RAMNIRANJAN JHUNJHUNWALA COLLEGE

GHATKOPAR (W), MUMBAI - 400 086

DEPARTMENT OF INFORMATION TECHNOLOGY
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M.Sc.(I.T.) SEM I
Image And Vision Processing

Name : Neha Dattatray Dawale
Roll No.: 06

Hindi Vidya Prachar Samiti's

RAMNIRANJAN JHUNJHUNWALA COLLEGE

(AUTONOMOUS)

Opposite Ghatkopar Railway Station, Ghatkopar West, Mumbai-400086

CERTIFICATE

This is to certify that Miss. **Neha Dattatray Dawale** with Roll No.**06** has successfully completed the necessary course of experiments in the subject of **Image And Vision processing** during the academic year **2020– 2021** complying with the requirements of RAMNIRANJAN **JHUNJHUNWALA COLLEGE OF ARTS, SCIENCE AND COMMERCE**, for the course of **M.Sc. (IT)** semester -I.

Internal Examiner

External Examiner

Head of Department

College Seal

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Practical 1

Implement Basic Intensity transformation functions

A. Image Inverse:

The negative or inverse of an image with intensity levels in the range [0, L-1] is obtained by using the negative transformation, which is given by the expression,

S = L – 1 – r

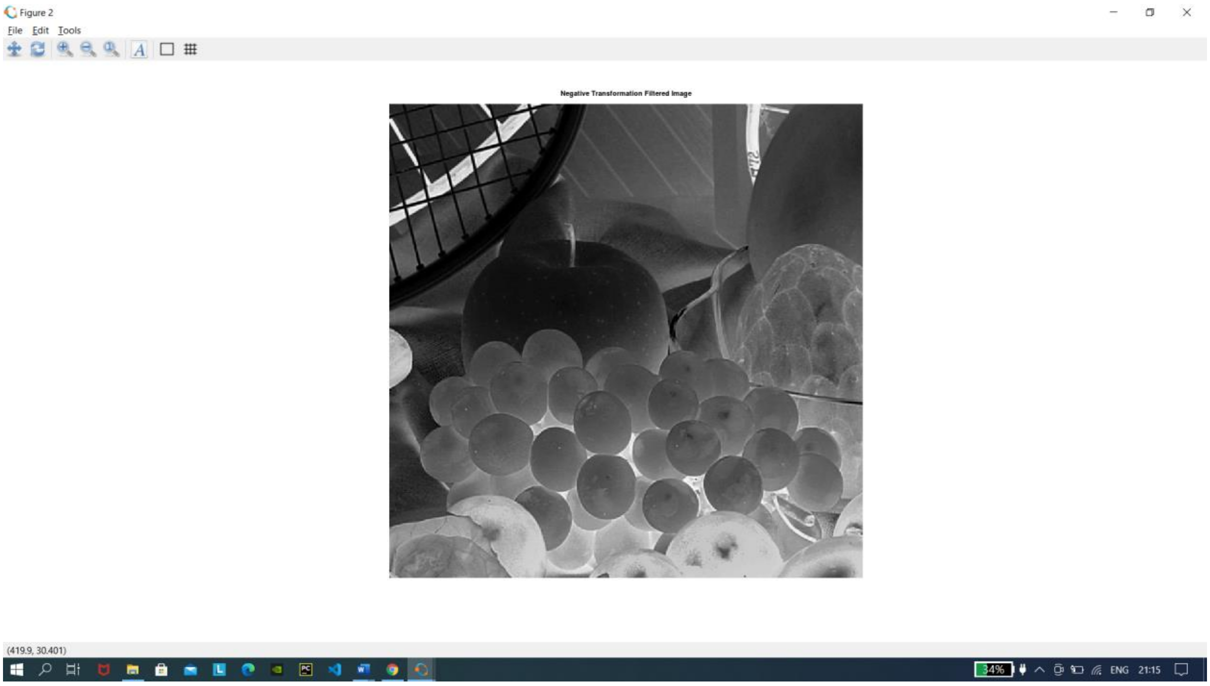
Where L – 1 (Maximum pixel value)

r (Pixel of an image)

Code:

```
pkg load image;
clear all;
close all;
x = imread('fruits.png');
x = rgb2gray(x);
x = im2double(x);
[row col] = size(x);
  for i = 1:row
      for j = 1:col
N(i,j)=1-x(i,j);
  endfor
endfor
figure
imshow(x);
title('Original Image');
figure
imshow(N);
title('Negative Transformation Filtered Image');
```

OutPut:



imread():

The *imread()* function reads images from the graphics files.

A = imread(filename) reads the image from the file specified by filename, inferring the format of the file from its contents. If filename is a multi-image file, then imread reads the first image in the file.

