Practical No. 1 & 2

Aim :- 2D Linear Convolution, Circular Convolution between two 2D matrices.

Theory :-

2D Linear convolution :- The linear convolution expresses the result of passing on image signal through a 2D linear convolution system h (or vice versa). The commutivity of the convolution is easily seen by making a substitution of variable in the double sum.

This important property is significant both conceptually, as a simple and direct means for effecting the frequency content of an image & computationally since the linear convolution has such a simple expression in the frequency domain.

Circular convolution - Circular convolution also known as cyslic convolution, which is the convolution of two periodic functions that have the same period. Periodic convolution arises, for example, in the content of the discrete - time fourier transform (DTFT)

Conclusion - Hence we have performed the convolution on the matrices.

Practical no. 2 : Circular Convolution

prac 2.sce (C:\Users\91832\Desktop\new dip\prac 2.sce) - SciNotes

File Edit Format Options Window Execute ?

prac 2.sce (C:\Users\91832\Desktop\new dip\prac 2.sce) - SciNotes

p7-lpf-hpf.sce | p7-lpf-hpf (1).sce | p-2-circular-conv.sce | prac 2.sce

```
clc;
clf;
clear all;

disp("This practical of Circular convolution was performed by 399 Khushi Singh");

g = input("Enter x sequence : ");
h = input("Enter h sequence : ");

n1 = length(g);
n2 = length(h);
n = max(n1,n2);
n3 = max(n1,n2);
n3 = n1 - n2;

if(n3 > 0)
   h = [h , zeros(1,n3)];
else
   g = [g , zeros(1 , -n3)];
end

for p = 1:n
    y (p) = 0;
    for q = 1:n
        j = p-q+1;
        if(j<=0)
           j = n + j;
        end
        y(p) = [y(p) + g(q) * h(j)];
    end
end
disp(y);
subplot(3,1,1);
plot(y);

```

Output:

Practical No - 2

Aim - To perform Image Quantization

Theory :-

Quantization is opposite to Sampling. It is done on y axis. When you are quantizing an image you are actually dividing a signal into quanta (partitions)

On the x axis of the signal are the co-ordinate values, and on the y axis we have amplitudes so digitizing the amplitudes is known as Quantization.

Many people are familiar with the process of resizing a digital image to a smaller size for the purpose of emailing photo or uploading them to social networking or photography website

Conclusion - Hence we have performed the Image Quantization

Practical No - 4

Aim - To perform Bit resolution on an image

Theory -

BPP or Bits per pixel is used to denote the number of bit per pixel & the number depend on the depth of color or BPP. A bit also known as a binary digit is the smallest unit of data in a computer. A bit has 0 to 1. The number of shades of gray in a digital image. Bit depth is defined as 2^n, where the multiplier 2 indicates that the image is in black as white & n represents the power to which the computer can multiply this function. Therefore a bit depth of 2^n would produce 2 shades of gray, a bit depth 2^n could produce 2 shades of gray, a bit produce 4096 shades of gray.

Conclusion - Hence we have performed Bit resolution on an image.

Practical No - 04

Aim - To perform DFT (Discrete Fourier Transform) & IDFT (Inverse Discrete fourier Transform)

Theory -

DFT (Discrete Fourier Transform)

The discrete Fourier Transform (DFT) is the primary transform used for numerical computating in digital signal processing. It is very widely used for spectrum analysis fast convolution & many other applications.

The DFT is widely used in part because it can be computed very efficiently using fast ~~function~~ fourier transform (FFT) algorithms

IDFT (Inverse Discrete fourier Transform)

The inverse of DFT transform N discrete - frequency samples to the same numbers of discrete time samples It can thus also be computed efficiently using FFTs .

ES

The inverse discrete Fourier transform (IDFT) is the discrete time version of the Inverse Fourier Transform. As for the FT and IFT the DFT & IFT represent a fourier transform pair in the discrete domain. The DFT allows one to convert a set of digital time samples to its frequency domain representation. In constrast, The IDFT can be used to invert the DFT samples, allowing one to reconstruct the signal samples x(k) directly from its frequency domain form, X(m)

Conclusion - Hence we have performed DFT & IDFT convolution.

