TPCT's
College of Engineering, Osmanabad

Laboratory Manual

Digital Image Processing

For
Final Year Students

Manual Prepared by

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TPCT's

College of Engineering
Solapur Road, Osmanabad
Department of Electronics &Telecommunication

Vision of the Department:

To be recognized by the society at large as an excellent department offering quality higher education in the Electronics & Telecommunication Engineering field with research focus catering to the needs of the public ind being in tune with the advancing technological revolution.

Mission of the Department:

To achieve the vision the department will

- Establish a unique learning environment to enable the student's face the challenges of the Electronics & Telecommunication Engineering field.
- Promote the establishment of centers of excellence in technology areas to nurture the spirit of innovation and creativity among the faculty & students.
- Provide ethical & value based education by promoting activities addressing the needs of the society.

- Enable the students to develop skill to solve complete technological problems of current times and also to provide a framework for promoting collaborative and multidisciplinary activities.

<u>College of Engineering , OSMANABAD</u>

Technical Document

This technical document is a series of Laboratory manuals of Electronics and Telecommunication Department and is a certified document of College of Engineering, Osmanabad. The care has been taken to make the document error-free. But still if any error is found. Kindly bring it to the notice of subject teacher and HOD.

Recommended by,

HOD

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Principal

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FORWORD

It is my great pleasure to present this laboratory manual for Final year engineering

Students for the subject of Digital Image Processing keeping in view the vast coverage required for visualization of concepts of Digital Image Processing.

As a student, many of you may be wondering with some of the questions in your mind regarding the subject and exactly what has been tried is to answer through this manual.

Faculty members are also advised that covering these aspects in initial stage itself, will greatly relived them in future as much of the load will be taken care by the enthusiasm energies of the students once they are conceptually clear.

H.O.D.

LABORATORY MANUAL CONTENTS

This manual is intended for the Final year students of engineering branches in the subject of Digital Image Processing.. This manual typically contains practical/Lab Sessions related Digital Image Processing covering various aspects related to the subject to enhance understanding.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the books.

Prof.S.G.Shinde.

SUBJECT INDEX

DOs and DON' Ts in Laboratory:

1. Do not handle any equipment before reading the instructions/Instruction manuals

2. Read carefully the power ratings of the equipment before it is switched on whether ratings 230 V/50Hz or 115V/60 Hz. For Indian equipments, the power ratings are normally 230 V/50Hz. If you have equipment with 115/60 Hz ratings, do not insert power plug, as our normal supply is 230 V/50 Hz, which will damage the equipment.

3. Observe type of sockets of equipment power to avoid mechanical damage

4. Do not forcefully place connectors to avoid the damage

5. Strictly observe the instructions given by the teacher/Lab Instructor

Instruction for Laboratory Teachers:

1. Submission related to whatever lab work has been completed should be done during the next lab session.

2. The promptness of submission should be encouraged by way of marking and evaluation patterns that will benefit the sincere students.

Pre-Lab

Introduction to MATLAB

Questions:

1] What do you mean by MATLAB?
2] Describe all MATLAB windows in detail.(command window, Graphics window , Editor window, Workspace, command history, current directory)
3] Describe all basic MATLAB command with example.

EXPERIMENT NO. 1

EXPERIMENT TITLE: Image Processing concept

AIM: To study the Image Processing concept.

OBJECTIVE: To study the Image Processing concept.

TOOLS REQUIRED: MATLAB

THEORY: Digital images play an important role both in daily life applications as well as in the areas of research technology. The digital image processing refers to the manipulation of an image by means of processor. The different elements of an image processing system include image acquisition, image storage, image processing and display

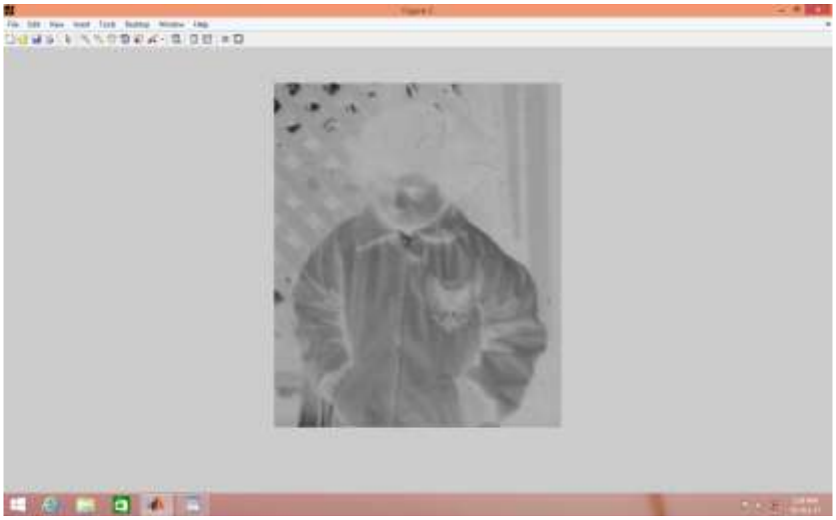
An image is two dimensional function that represent a message of sum characteristics such as brightness or color of viewed scene in the first mat lab program the command used from mat lab is imcomplement

PROGRAM:

```
% Program to study the image processing concept

I=imread('pout.tif');

J=imcomplement(I);

figure,imshow(I)

figure,imshow(J)

K=imadjust(I,[0;0.4],[0.5;1])

figure,imshow(K)
```

Result:

Original Image



Complement Image

Conclusion: Thus we have studied the how to obtain complement image from the original image.