A = imread(filename,fmt) additionally specifies the format of the file with the standard file extension indicated by fmt. If imread cannot find a file with the name specified by filename, it looks for a file named *filename.fmt*.

im2double():

I2 = im2double(I)
I2 = im2double(I,'indexed')

I2 = im2double(I) converts the image I to double precision. I can be a grayscale intensity image, a truecolor image, or a binary image. im2double rescales the output from integer data types to the range [0, 1].

I2 = im2double(I,'indexed') converts the indexed image I to double precision. im2double adds an offset of 1 to the output from integer data types.

subplot():

subplot(m,n,p) divides the current figure into an m-by-n grid and creates axes in the position specified by p. MATLAB® numbers subplot positions by row. The first subplot is the first column of the first row, the second subplot is the second column of the first row, and so on. If axes exist in the specified position, then this command makes the axes the current axes

imshow():

imshow(I) displays the grayscale image I in a figure. imshow uses the default display range for the image data type and optimizes figure, axes, and image object properties for image display.

B) Log Transformation:

The log transformation maps a narrow range of low intensity values in the input into a wider range of output levels. We use the transformation if this type to extend the values of dark pixel in an image while compress the higher-level values.

The general form of the log transformation is:

$s = c \log (r + 1)$

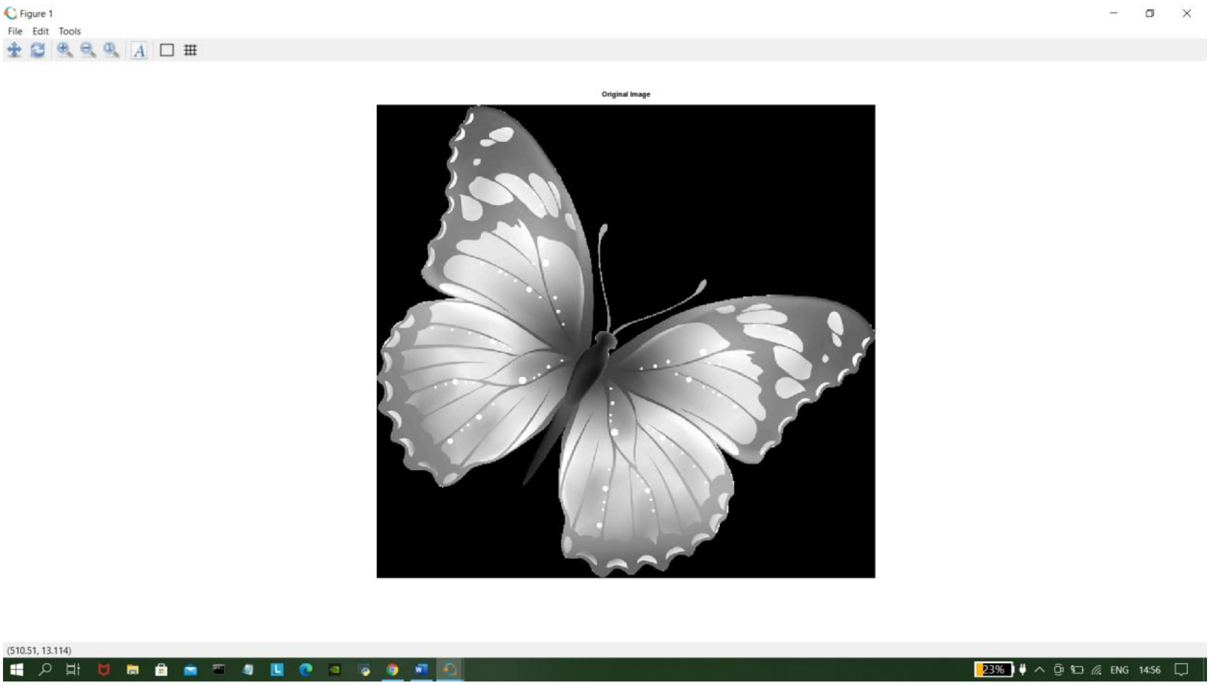
Where c is a constant, and $r \geq 0$.

