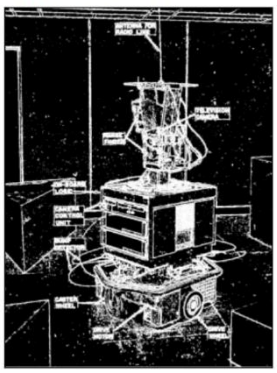
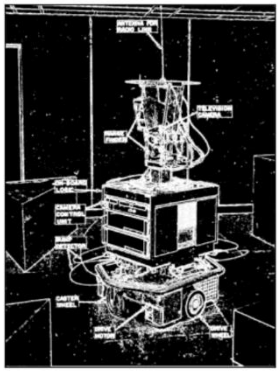
Lab 2 – Noise Filtering

QUESTION 1: Can you describe the effect in comparison with applying the edge filter to the image directly?

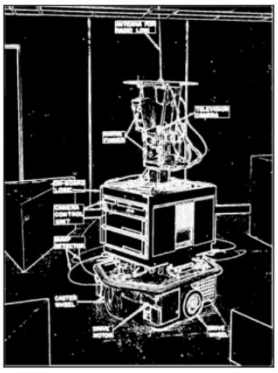
Original Image with edge detector



3x3 gaussian applied with edge detector



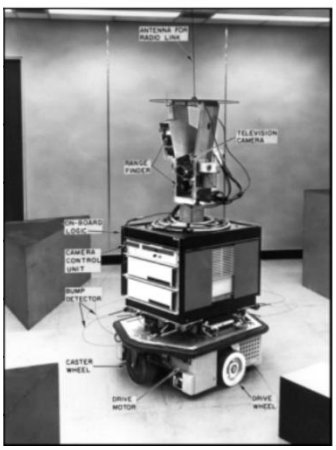
5x5 gaussian applied with edge detector



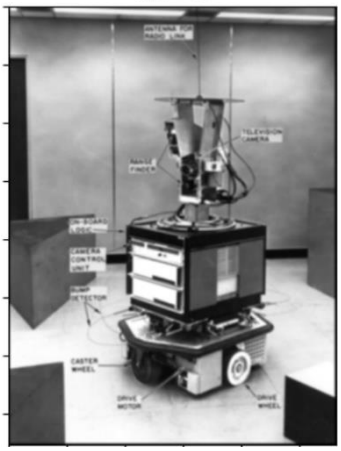
As seen in the above images, when the edge detector (in this case a sobel filter with a pythagorean magnitude function) is applied with thresholding to the original image, a representation of the edges is produced with a great deal of noise in the image, shown by the white dots throughout. When the 3x3 Gaussian is applied before edge detection with the same threshold, this noise is reduced, resulting in fewer white dots, and then when the 5x5 gaussian is applied, there is again less noise. This is because a 5x5 filter has a larger area than a 3x3 filter, and so, during convolution, it takes into account more neighbouring voxels when computing an average weight of voxel. This results in a stronger smoothing effect and a greater reduction of noise, while maintaining the important features of the image.

Question 2: What is the effect of increasing the size of the Gaussian Filter (3x3 versus 5x5 for example)? What is the effect of changing the standard deviation s? Why do you see what you see?

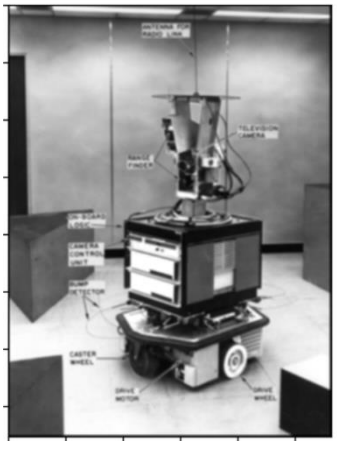
SD = 1



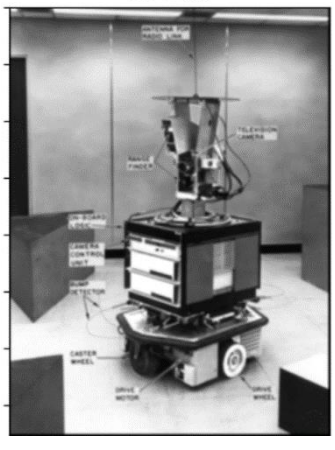
SD = 5



SD = 10



SD = 50



```
# Complete Task 2 here

#set parameters
std_dev = 1
mean = 0
x = 4

#instantiate vector with parameters
vec = np.arange(-x,x+1,1,np.float32)

#create gaussian sample of size 9
a = sample_gaussian(std_dev, mean,vec)

#matrix multiplication with itself to produce 9x9 mask
outer = np.outer(a,a)

#convolve with image
NinexNineMaskConvolve = scipy.signal.convolve2d(shakey, outer)

#show image with mask applied
plt.imshow(NinexNineMaskConvolve, cmap="gray")
plt.title("SD = 1")
plt.show()

###### Repeated code with varied standard deviations###############
```

Increasing the size of the Gaussian filter increases the effect of smoothing, as mentioned above, a larger filter considers more neighbouring voxels when it averages them, and so smooths the image more, resulting in less noise in a 3x3 filter than in a 5x5. When the 9x9 gaussian is applied and the standard deviation is increased, the picture becomes more blurry. This is because when the standard deviation is increased, the gaussian is generated with a higher variance. Therefore, the voxels further away from the centre voxel of the mask are given more weight compared to the centre voxel, this means that they have more of an effect of the output when the convolution takes place, this results in the image becoming more blurry as standard deviation is increased.