EXPERIMENT NO. 2

EXPERIMENT TITLE: Histogram equalization image

AIM: To obtain histogram equalization image.

OBJECTIVE: To obtain histogram equalization image.

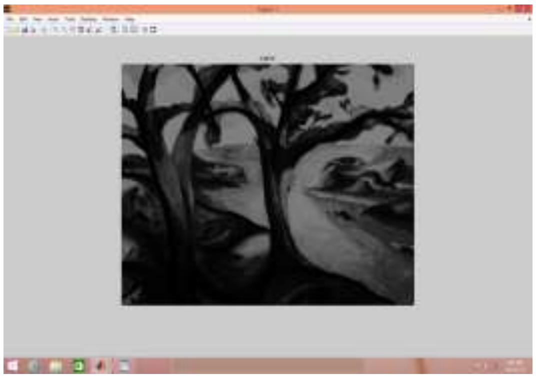
TOOLS REQUIRED: MATLAB

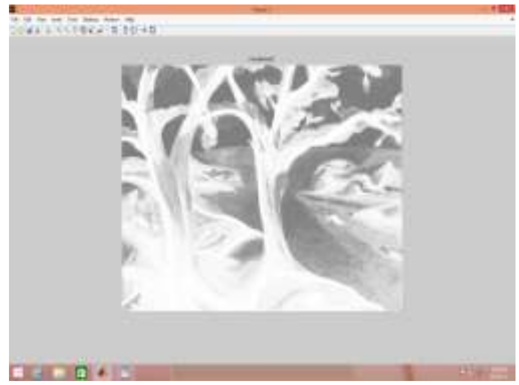
THEORY: Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. Histogram equalization often produces unrealistic effects in photographs; however it is very useful for scientific images like thermal or x-ray images, often the same class of images to which one would apply false color. Also histogram equalization can produce undesirable effects when applied to images with low color depth. For example, if applied to 8-bit image displayed with 8 bit gray scale it will further reduce color depth (number of unique shades of gray) of the image. Histogram equalization will work the best when applied to images with much higher depth than palette size, like continuous data or 16-bit gray-scale images.

PROGRAM:

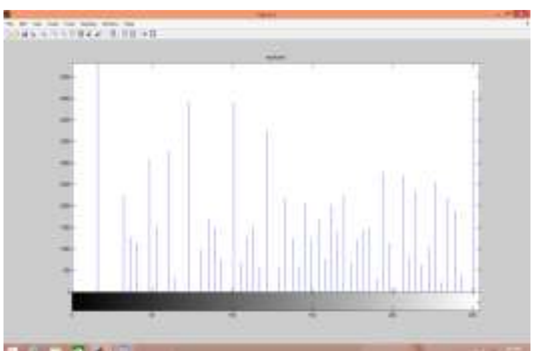
```
% Program to obtain histogram equalization concept
I=imread('trees.tif');
J=imcomplement(I);
imhist(J,100);
imshow(I);
title('original');
figure,imshow(J);
title('complement');
I=histeq(I);
figure,imhist(I,64);
title('equilized');
figure,imhist(J,64);
title('histogram');
n=numel(I);
p=imhist(I)/n;
figure,plot(p);
title('normalized');
K=imadjust(I,[0;1],[0.4;1],0.5);
figure,imshow(K);
title('adjusted image');
T=maketform('affine',[.3 0 0;.5 1 0;0 1 1]);
tformfwd([0,0],T);
I2=imtransform(I,T);
figure,imshow(I2);
title('forward image');
```

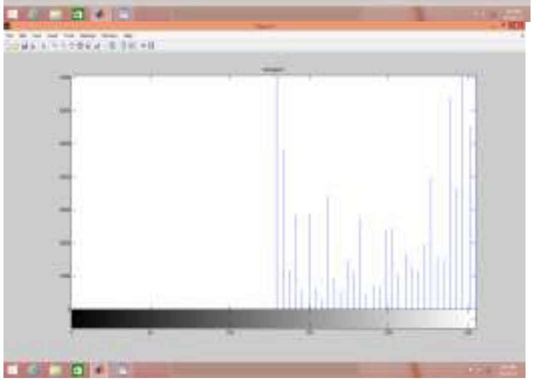
Result:





Original Histogram





Equalized Histogram

Conclusion: Thus we have obtained the Equalized Histogram from the original Histogram.

EXPERIMENT NO. 3
EXPERIMENT TITLE: Averaging filter in spatial domain

AIM: To Implement smoothing or averaging filter in spatial domain.

OBJECTIVE: To Implement smoothing or averaging filter in spatial domain.

TOOLS REQUIRED: MATLAB

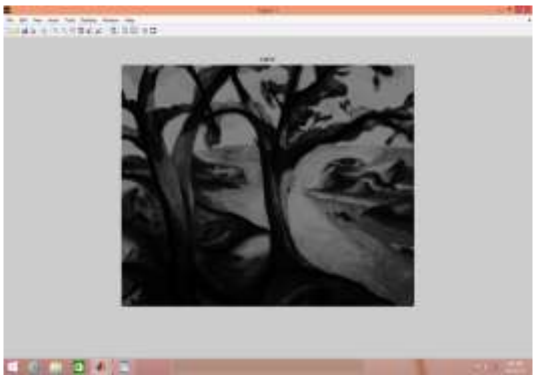
THEORY: Filtering is a technique for modifying or enhancing an image. ... Mask or filters will be defined. The general process of convolution and correlation will be introduced via an example. Also smoothing linear filters such as box and weighted average filters will be introduced.