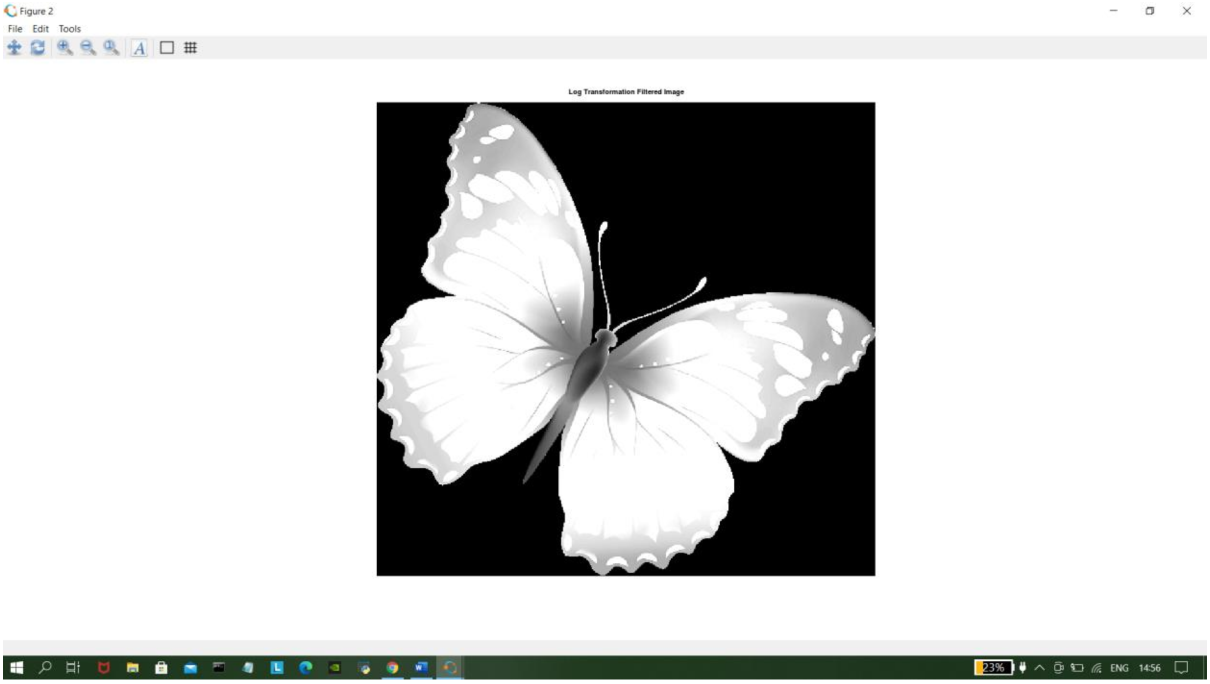
Code:

```
pkg load image;

clear all;

close all;

x = imread('butterfly.png');

x = rgb2gray(x);

x = im2double(x);

[row col] = size(x);

c=2;

for i = 1:row
```

```
for j = 1:col
N(i,j)=c*log(1+x(i,j));
endfor
endfor
figure
imshow(x);
title('Original Image');
figure
imshow(N);
title('Log Transformation Filtered Image');
```

OutPut:





rgb2gray():

`I =rgb2gray(RGB)` converts the truecolor image `RGB` to the grayscale image `I`. The `rgb2gray` function converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.

imwrite():

imwrite(A,filename) writes image data A to the file specified by filename, inferring the file format from the extension. imwrite creates the new file in your current folder. The bit depth of the output image depends on the data type of A and the file format.

(C) Power-Law Transformation:

Power-law curves with fractional values of γ map a narrow range of dark input values into a wider range of output values, with the opposite being true for higher values of input levels.

The nth power and nth root curves shown in below figure can be given by the expression as s = c r γ, This transformation function is also called as gamma correction. For various values of γ different levels of enhancements can be obtained. It is used to correct power law response phenomena. The different display monitors display images at different intensities and clarity. That means, every monitor has built-in gamma correction in it with certain gamma ranges and so a good monitor automatically corrects all the images displayed on it for the best contrast to give user the best experience. The gamma variation changes ratio of red green & blue along with intensity in color images. The difference between the log-transformation function and the power-law functions is that using the power-law function a family of possible transformation curves can be obtained just by varying the λ. This process is also called a gamma correction.

The Power Low Transformations can be given by the expression:

$s = c * r ^ \gamma$ where, s is the output pixels value r is the input pixel value c and γ are the real numbers

code:

```
pkg load image;

clear all;

close all;

 x = imread('leenanew.tif');

#x = rgb2gray(x); #Converting RGB image to gray-level image

 x = im2double(x);

 [row col] = size(x);

 gamma=2;

 c=1;

 for i = 1:row

for j = 1:col

N(i,j)=c*(x(i,j)^gamma);

endfor

endfor

figure, imshow(x); title('Original Image');

figure, imshow(N); title('Gamma Transformation Filtered Image');
```

Output:

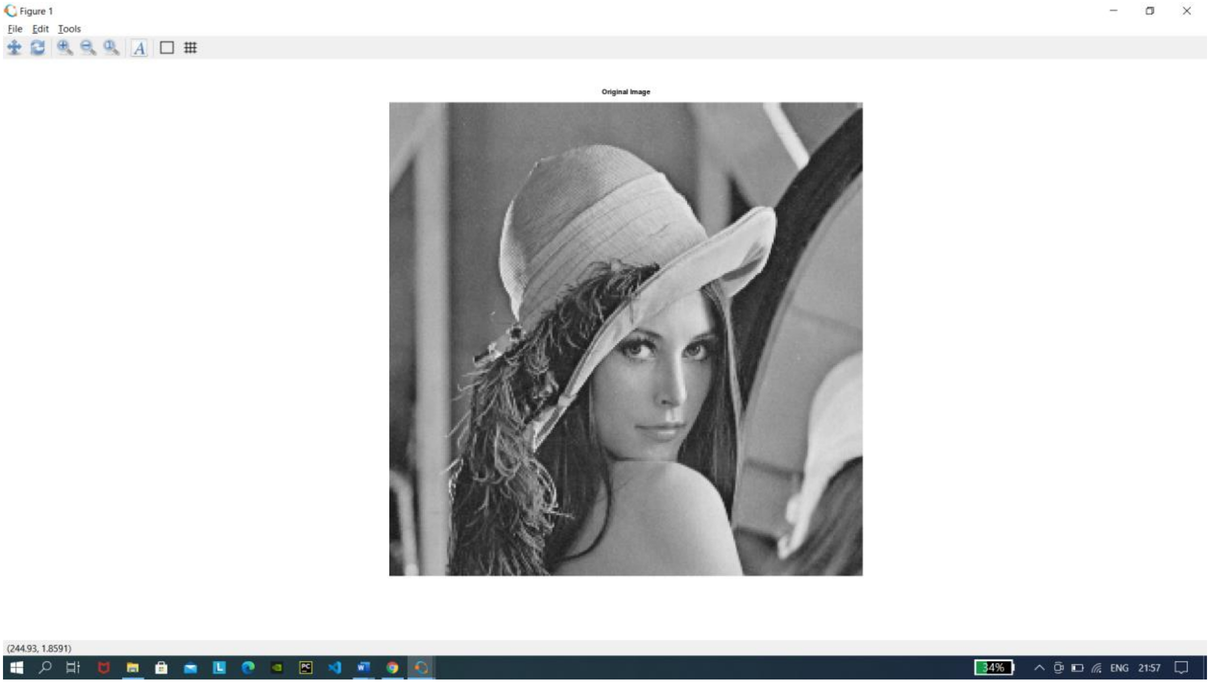


Figure 1
File Edit Tools
Original Image
(244.93, 1.8591)
34%
ENG 21:57

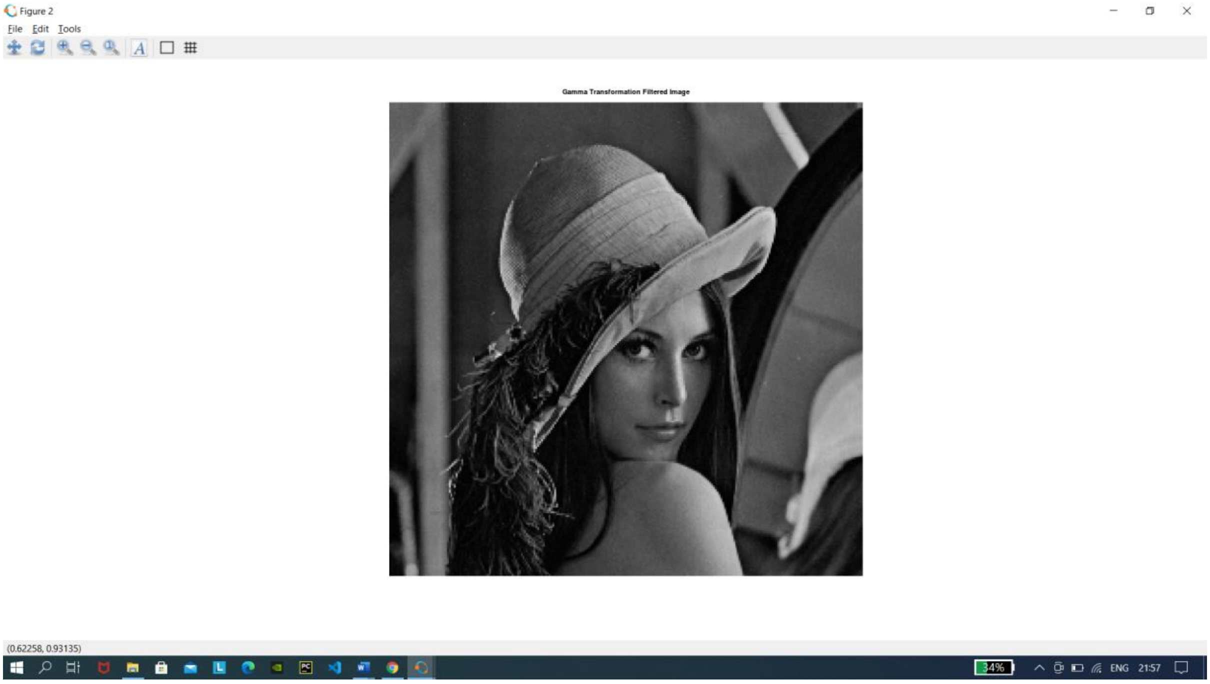


Figure 2
File Edit Tools
Gamma Transformation Filtered Image
(0.62258, 0.93135)
34%
ENG 21:57

