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```

Image and Video Processing Assignment - 4

```
clc;
clear all;
close all;
```

Question 1: Salt and Pepper Noise

```
% The function adds salt and pepper noise to input image
function [out] = salt_and_pepper(img, level)
% img: Input image on which noise is to be added
% level: The level of noise
%
% out: Output image

[row, col] = size(img);
noise_function = randi(255, row, col);

out = img;

% Adding salt and pepper noise
out(noise_function<=level) = 0;
out(noise_function>=255-level) = 255;

end
```

Salt and Pepper Noise addition example

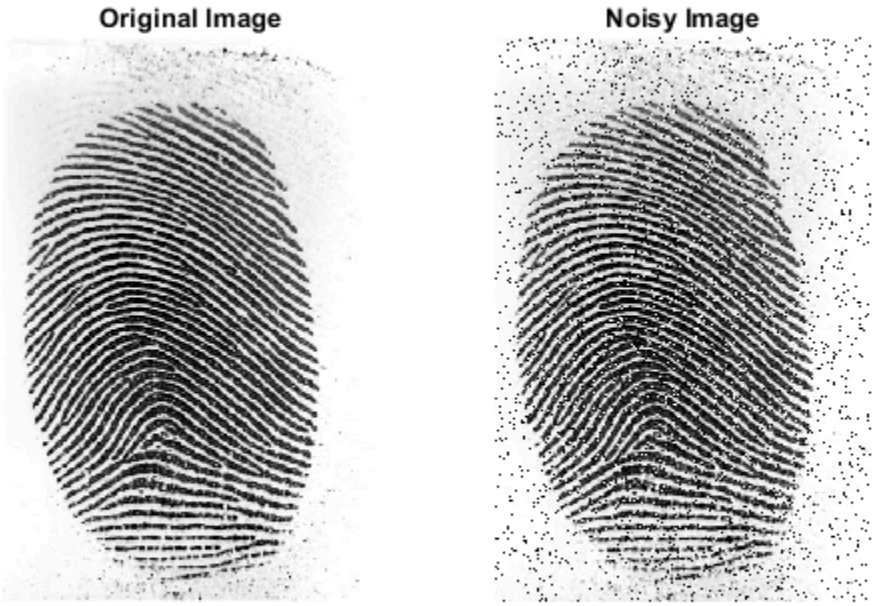
The salt and pepper noise is added to an image

```
% Read the input image
% Read the input image as a double
orig_img = imread('fingerprint.jpg');
orig_img = rgb2gray(orig_img);
img = double(orig_img);

% Salt and Pepper Noise addition
out = salt_and_pepper(img, 10);
out = mat2gray(out);

figure('Name', 'Salt and Pepper');
subplot(121)
imshow(orig_img);
title('Original Image');

subplot(122)
imshow(out);
title('Noisy Image');
```



Question 2: Median Filter

```
% The function removes noise using median filter
function [out] = median_filter(img, filter_size)
% img: Input image on which noise is to be added
% filter_size: The size of the median filter
% out: Output image

[row, col] = size(img);
out = img;

for i = 1+floor(filter_size/2):row - floor(filter_size/2)
    for j = 1+floor(filter_size/2):col - floor(filter_size/2)
        x_start = i - floor(filter_size/2);
        y_start = j - floor(filter_size/2);

        x_end = i + floor(filter_size/2);
        y_end = j + floor(filter_size/2);

        % Replacing with the median value
        img_section = img(x_start:x_end, y_start:y_end);
        out(i,j) = median(img_section, 'all');
    end
end

end
```

Noise removal using Median filter

This demonstrates removal of salt and pepper noise using a median filter

```
% Read the input image
% Read the input image as a double
orig_img = imread('fingerprint.jpg');
orig_img = rgb2gray(orig_img);
img = double(orig_img);

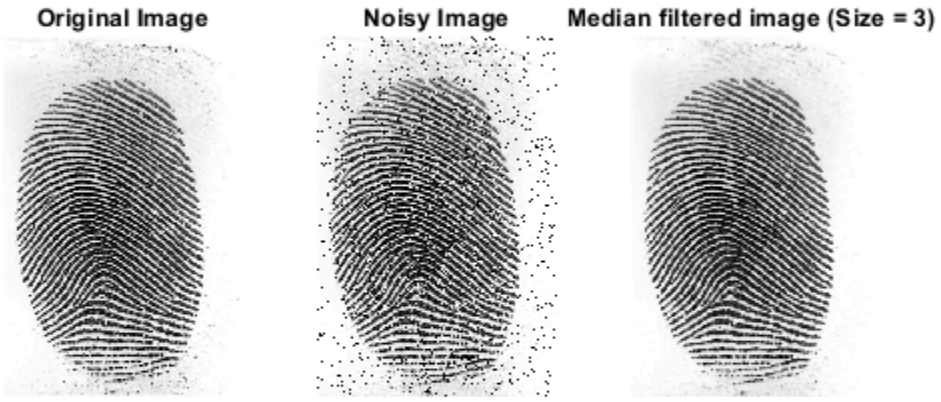
% Salt and Pepper Noise addition
out = salt_and_pepper(img, 10);
out = mat2gray(out);

% Median filtering
out1 = median_filter(out, 3);
out1 = mat2gray(out1);

figure('Name', 'Median Filtering');
subplot(131)
imshow(orig_img);
title('Original Image');
```

```
subplot(132)
imshow(out);
title('Noisy Image');

subplot(133)
imshow(out1);
title('Median filtered image (Size = 3)');
```