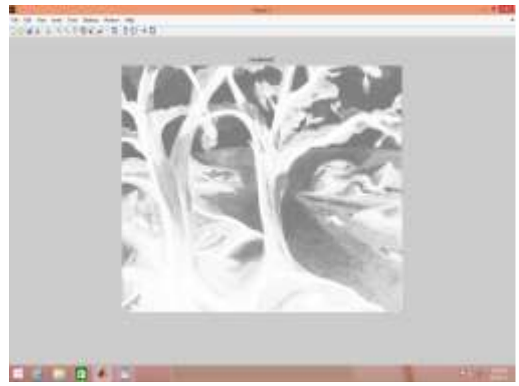
In statistic and image processing, to smooth a data set is to create an approximating function that attempts to capture important patterns in the data, while leaving out noise or other fine-scale structures/rapid phenomena. In smoothing, the data points of a signal are modified so individual points (presumably because of noise) are reduced, and points that are lower than the adjacent points are increased leading to a smoother signal. Smoothing may be used in two important ways that can aid in data analysis by being able to extract more information from the data as long as the assumption of smoothing is reasonable by being able to provide analyses that are both flexible and robust. different algorithms are used in smoothing.

PROGRAM:

```
% Program for implementation of smoothing or averaging filter in spatial domain
I=imread('trees.tif');
subplot(2,2,1);
imshow(J);
title('original image');
f=ones(3,3)/9;
h=imfilter(I,f,'circular');
subplot(2,2,2);
imshow(h);
title('averaged image');
```

Result:





Conclusion: Thus we have performed the smoothing or averaging filter operation on the Original image and we get filtered image.

EXPERIMENT NO. 4

EXPERIMENT TITLE: Opening and Closing of the image

AIM: Program for opening and closing of the image.

OBJECTIVE: Program for opening and closing of the image.

TOOLS REQUIRED: MATLAB

THEORY: In mathematical morphology, opening is the dilation of the erosion of

a set by a structuring elements B:

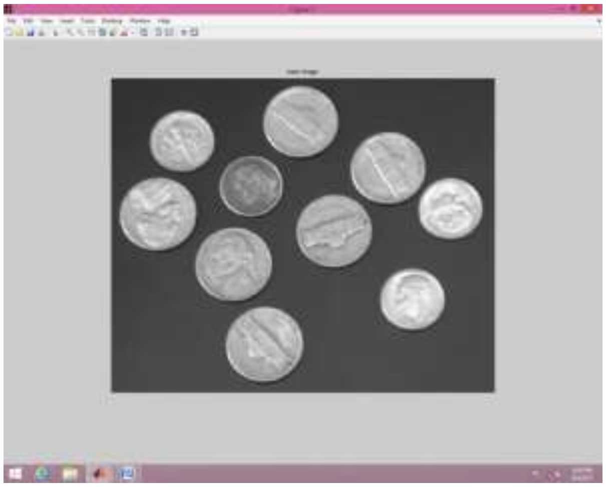
Together with closing, the opening serves in computer vision and image processing as a basic workhorse of morphological noise removal. Opening removes small objects from the foreground (usually taken as the bright pixels) of an image, placing them in the background, while closing removes small holes in the foreground, changing small islands of background into foreground. These techniques can also be used to find specific shapes in an image. Opening can be used to find things into which a specific structuring element can fit (edges, corners, ...).

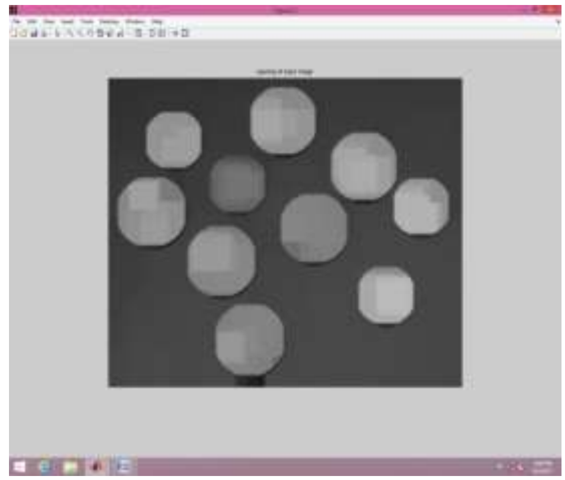
In mathematical morphology, the closing of a set (binary image) A by a structuring element B is the erosion of the dilation of that set. In image processing, closing is, together with opening, the basic workhorse of morphological image removal. Opening removes small objects, while closing removes small holes.

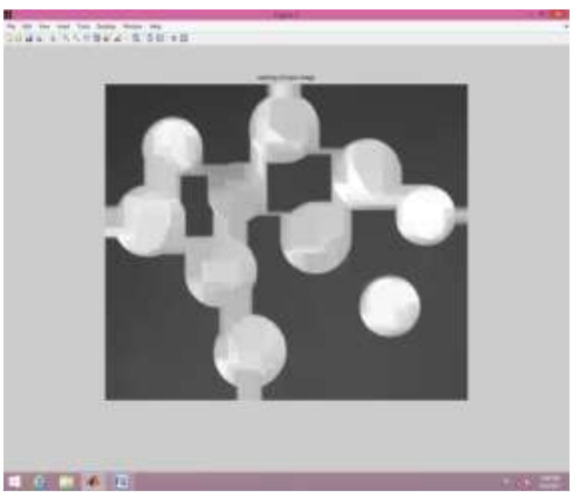
PROGRAM:

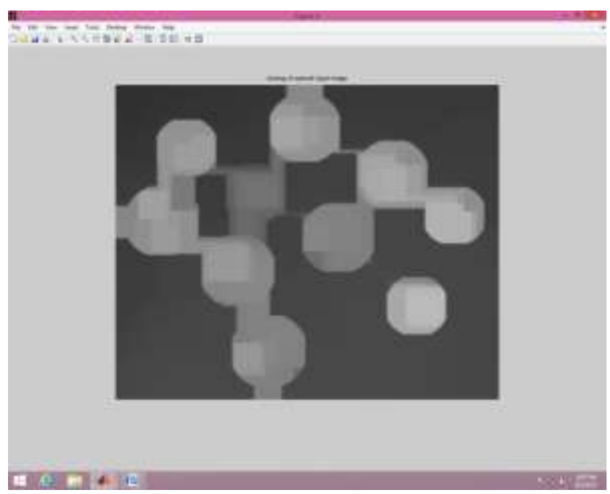
```
f=imread('coins.png');
se=strel('square',20);
fo=imopen(f,se);
figure,imshow(f)
title('input image');
figure,imshow(fo)
title('opening of input image');
fc=imclose(f,se);
figure,imshow(fc)
title('opening of input image');
foc=imclose(fo,se);
figure,imshow(foc)
title('closing of opened input image');
```

Result:









Conclusion: Thus we have obtained the opened image and closed image from the original Image.

Practice Work:

EXPERIMENT NO. 5

EXPERIMENT TITLE: Region of Interest for the image

AIM: To fill the region of interest for the image.

OBJECTIVE: To fill the region of interest for the image

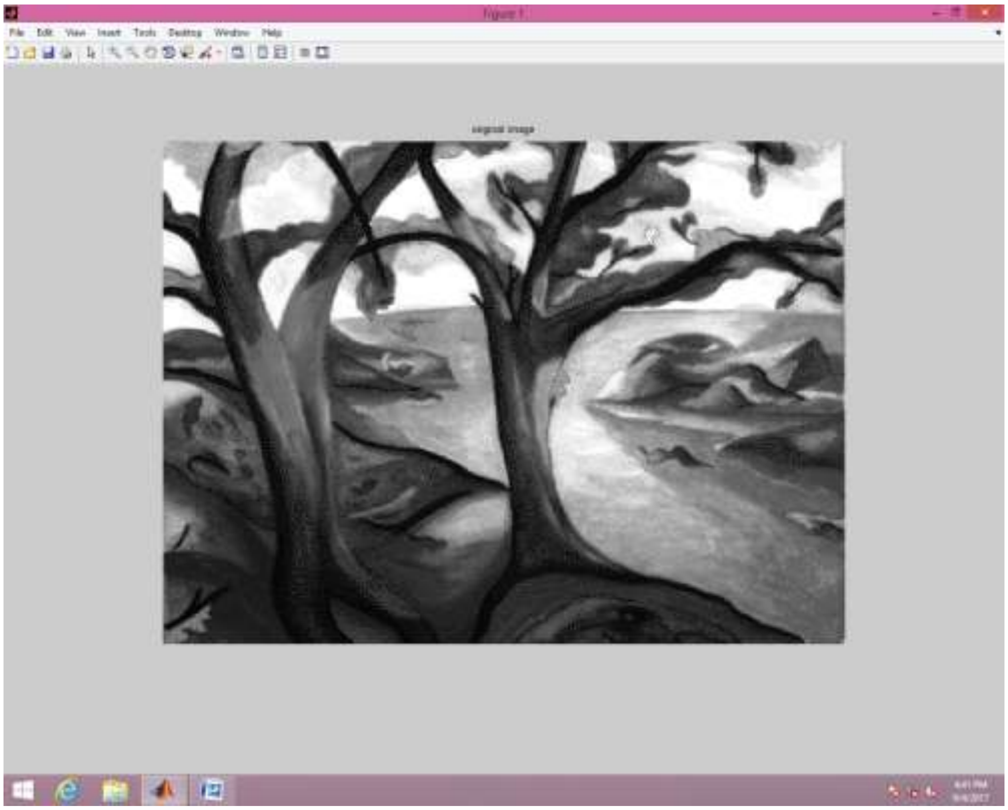
TOOLS REQUIRED: MATLAB

THEORY: A region of interest (often abbreviated ROI), are samples within a data set identified for a particular purpose. The concept of a ROI is commonly used in many application areas. For example, in medical imaging, the boundaries of a tumor may be defined on an image or in a volume, for the purpose of measuring its size. The endo cardial border may be defined on an image, perhaps during different phases of the cardiac cycle, for example, end-systole and end-diastole, for the purpose of assessing cardiac function. In geographical information systems(GIS), a ROI can be taken literally as a polygonal selection from a 2D map. In computer vision and optical character recognition, the ROI defines the borders of an object under consideration. In many applications, symbolic (textual) labels are added to a ROI, to describe its content in a compact manner. Within a ROI may lie individual points of interest (POIs).