Practical 2

(A)Contrast Stretching

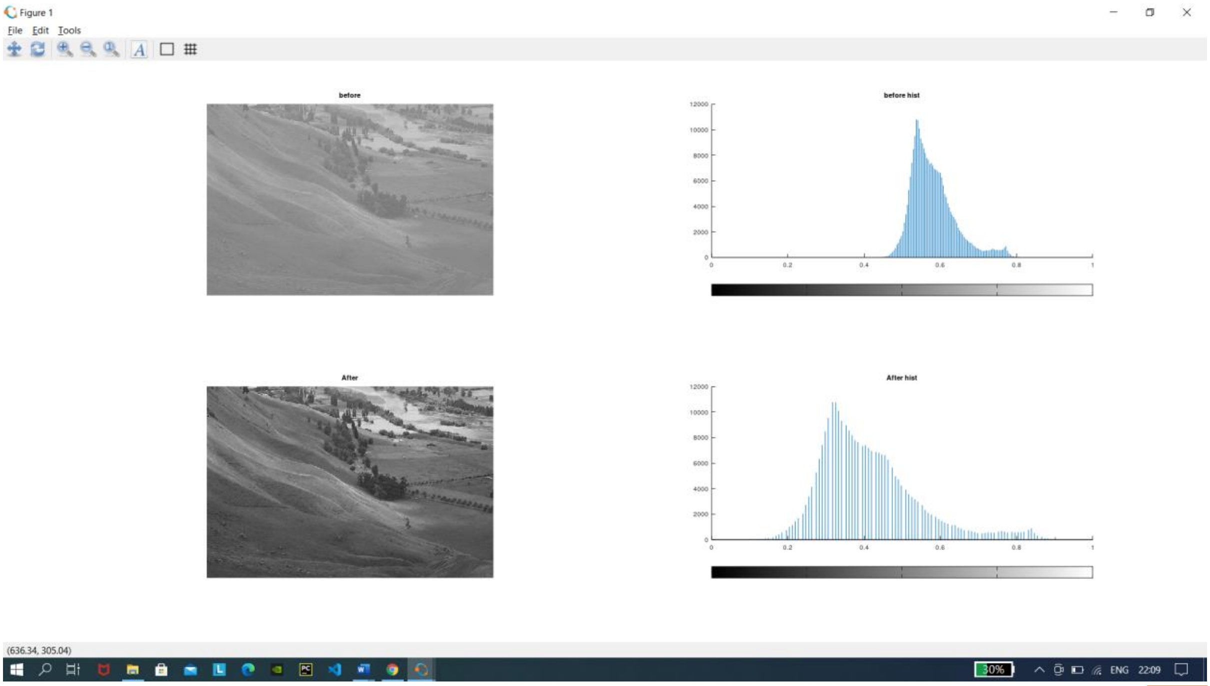
Contrast stretching is also known as normalization. It is a simple image enhancement technique. The quality of image is enhanced by stretching the range of intensity values.

Using imadjust fucation:

Code:

```
pkg load image;

a=imread('fields.jpg');

#agray=rgb2gray(a);

ad=im2double(a);

subplot(2,2,1); imshow(ad); title("before");

subplot(2,2,2); imhist(ad); title("before hist");

imad=imadjust(ad,[0.44 0.8],[0.1 0.9]);

subplot(2,2,3); imshow(imad); title("After");

subplot(2,2,4); imhist(imad); title("After hist");
```

output:



imadjust():

Adjust image or colormap intensity (values).

Returns an image of equal dimensions to I, cmap, or RGB, with its intensity values adjusted, usually for the purpose of increasing the image contrast.

The values are rescaled according to the input and output limits, low_in and high_in, and low_out and high_out respectively. The first pair sets the lower and upper limits on the input image, values above and below them being clipped. The second pair sets the lower and upper limits for the output image, the interval to which the image will be scaled after clipping the input limits.

For example:

imadjust (img, [0.2; 0.9], [0; 1])

will clip all values in img outside the range [0.2 0.9], and then rescale them linearly into the range [0 1].