Practical No. 6

Aim - To perform

→ Image Negative
→ Thresholding
→ Gray level slicing without Background
→ Gray level slicing with Background
→ Bitplane

Theory -

Negative Image - Displaying of an x-ray image. It implies inverting grey level. Black in original will look white & vice versa. Formula is $s = (L - D - r)$ L is number of gray level 256.

Thresholding Image. Extreme contrast stretching (increase contrast of images by making dark position darker & bright portion brighter)
and last slope zero and the center slope is increased. Thus $r1 = r2$. $s1 = 0$ & $s2 = L-1$ L is number of gray levels.

Gray level slicing without Background:

Thresholding splits gray level into two parts. We need to highlight specific range of gray values for eg enhancing flaws in X-ray image. Here we select a band of gray level values - First we use gray level slicing without background. $s = L-1$ for $a <= r <= b$

8S

Gray level Slicing with Background = In some application we not only need to enhance band of gray levels but also retain background. The transformation is $S = L-1$, for $a <= r <= b$ & $s = r$ for all other values.

Bitplane :- An Images bit word, Then the 0th bit plane consists of last bit each gray value As the last bit has the least effecting terms of the magnitude of the value, it is called LSB & The corresponding plane a lsb plane.

Similarly 7th bit plane consiste of first bit in each value. So it i's MSB plane. for a gray scale image we start by making it a matrix of type double ie so we can perform arithmetic on the values And now we isolate bit plane by dividing matrix cd by successive powers of two, neglecting the remainder ie checking whether final bit is 0 or 1 using mod function.

Conclusion:- Hence we have performed Image Negative Thresholding, Gray level slicing without Background, Gray level slicing with Background & Bitplane on an image.

9/1/2023

Practical : 07

Aim : Dilation . Erosian opening closing operation of a given image.

Theory :

The process of dilation allows the object to expand & thereby filled holds & connecting disjoint let A & B represents the two sets in two sets in two dimensional internal space & dilation of A & B is represented as - $A \oplus B = z / \hat{B}_z A \neq \phi$.

(A represents the input image, B represents structuring element)

Dilation of A & B represents set of all displacements z such that $B^\wedge$ & A overlap by atleast one element operation of dilation adds pixels to the object boundary & number of pixels added depends on size & shape of structuring element.

(2) Erosian :

In case of erosian operation the holds in object are analyzed & boundaries of image get shrinked & thereby getting rid of irrelevant data, by reduction in the ~~image~~ size.

$$A \ominus B = z / \hat{B}_z \in A$$

Erosion of the input image A with structuring element B represents all set of points z such that B when shifted by z represents subset of A & then it reduces number of pixels from object boundaries.

③ Opening operation

The opening of an image is obtained eroding input image followed by dilution process. This operation is used in smoothening of the image & thereby isolating the object which may be touching one another & the process is used in analysis of wear particles in engine oil & remaining the ink particles in the recycled paper Open $(A, B) = D(E(A,B))$

$= (A \ominus B) \oplus B.$

④ Closing Operation

In the closing operation morphological operation an image is first subjected to dilation followed by the process of erosian.

$$\text{Close } (A,B) = \cancel{E(D(A,B))}$$
$$= (A \oplus B) \ominus B.$$

Conclusion

Successfully implemted dilation erosian, opening closing operation.

Practical : 08

Aim : Perform low pass and high pass filter on an image

Low Pass filter :

In image processing a low pass filter is used to smooth or blur an image. It works by averaging the intensities of the surrounding pixel, reducing the high frequency content and presenuing the low frequency information. This can be useful for tasks such as removing noise, reducing image detail and smoothing the overall apperance of an image

High Pass filter :

In image processing a high pass filter is used to enhance the high frequency content of an image, such as edges and details. It works by subtracting a low-pass filtered version of an image from the original images, effectively removing the low frequency information and emphazing the high frequency information.

Conclusion : Hence, we have performed HPF & LPF on an image.

Practical No : 09

Aim :- To perform Prewitt and Sobel operators on a given image.

