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AIM: To perform Image Enhancement(SD) Neighbourhood Processing Techniques: Smoothing Operators

PROBLEM STATEMENT:

Add Gaussian Noise, Remove using Averaging Filter

Add Salt & Pepper Noise, Remove using Median Filter

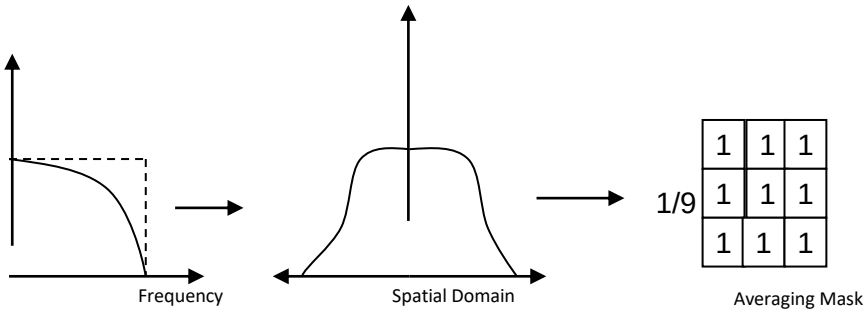
THEORY:

Smoothing

Low pass filtering removes the high frequency content from the image. It is used to remove the noise present in the image which is generally a high frequency signal.

1. **Averaging Filter**

If an image has Gaussian noise, a low pass averaging filter is used to remove the noise. The frequency response and spatial response is show below.



From spatial response we generate the mask that would give us the low pass filtering operation. Here all the coefficients are positive and the multiplying factor for a M X N matrix is 1 / (M X N).

2. **Median Filtering**

The averaging filter removes the noise by filtering it till it is no longer seen. But in the process it also blurs the edges. If e use averaging filter to remove salt and pepper noise from an image it will blur the noise but will also ruin the edges. Hence when we need to remove salt and pepper noise we use non-linear filter known as Median Filter. They are also called order statistical filters because their response is based on the ordering and ranking of the pixels contained within the mask.

Steps to perform median filtering:

1. Assume 3 X 3 empty mask.
2. Place it on let hand side corner.
3. Arrange the 9 pixels in ascending or descending order
4. Choose the median from these nine values.
5. Place this median at the centre.
6. Move the mask in similar fashion as the averaging mask

In median filtering the grey level of the centre pixel is replaced by the median filter value of the neighbourhood.

RESULT:

The average filters seems to blur the image and reduce the overall quality of the image. Whereas the gaussian filters sharpness the image too much thereby making it tough to be visible and get any information. Thou by combining both of the filters the overall quality of the image increases and it also creates a good amount of depth in the image.The median filter seems to be just as like as the average i.e. it reduces the quality of the image.

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IPCV - LAB4

In [ ]:
```
import cv2
import numpy as np
import matplotlib.pyplot as plt
from google.colab.patches import cv2_imshow
```

In [ ]:
```
img = cv2.imread('/content/gateway.jpeg', 0)
cv2_imshow(img)
```

In [ ]:
```
img.shape
```

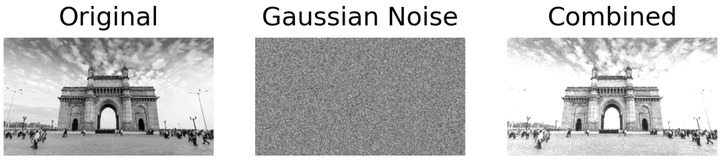
Out[ ]:
```
(168, 300)
```

In [ ]:
```
gauss_noise=np.zeros((168,300),dtype=np.uint8)
cv2.randn(gauss_noise,128,20)
gauss_noise=(gauss_noise*0.5).astype(np.uint8)
```

In [ ]:
```
gn_img=cv2.add(img, gauss_noise)
```

In [ ]:
```
fig=plt.figure(dpi=300)

fig.add_subplot(1,3,1)
plt.imshow(img,cmap='gray')
plt.axis("off")
plt.title("Original")

fig.add_subplot(1,3,2)
plt.imshow(gauss_noise,cmap='gray')
plt.axis("off")
plt.title("Gaussian Noise")

fig.add_subplot(1,3,3)
plt.imshow(gn_img,cmap='gray')
plt.axis("off")
plt.title("Combined")
```