Contrast Stretching

Using Inputs from user r1,r2,s1,s2

Code:

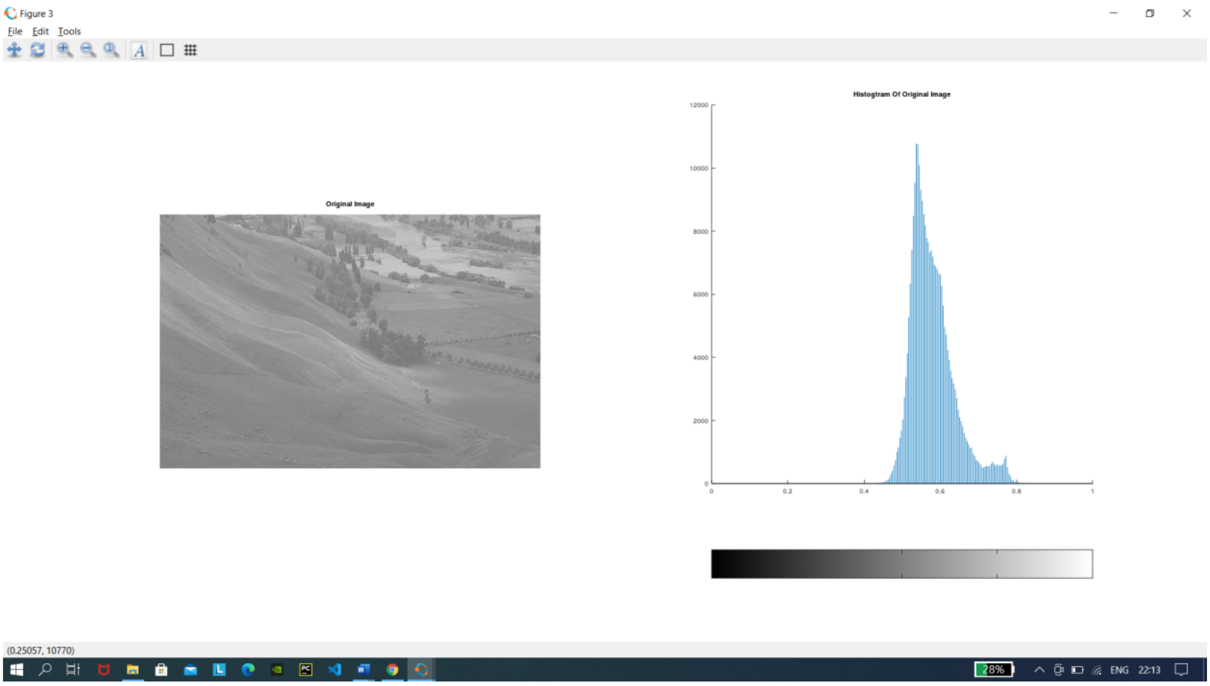
```
pkg load image;

clear all;

close all;

r = imread("fields.jpg");

#r=rgb2gray(r);

r = im2double(r);

[m n] = size(r); % Getting the dimensions of the image.

#here we are taking 4 input from user

r1=input("Enter R1: ");

r2=input("Enter R2: ");

s1=input("Enter S1: ");
```

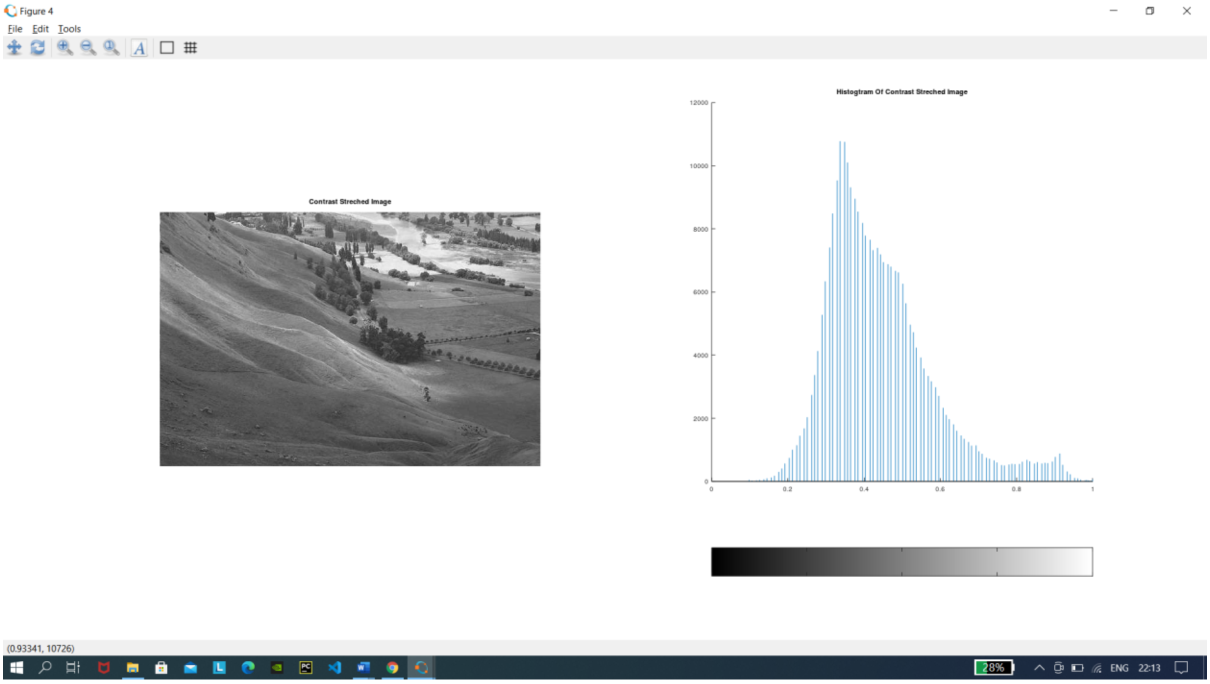
```
s2=input("Enter S2: ");
#Calculation of contrast stretching
a = s1/r1;
b = (s2-s1)/(r2-r1);
c = (255-s2)/(255-r2);
for i=1:m
  for j=1:n
    if r(i,j) < r1
    s(i,j) = a*r(i,j);
    elseif r(i,j) < r2
    s(i,j) = b*(r(i,j)-r1)+s1;
    else
     s(i,j) = c*(r(i,j)-r2)+s2;
    endif
  endfor
endfor
#Displaying the Original and Contrast Images
figure(3);
subplot(1,2,1)
imshow(r);
title("Original Image");
subplot(1,2,2)
imhist(r);
title('Histogtram Of Original Image');
figure(4);
```

```
subplot(1,2,1)

imshow(s);

title("Contrast Streched Image");

subplot(1,2,2)

imhist(s);

title('Histogtram Of Contrast Streched Image');
```