Theory :

Prewitt and sobel Operator

$x-1, y+1$	$x, y+1$	$x+1, y+1$	z_1	z_2	z_3
$x-1, y$	x, y	$x+1, y$	z_4	z_5	z_6
$x-1, y-1$	$x, y-1$	$x+1, y-1$	z_7	z_8	z_9

i) Prewitt Operator :

Prewitt IMS in his paper "Object Enhancement & Extention in 1970 came up with a 3×3 masks. The prewitt operator os is now called, while aproximating the first derivative, assign similar weight to all the neighbour of the candidate pixel whose edge strength is being calculated.

$$\nabla f = |(z_7 + z_8 + z_9) - (z_1 + z_2 + z_3)| + |(z_3 + z_6 + z_9) - (z_1 + z_4 + z_7)|$$

From this equator the mask we obtain are

-1	-1	-1		-1	0	1
0	0	0		-1	0	1
1	1	1		-1	0	1

These masks are known as Prewitt masks

f_x

ii) Sobel operator

Duda RO. Hart PE in 1973 published a paper pattern classification & Analysis in with they use a new operator known as Sobel operator. In the sobel operator higher weights are assigned to the pixel close to the candidate pixels.

$$\nabla f = |(z_7 + 2z_8 - 1\ z_9| - (z_1 + 2z_2 + z_3) + (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)|$$

from the equation the masks that we obtain

-1	-2	-1		-1	0	1
0	0	0		2	0	2
1	2	1		-1	0	1
	f_x				f_y	

58.

If we are considering the gradient to directive we detect the edges which are perpendicular to the direction of the gradient & in case of y gradient the edges detected in horizontal direction

Both the prewitt & sobel operator represent a 3×3 mask generating filtered image.

Implementation of Prewitt & Sobel Operator

1. Add the fx and fy mask first
2. Convolve the new mask with the original image.

Prewitt mask

$$\underset{f_x}{\begin{matrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{matrix}} + \underset{f_y}{\begin{matrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{matrix}} = \underset{f_x + f_y}{\begin{matrix} -2 & -1 & 0 \\ -2 & 0 & 2 \\ 0 & 2 & 2 \end{matrix}}$$

Conclusion : Hence we have successfully performed Prewitt & Sobel operator or a given image.

Practical No : 10

Aim:- To perform butterworth LPF on a given image

Theory:-

In the field of Image processing, Butterworth Lowpass filter (BLPF) is used for image smoothing in the frequency domain. It removes high-frequency noise from a digital Image and preserves low-frequency components. The Transfer function of BLPF of order n is define as.

$$H(u,v) = \frac{1}{1 + [D(u,v)/D_0]^{2n}}$$

$n \rightarrow$ represents order of filter

$D_0 \rightarrow$ is a positive constant BLPF passes all the frequency less than Do value without a function & cuts off all the frequencies greater than it.

• $D(u,v)$ is the Distance from any point (u,v) to the origin to the frequency plane.

ie.

$$D(u,v) = \sqrt{(u^2 + v^2)}$$

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$$H(u,v) = \frac{1}{1+[(D_0/D(u,v)]^{2n}}$$

Butterworth HPF

D(u,v) represents the distance of (u,v) co-ordinate from the origin

Do represents the cut off frequency

0,0	0,1	0,2	0,3
1,0	1,1	1,2	1,3
2,0	2,1	2,2	2,3
3,0	3,1	3,2	3,3

The Butterworth filter is a type of signal processing filter to have as frequency response as possible (no ripples) in the pass-band & zero roll of response in the stop band butterworth filter one of the most commonly used digital filters in motion analysis.

Conclusion - Thus, we have performed Butterworth LPF on the given image.

Practical No: 011

Aim :- Perform the Gaussian low pass filter.

Theory :-

low pass filter are used for smoothening the image.

· Gaussian low pass filter :-

A Gaussian filter is a low pass filter used for reducing noise (high frequency component) and blurning regions of an image.

· The filter is implemented as an add size Symmetric kurnel which is passed through each pixel of the region of interest to get the desired Effect.

· The kernel is not hard towards drastic color changed (Edges) due to it pixels towards the center of the kernel having more weightage towards the final value then the periphery.

· A gaussian filter could be considered as an approximation of the gaussian function.

In the process of using gaussian filter on an image we firstly define the size of the kernel matrix that would be used for demising the image. The size are generally odd numbers i.e the overall pixel results can be computed on the central pixel.

The values inside the kernel are computed by the gaussian function, which is follows.

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

Conclusion :-

Hence, successfully implemented gaussian low pass filter.