Out[ ]:
```
Text(0.5, 1.0, 'Combined')
```



In [ ]:
```
filter = np.array([[1/9 for i in range(3)] for j in range(3)])
filter
```

Out[ ]:
```
array([[0.11111111, 0.11111111, 0.11111111],
       [0.11111111, 0.11111111, 0.11111111],
       [0.11111111, 0.11111111, 0.11111111]])
```

In [ ]:
```
gn_img
```

Out[ ]:
```
array([[255, 253, 237, ..., 152, 164, 191],
       [238, 237, 239, ..., 180, 167, 199],
       [238, 228, 236, ..., 193, 157, 213],
       ...,
       [242, 255, 250, ..., 237, 235, 224],
       [236, 255, 249, ..., 235, 241, 251],
       [252, 255, 233, ..., 241, 240, 227]], dtype=uint8)
```

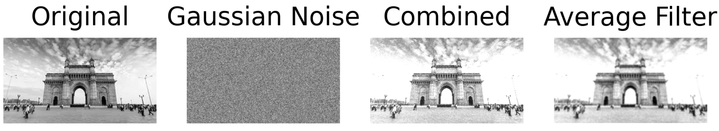
Average Filter

In [ ]:
```
output = []
for r in range(gn_img.shape[0]-2):
  temp = []
  for c in range(gn_img.shape[1]-2):
    lhs = gn_img[r:r+3, c:c+3]
    ans = 0
    for r_f in range(filter.shape[0]):
      for c_f in range(filter.shape[1]):
        ans += lhs[r_f][c_f]*filter[r_f][c_f]
    temp.append(ans)
  output.append(temp)
```

In [ ]:
```
output = np.array(output)
cv2_imshow(output)
```

In [ ]:
```
fig=plt.figure(dpi=400)

fig.add_subplot(1,4,1)
plt.imshow(img,cmap='gray')
plt.axis("off")
plt.title("Original")

fig.add_subplot(1,4,2)
plt.imshow(gauss_noise,cmap='gray')
plt.axis("off")
plt.title("Gaussian Noise")

fig.add_subplot(1,4,3)
plt.imshow(gn_img,cmap='gray')
plt.axis("off")
plt.title("Combined")

fig.add_subplot(1,4,4)
plt.imshow(output,cmap='gray')
plt.axis("off")
plt.title("Average Filter")
```

Out[ ]:
```
Text(0.5, 1.0, 'Average Filter')
```



In [ ]:

Median Filter

In [ ]:
```
import random
salt_and_pepper_img = img.copy()
salt_and_pepper_img
```

Out[ ]:
```
array([[193, 188, 180, ..., 107, 100, 111],
       [182, 179, 173, ..., 111, 106, 115],
       [170, 168, 165, ..., 117, 115, 123],
       ...,
       [182, 182, 181, ..., 173, 167, 161],
       [189, 188, 187, ..., 177, 176, 175],
       [176, 175, 173, ..., 161, 166, 171]], dtype=uint8)
```

In [ ]:
```
for i in range(200):
  row = random.randint(0, img.shape[0]-1)
  col = random.randint(0, img.shape[1]-1)
  n = random.randint(0,1)
  if(n==0):
    salt_and_pepper_img[row][col] = 0
  else:
    salt_and_pepper_img[row][col] = 255
```

In [ ]:
```
cv2_imshow(salt_and_pepper_img)
```

In [ ]:
```
output = []
for r in range(salt_and_pepper_img.shape[0]-2):
  temp = []
  for c in range(salt_and_pepper_img.shape[1]-2):
    lhs = salt_and_pepper_img[r:r+3, c:c+3]
    lhs_flatten = lhs.flatten()
    lhs_flatten.sort()
    temp.append(lhs_flatten[4])
  output.append(temp)
```

In [ ]:
```
output = np.array(output)
```

In [ ]:
```
fig=plt.figure(dpi=400)

fig.add_subplot(1,3,1)
plt.imshow(img,cmap='gray')
plt.axis("off")
plt.title("Original")

fig.add_subplot(1,3,2)
plt.imshow(salt_and_pepper_img,cmap='gray')
plt.axis("off")
plt.title("Combined")

fig.add_subplot(1,3,3)
plt.imshow(output,cmap='gray')
plt.axis("off")
plt.title("Median Filter")
```

Out[ ]:
```
Text(0.5, 1.0, 'Median Filter')
```