Output:

Enter R1: 0.44
Enter R2: 0.8
Enter S1: 0.1
Enter S2: 0.98





(B) Thresholding:

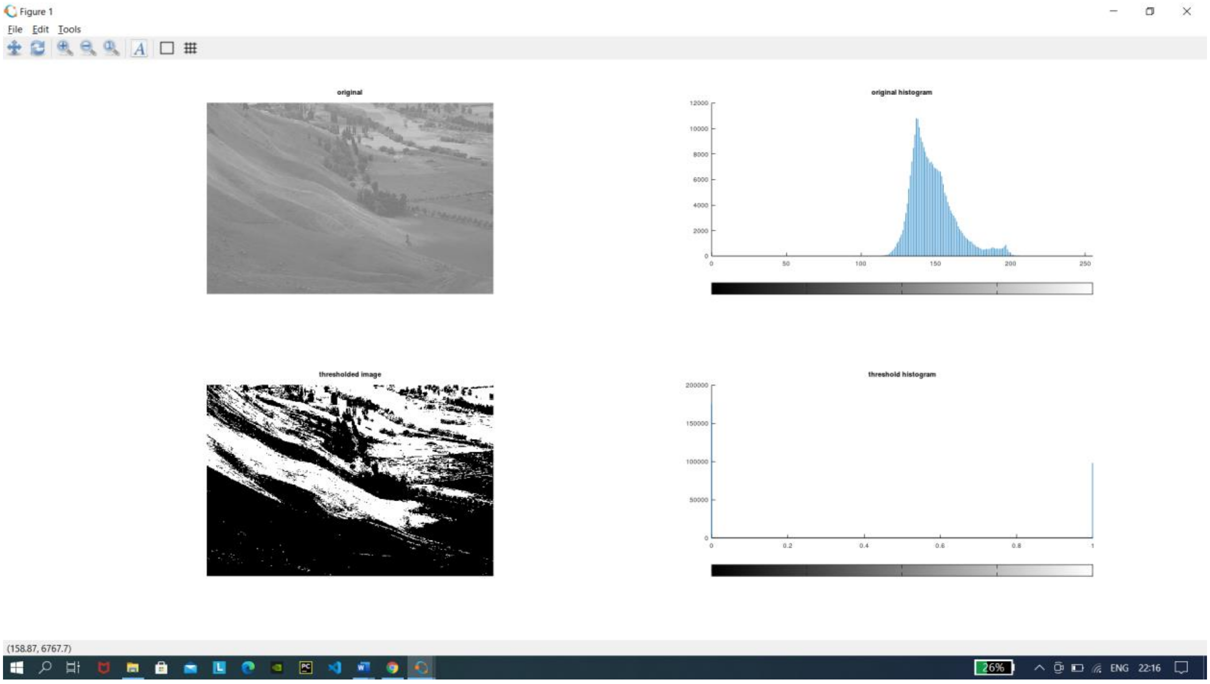
Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding is most effective in images with high levels of contrast.

Code:

```
pkg load image;
clear all;
r=imread("fields.jpg");
#r=rgb2gray(r);
#r=im2double(r);
imhist(r);
thr=150;
[m n]=size(r);
s=zeros(m,n);
for i=1:m
```

```
 for j=1:n
   if(r(i,j))>thr
   s(i,j)=1;
   else
   s(i,j)=0;
   endif
 endfor
endfor

subplot(2,2,1); imshow(r); title("original");
subplot(2,2,2); imhist(r); title("original histogram");
subplot(2,2,3); imshow(s); title("thresholded image");
subplot(2,2,4); imhist(s); title("threshold histogram");
```

Output:



zeros():

B = zeros(n) returns an n-by-n matrix of zeros. An error message appears if n is not a scalar.