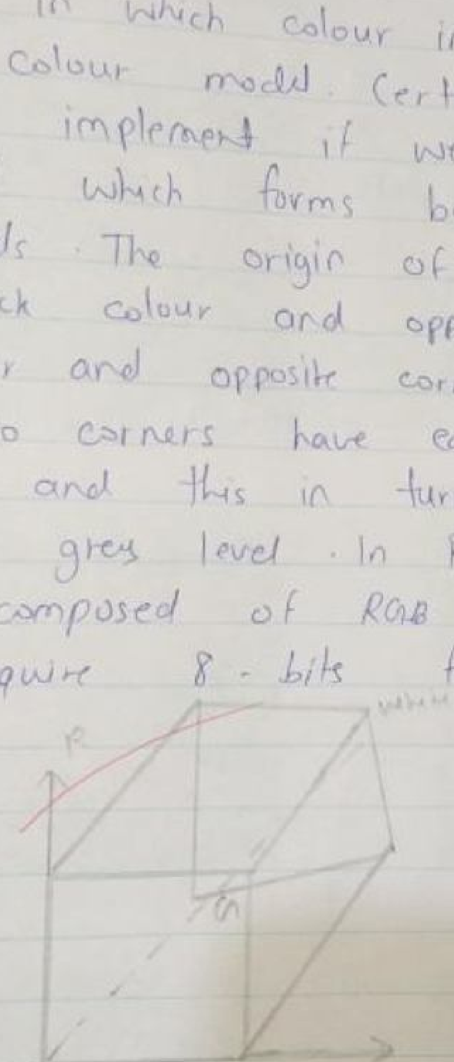
Practical No: 12

Aim :- To perform colour model on a given image.

Theory :-

Colourmodel :-

The way in which colour information is stored defines a colour model. Certain operations are easier to implement if we move away from RGB model which forms basis for different colour models. The origin of RGB colour space defines black colour and opposite corner represents white colour and opposite corner and the line joining two corners have equal values of RGB component and this in turn produces various shades of grey level. In RGB model, each pixel is composed of RGB values and these colours require 8-bits for its representation.



The RGB image is visualised as stack of 3 planes of size m×n where m×n represents size of image and when we read an image and display pixel values, we get component value

EAP

the term (1,2,3) represents the RGB component at the pixel at (1,1) position and thus it gives different colours at (1,1) position.
The different colors models which evolve from basic colour model are as follows :-

i. NTSC
ii. YCbCr
iii. CMY (Cyan Magneta Yellow)
iv. CMYK
v. HSI
vi. SECAM (Sequential colour and memory)

Conclusion :-

Hence, successfully performed colour model on a given image.

Practical No: 13

Aim:- To perform edge detection on a given image using different operator : ordinary, Roberts, ~~Pr~~ prewitts, sobel, LoG, Scanny.

Theory :-

Ordinary Operator : It is also derivative operator is used to find edges in an image. The major different between laplacian sothes operative like prewitt, sobel, Robinson and kirsch is that all the first derivative masks but laplacian is a second order derivative mask It is defined as the sum at the second derivatives of the image with respect to x & y.

Mathematical equation

$$\Delta f(x,y) = \partial^2 f(x,y)/\partial x^2 + \partial^2 f(x,y)/\partial y^2$$

Robert Operator : This gradient based operator computes the sum at squares of the difference between diagonally adjoint pixels in an image through discrete differentiation.

- Then the gradient approximation is made.
- It uses the following 2x2 kernel or masks.

$$M_x = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \quad M_y = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

Prewitt Operator : This operator is similar to the Sobel operator.

- It also detects vertical & horizontal edges of an image.
- It its one of the best ways detect the orientation & magnitude of an image.
- It uses the kernels or masks:

$$M_y = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad M_y = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

Sobel Operator : It is a discrete differentiation operator. it computes the gradient approximation of image intensity function for image edge detection the pixel ~~at~~ on image, the sobel operator produces either ~~the~~ the normal to a vector or the corresponding gradient vector.

- It use two 3×3 Kernels or masks which are convolved with the input image to calculate the vertical & horizontal approximations respectively.

$$M_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad M_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

Laplacian of gaussian (LoG) : It is a guassian based operator which uses the laplacian to take the second derivative of an image.