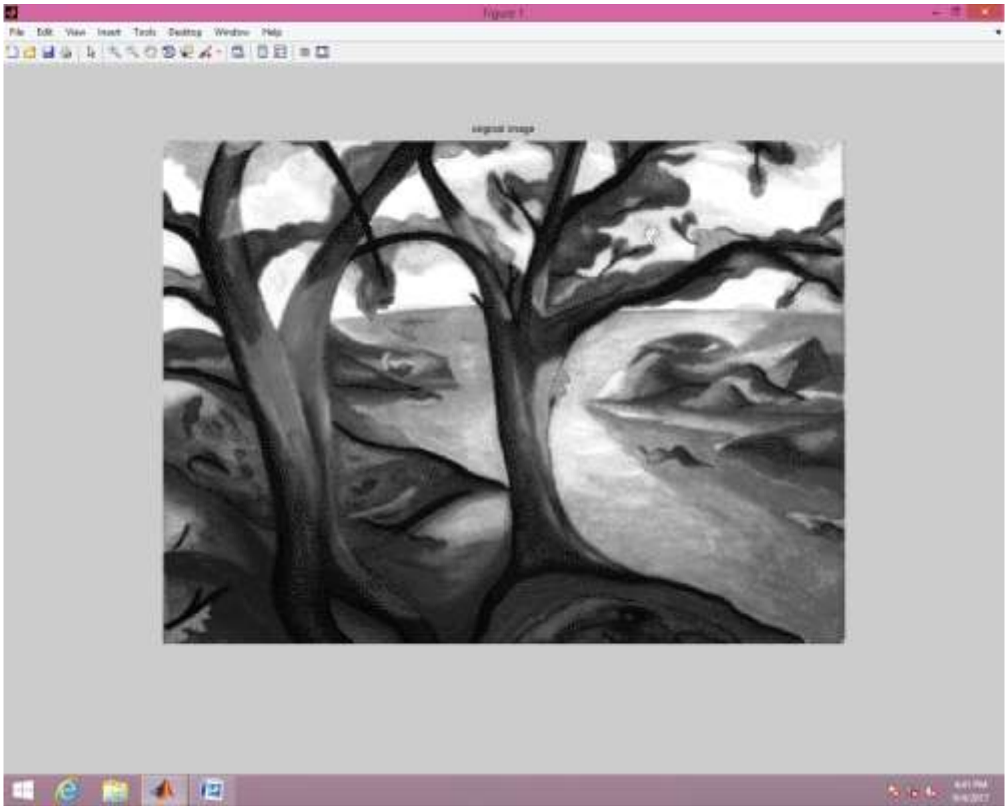
PROGRAM:

```
% Program for ROI

clc;
close all;
load trees
I=ind2gray(X,map);
imshow(I)
title('original image');
I2=roifill;
imshow(I2)
title('OUTPUT IMAGE');
```

Result:



Original Image



Output image

Conclusion: - Thus we have filled the interested region in the original image.

Practice Work:

EXPERIMENT NO. 6

EXPERIMENT TITLE: Edge detection algorithm

AIM: Program for edge detection algorithm.

OBJECTIVE: Program for edge detection algorithm

TOOLS REQUIRED: MATLAB

THEORY: The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986. Canny also produced a computational theory of edge detection explaining why the technique works.

The Process of Canny edge detection algorithm can be broken down to 5 different steps:

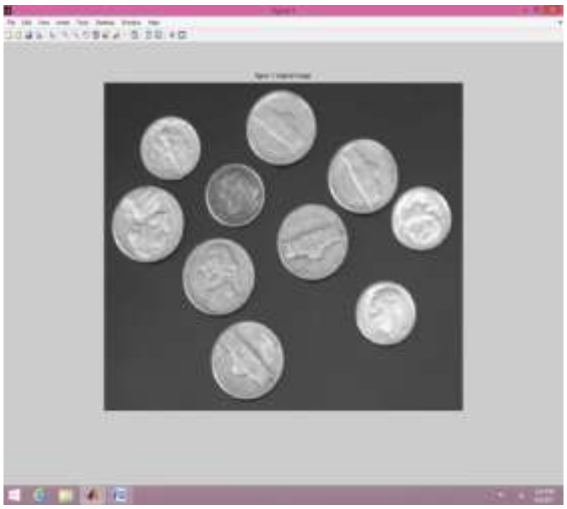
1. Apply Gaussian filter to smooth the image in order to remove the noise
2. Find the intensity gradients of the image
3. Apply non-maximum suppression to get rid of spurious response to edge detection
4. Apply double threshold to determine potential edges
5. Track edges by hypothesis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

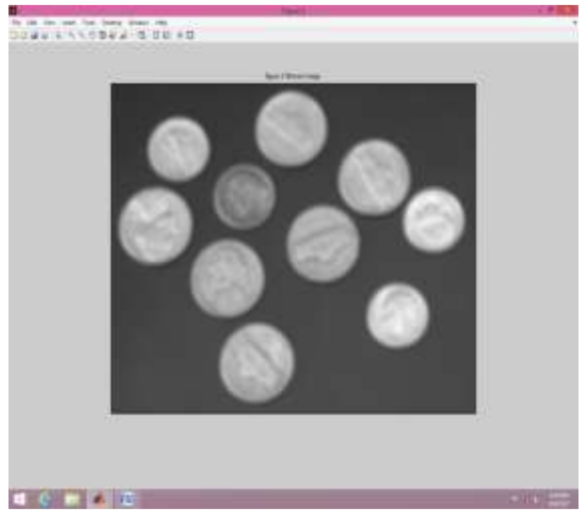
PROGRAM:

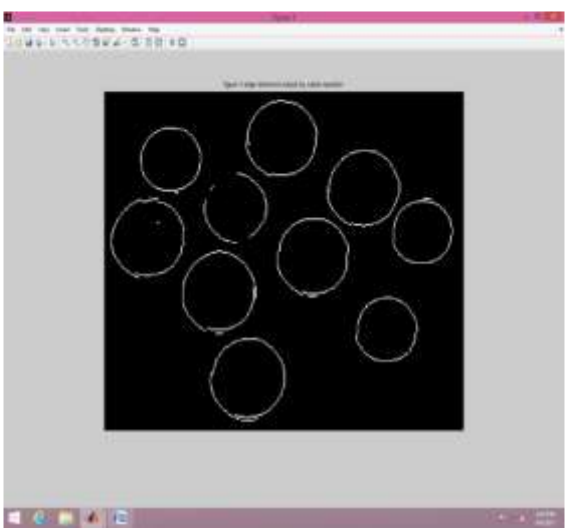
```
%Program for edge detection algorithm

I=imread('coins.png');
figure,imshow(I)
title ('figure 1 original image');
h=ones(5,5)/25;
b=imfilter(I,h);
figure,imshow(b)
title ('figure 2 filtered image');
c=edge(b,'sobel');
figure,imshow(c)
title ('figure 3 edge detected output by sobel operator');
d=edge(b,'prewitt');
figure,imshow(d)
title ('figure 4 edge detected output by prewitt operator');
e=edge(b,'robert');
figure,imshow(e)
title ('figure 5 edge detected output by robert operator');
f=edge(b,'canny');
figure,imshow(f)
```

title ('figure 6 edge detected output by canny operator');

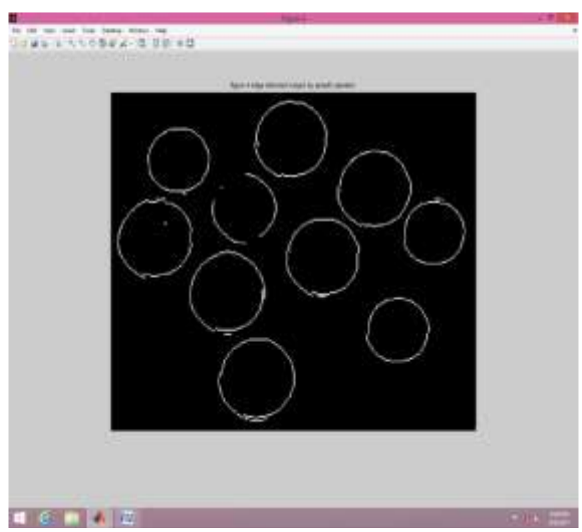
Result:







Edge detected image



Edge detected image

Conclusion: Thus we have detected the edges in the original image.

EXPERIMENT NO. 7

EXPERIMENT TITLE: Sharpen image using gradient mask

AIM: Program of sharpen image using gradient mask.

OBJECTIVE: Program of sharpen image using gradient mask.

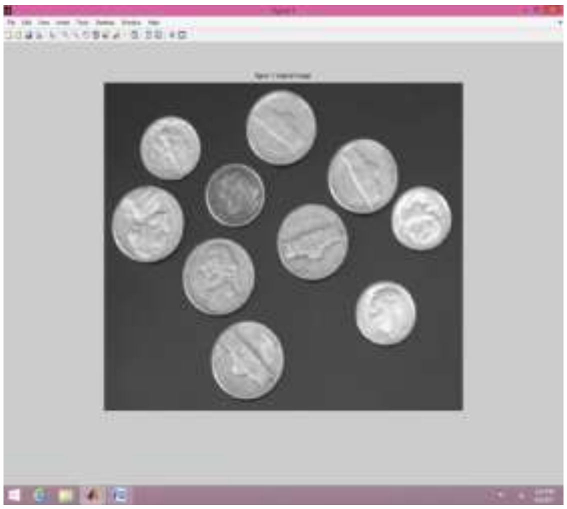
TOOLS REQUIRED: MATLAB

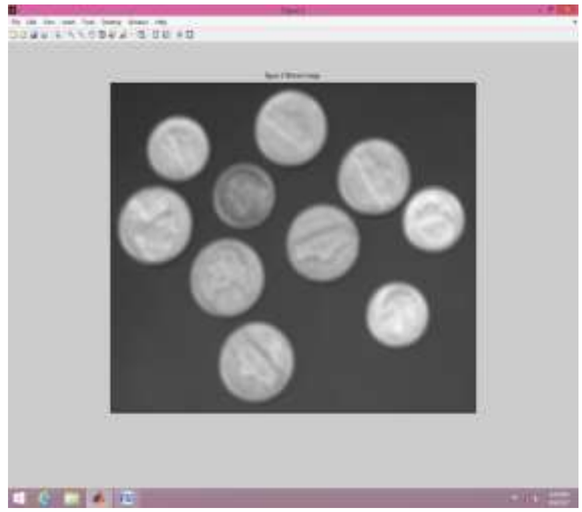
THEORY: An image gradient is a directional change in the intensity or color in an image. The gradient of the image is one of the fundamental building blocks in image processing. For example the Canny edge detector uses image gradient for edge detection. Mathematically, the gradient of a two-variable function (here the image intensity function) at each image point is a 2D vector with the components given by the derivatives in the horizontal and vertical directions. At each image point, the gradient vector points in the direction of largest possible intensity increase, and the length of the gradient vector corresponds to the rate of change in that direction.

PROGRAM:

```
% Program of sharpen image using gradient mask
I=imread('coins.png');
subplot(2,2,1);
imshow(I)
title('Original Image');
h=fspecial('sobel');
f=imfilter(I,h,'replicate');
subplot(2,2,2);
imshow(F)
title('filtered image by sobel mask');
s=I+F;
subplot(2,2,4);
imshow(s)
title('Final o/p Image');
```

Result:





Original Image

Conclusion: Thus we have perform the sharpening operation using gradient mask on the Original image.