Question 3: Contraharmonic mean filter

```
% The function removes noise using median filter
function [out] = contraharmonic_mean(img, filter_size, Q)
% img: Input image on which noise is to be added
% filter_size: The size of the median filter
% Q: The order of the filter
% out: Output image

[row, col] = size(img);
out = img;

for i = 1+floor(filter_size/2):row - floor(filter_size/2)
    for j = 1+floor(filter_size/2):col - floor(filter_size/2)
        x_start = i - floor(filter_size/2);
        y_start = j - floor(filter_size/2);
```

```
            x_end = i + floor(filter_size/2);
            y_end = j + floor(filter_size/2);

            img_section = img(x_start:x_end, y_start:y_end);

            % Finding the contraharmonic mean
            num = sum(sum(img_section.^(Q+1)));
            den = sum(sum(img_section.^(Q)));

            out(i,j) = num / den;
        end
    end

    end
```

Noise removal using Contraharmonic mean filter

This demonstrates removal of salt and pepper noise using a contraharmonic mean filter

```
% Read the input image
% Read the input image as a double
orig_img = imread('fingerprint.jpg');
orig_img = rgb2gray(orig_img);
img = double(orig_img);

% Salt and Pepper Noise addition
out = salt_and_pepper(img, 10);
out = mat2gray(out);

% Contraharmonic mean filtering with positive Q
out1 = contraharmonic_mean(out, 3, 1);
out1 = mat2gray(out1);

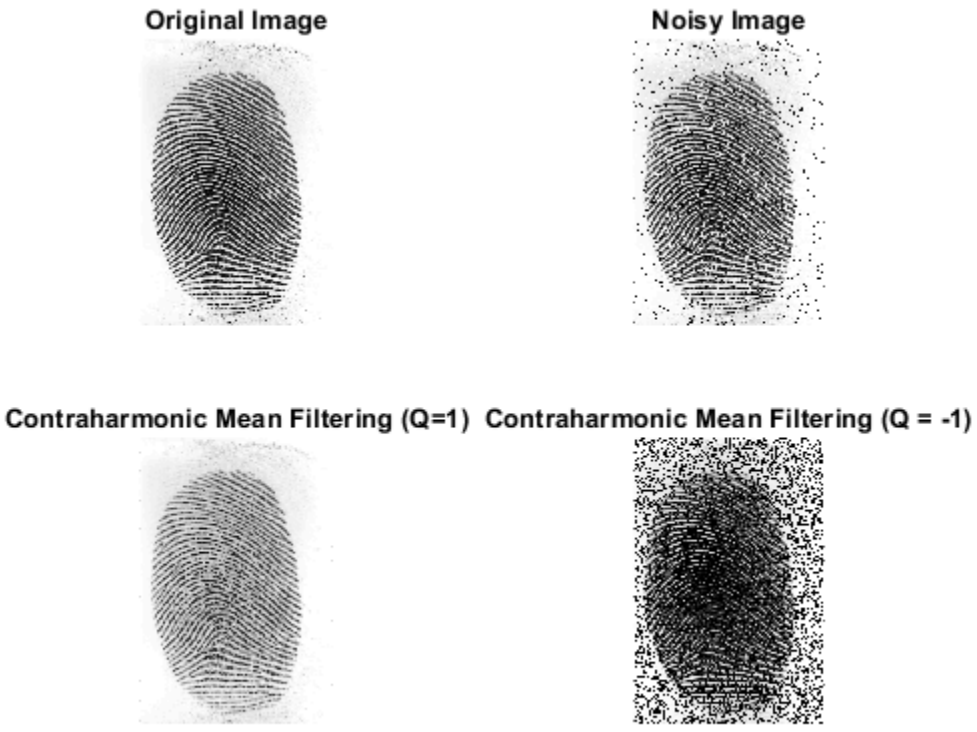
% Contraharmonic mean filtering with negative Q
out2 = contraharmonic_mean(out, 3, -1);
out2 = mat2gray(out2);

figure('Name', 'Contraharmonic Mean Filtering');
subplot(221)
imshow(orig_img);
title('Original Image');

subplot(222)
imshow(out);
title('Noisy Image');

subplot(223)
imshow(out1);
title('Contraharmonic Mean Filtering (Q=1)');
```

```
subplot(224)
imshow(out2);
title('Contraharmonic Mean Filtering (Q = -1)');
```



Conclusion

This experiment demonstrates how impulse noise (salt and pepper) can be added to an image. We also learnt how such impulse noises can be removed using median and contraharmonic mean filters. Contraharmonic mean filter is very senstitive to the value of Q or the order. The positive value of Q can be used to remove pepper noise and the negative value can be used to remove salt noise, but not both simultaneously.

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