- This really works well when the transition of the grey level seems to be abrupt.
- Here the gaussian operator reduces the noise and the laplacian operator detects the sharp edges.
- The gaussian function is defined by the formula

$$G(x,y) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp - \left(\frac{x^2 - y^2}{2\sigma^2}\right)$$

Conclusion:

Hence, we successfully performed edge detection using different operation.

Practical No - 3

Aim - To perform Image Quantization

Theory :-

Quantization is opposite to sampling. It is done on y axis. When you quantizing an image you are actually dividing a signal into quanta (partitions)

On the x axis of the signal are to co-ordinate values, and on the y-axis we have amplitudes so digitizing the amplitudes is known as Quantization.

Many people are familiar with the process of resizing a digital image to a smaller size for the purpose of emailing photo or uploading them to social networking an photography websites

Conclusion - Hence we have performed the Image Quantization.

Practical : 11

AIM: Demo of Image Histogram

Theory:

- Histogram of an Image represent the relative frequency of the occurance of the variable grey level of an image and there by the graphical representation of the image is obtained
- The concept is used in analyzing the img in forms at adjusting the img brightness, contrast values and sharpening the image by expanding the grey level values along the x-axis & corresponding intensity of the y-axis and to achieve the above test the following 3 histogram techniques are used.

) Histogram sliding:

It is used for shifting the image towards the right or left along the x-axis.

) Histogram stretching:

Used in the adjusting the contrast value of the image by increasing the px intensity values between the min & max range.

Histogram Equalization:

It is use for increasing the dynamic range of px values and there by making on equal count at the pxs and each travels and though resulting image in a flat histogram.

Conclusion: Successfully performed image histogram.

Prac 11

```
clc;
clf;
i=imread("C:\Users\HP\Documents\Dip
Pracs\cameraman. jpg")ihsv=rgb2hsv(i)
ih=imhistequal(ihsv(:, :, 3)
)ihsv(:, :, 3)=ih
io=hsv2rgb(ih)
subplot(1, 2, 1);
imshow(i);
title("Original Image");
subplot(1, 2, 2);
imshow(ihsv);
title("Color Image Histogram")
```

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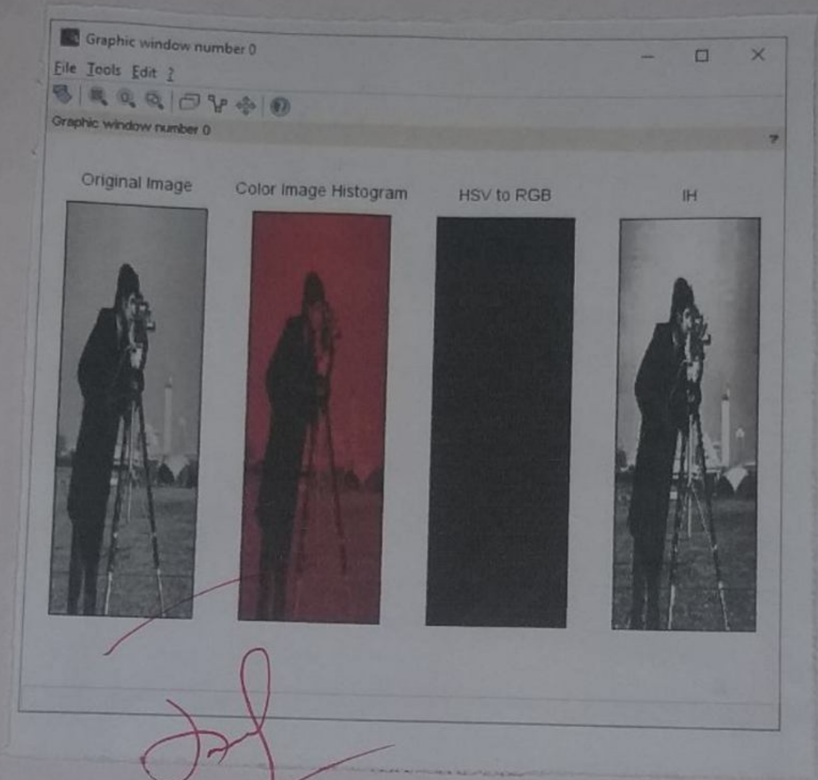
Graphic window number 0
File Tools Edit ?
Graphic window number 0
Original Image
Color Image Histogram
HSV to RGB
IH