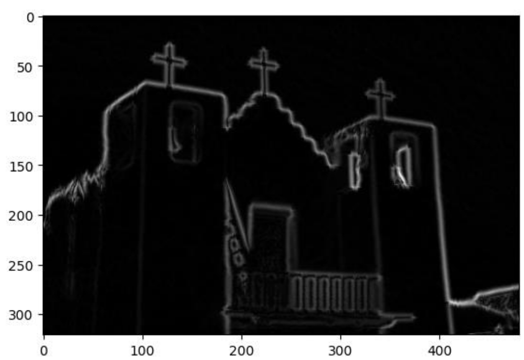
Iy



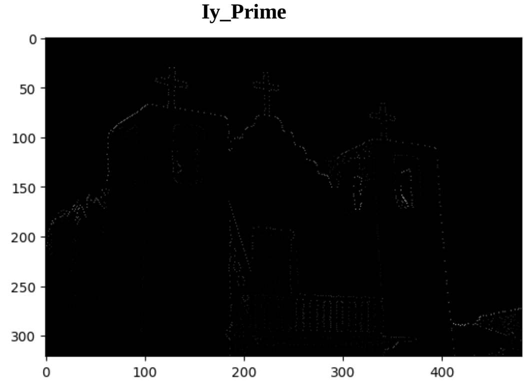
Ix_Prime



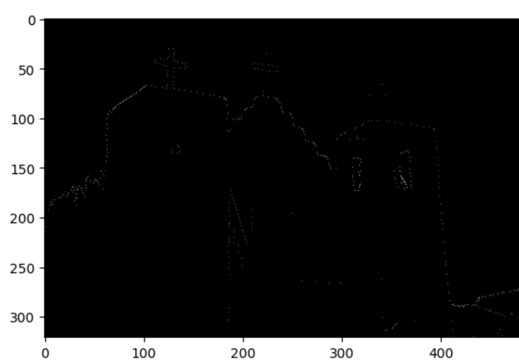
Iy_Prime



Magnitude



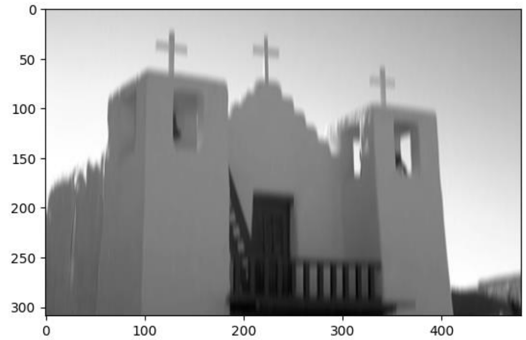
NonMax_Suppression



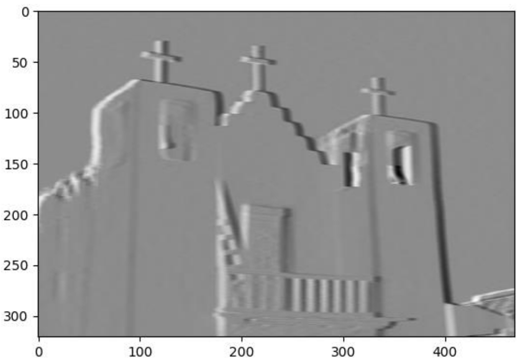
Hysterisis_Threshold

Sigma = 4

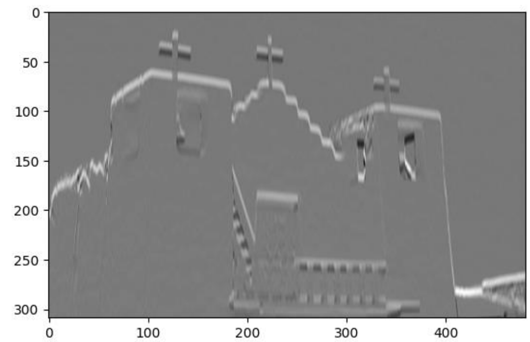
Ix



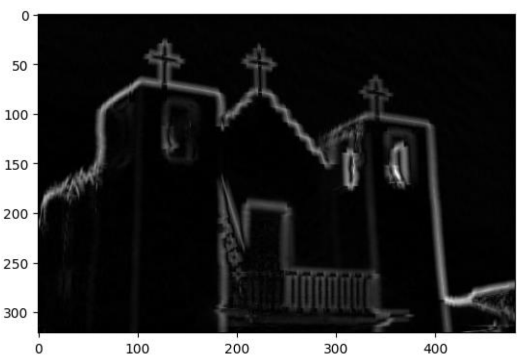
Iy



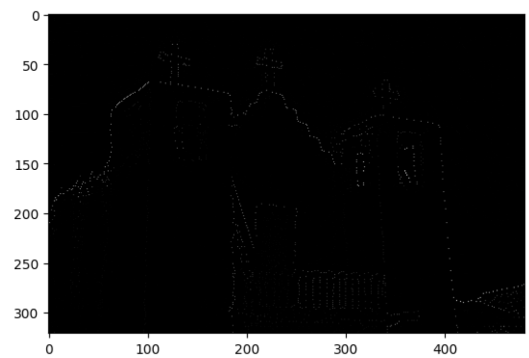
Ix_Prime



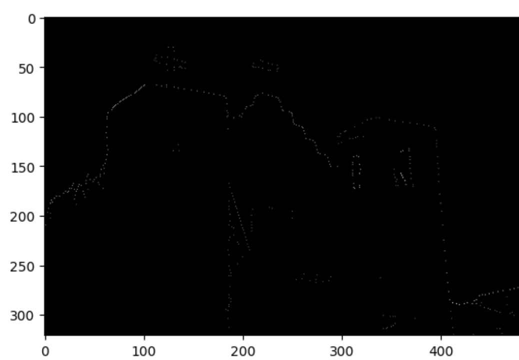
Iy_Prime



Magnitude



NonMax_Suppression



Hysterisis_Threshold