Practice Work:

EXPERIMENT NO. 8

EXPERIMENT TITLE: Erosion and Dilation

AIM: Program for morphological operation: erosion and dilation.

OBJECTIVE: Program for morphological operation: erosion and dilation.

TOOLS REQUIRED: MATLAB

THEORY: Erosion (usually represented by ⊖) is one of two fundamental operations (the other being dilation) in morphological image processing from which all other morphological operations are based. It was originally defined for binary images, later being extended to grayscale images, and subsequently to complete lattices.

With A and B as two sets in Z2 (2D integer space), the dilation of A and B is defined as

A(+)B={Z|(Bˆ)Z∩A ≠ ϕ}

In the above example, A is the image while B is called a structuring element.

In the equation,(Bˆ)Z simply means taking the reflections of B about its origin and shifting it by Z. Hence dilation of A with

B is a set of all displacements, Z, such that (Bˆ)Z and A overlap by at least one element. Flipping of B about the origin and then moving it past image A is analogous to the convolution process. In practice flipping of B is not done always.

Dilation adds pixels to the boundaries of object in an image. The number of pixels added depends on the size and shape of the structuring element. Based on this definition, dilation can be defined as

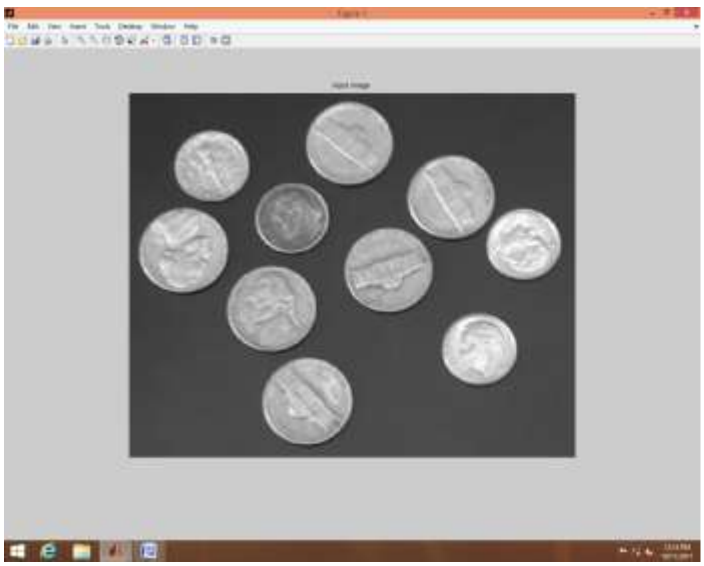
A(+)B={{Z|(Bˆ)Z∩A} ϵ A}

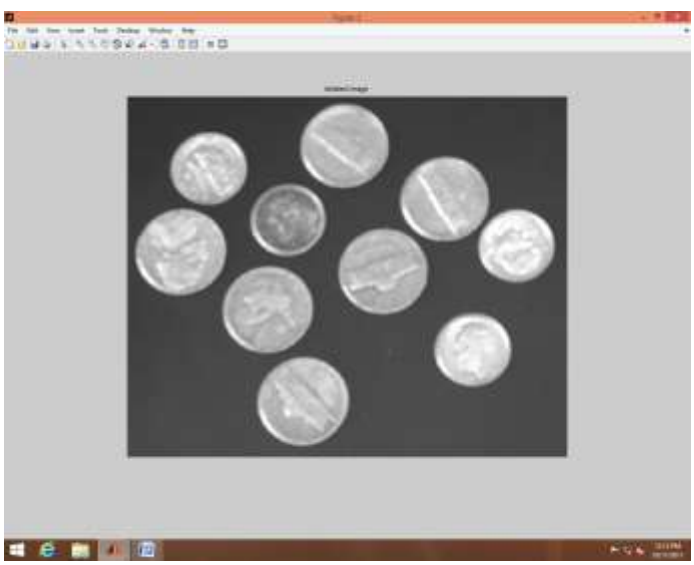
PROGRAM:

```
% Program for morphological operations: Erosions& Dilation
f=imread('coins.png');

B=[0 1 1;1 1 1;0 1 0];

f1=imdilate(f,B);

se=strel('disk',10);

f2=imerode(f,se);

figure,imshow(f)

title('input image');

figure,imshow(f1)
```

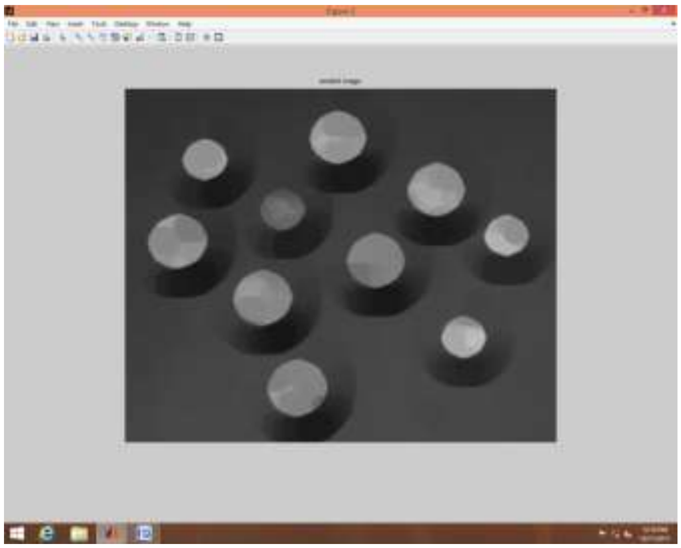
```
title('delated image');
figure,imshow(f2)
title('eroded image');
```

Result:





Erroded Image



Dilated Image

Conclusion: Thus we have obtained the eroded and dilated image for the original image

Practice Work:

EXPERIMENT NO. 9

EXPERIMENT TITLE: DCT/IDCT computation

AIM: Program for DCT/IDCT computation.

OBJECTIVE: Program for DCT/IDCT computation.

TOOLS REQUIRED: MATLAB

THEORY: A discrete cosine transform (DCT) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. JPEG) (where small high-frequency components can be discarded), to spectral methods for the numerical solution of partial differential equations. The use of cosine rather than sine functions is critical for compression, since it turns out (as described below) that fewer cosine functions are needed to approximate a typical signal, whereas for differential equations the cosines express a particular choice of boundary conditions.

In particular, a DCT is a Fourier-related transform similar to the discrete Fourier transform (DFT), but using only real numbers. The DCTs are generally related to Fourier Series coefficients of a periodically and symmetrically extended sequence whereas DFTs are related to Fourier Series coefficients of a periodically extended sequence. DCTs are equivalent to DFTs of roughly twice the length, operating on real data with even symmetry (since the Fourier transform of a real and even function is real and even), whereas in some variants the input and/or output data are shifted by half a sample. There are eight standard DCT variants, of which four are common.

Like for the DFT, the normalization factor in front of these transform definitions is merely a convention and differs between treatments. For example, some authors multiply the transforms by so that the inverse does not require any additional multiplicative factor. Combined with appropriate factors of $\sqrt{(2/N)}$, this can be used to make the transform matrix orthogonal.

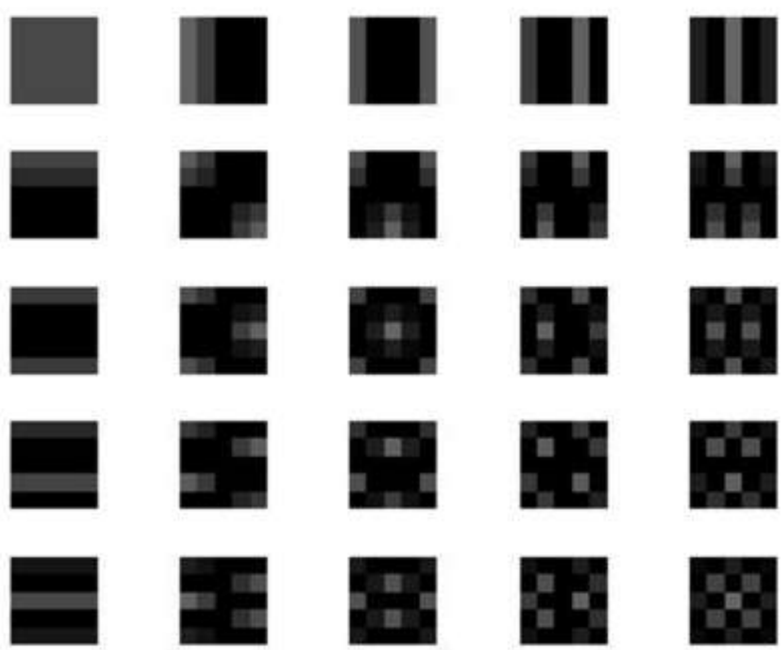
PROGRAM:

```
clc;
clear all;
close all;

m=input('Enter the basis matrix          % Request user input
dimension: ');
n=m;
alpha2=ones(1,n)*sqrt(2/n);
alpha2(1)=sqrt(1/n);
alpha1=ones(1,m)*sqrt(2/m);
alpha(1)=sqrt(1/m); % square root.
for u=0:m-1
```

```
    for v=0:n-1
        for x=0:m-1
            for y=0:n-1
                a{u+1,v+1}(x+1,y+1)=alpha1(u+1)*alpha2(v+1)*...
                cos((2*x+1)*u*pi/(2*n))*cos((2*y+1)*v*pi/(2*n));
            end
        end
    end
end
mag=a;
figure(3)                                          % Create figure graphics object
k=1;

% Code to plot the basis
for i=1:m
    for j=1:n
        subplot(m,n,k)                         % Create axes in tiled positions
        imshow(mag{i,j},256)                   % Display image
        k=k+1;
    end
end
```

Enter the basis matrix dimension: 5

Result:



Conclusion: Thus we have obtained the DCT/IDCT for the image.

4. Quiz on the Subject

1. Define image .
2. What is mean by enhancement
3. What are the different transforms used in image processing.
4. Define gradient mask.
5. What is mean by segmentation
6. Define erosion of the image.
7. What are the different types of morphological operations used in the image processing

5. Conduction of VIVA-VOCE Examinations:

Teacher should conduct oral exams of the students with full preparation. Normally the objective questions with guess are to be avoided. To make it meaningful, the questions should be such that depth of the student in the subject is tested. Oral Exams are to be conducted in co-cordial situation. Teachers taking oral exams should not have ill thoughts about each other & courtesies should be offered to each other in case of opinion, which should be critically suppressed in front of the students.

6.Evaluation and marking system:

Basic honesty in the evaluation and marking system is essential and in the process impartial nature of the evaluator is required in the exam system. It is a primary responsibility of the teacher to see that right students who really put their effort & intelligence are correctly awarded.

The marking pattern should be justifiable to the students without any ambiguity and teacher should see that students are faced with just circumstance.