B = zeros(m,n) or B = zeros([m n]) returns an m-by-n matrix of zeros.

(C) Image reconstruction using n bit planes

Code:

```
pkg load image
A=imread('doller.png');
g=rgb2gray(A);
B=zeros(size(g));

#Getting the bit at specified position#
g1 = bitget(g,1);
g2 = bitget(g,2);
g3 = bitget(g,3);
g4 = bitget(g,4);
g5 = bitget(g,5);
g6 = bitget(g,6);
g7 = bitget(g,7);
g8 = bitget(g,8);

figure,
subplot(2,2,1)
imshow(logical(g1));
title('Bit 1');
subplot(2,2,2)
imshow(logical(g2));
title("Bit 2");
subplot(2,2,3)
imshow(logical(g3));
title('Bit 3');
subplot(2,2,4)
imshow(logical(g4));
title('Bit 4');
```

```
figure,
subplot(2,2,1)
imshow(logical(g5));
title('Bit 5');
subplot(2,2,2)
imshow(logical(g6));
title("Bit 6");
subplot(2,2,3)
imshow(logical(g7));
title('Bit 7');
subplot(2,2,4)
imshow(logical(g8));
title('Bit 8');

#B=bitset(B,4,bitget(A,4));
B=bitset(B,5,g5);
B=bitset(B,6,g6);
B=bitset(B,7,g7);
B=bitset(B,8,g8);
B=uint8(B);
figure,
subplot(1,2,1),imshow(B); title("5,6,7,8")
subplot(1,2,2),imshow(g); title("original image");
```

Output:


Figure 1
File Edit Tools
Bit 1
Bit 2
Bit 3
Bit 4
(353.43, 137.01)


Figure 2
File Edit Tools
Bit 5
Bit 6
Bit 7
Bit 8

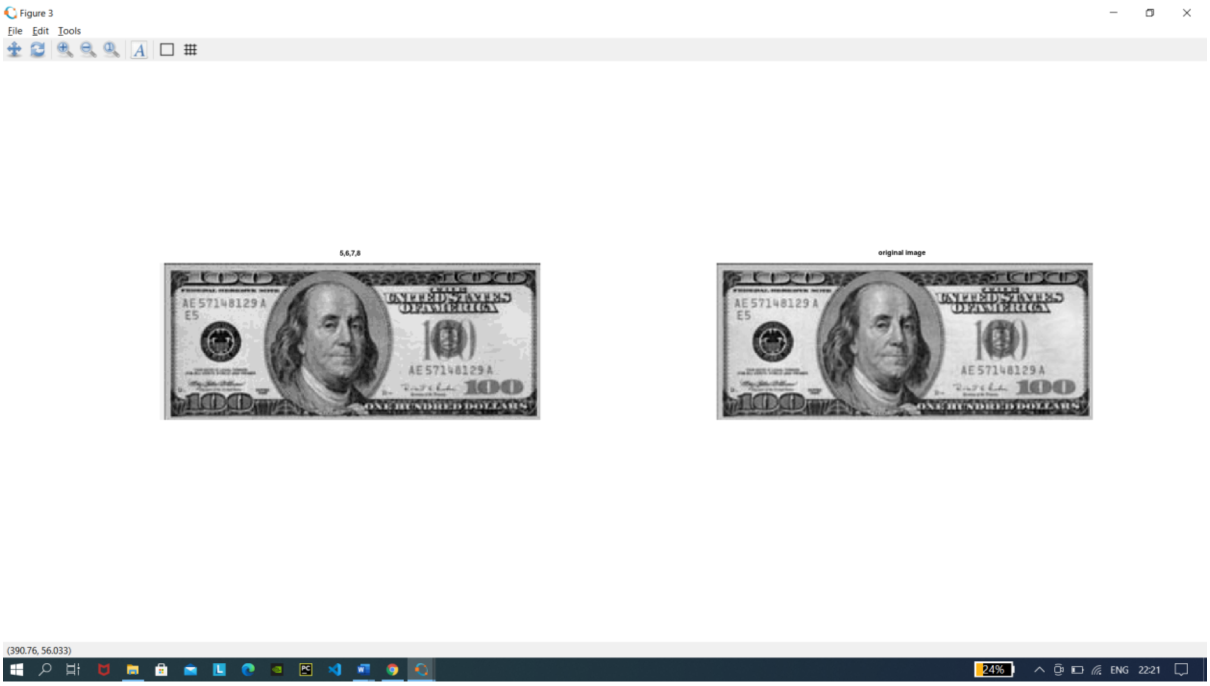


Figure 3
File Edit Tools
5,6,7,8
original image
(390.76, 56.033)

1. The nth plane in the pixels are multiplied by the constant 2^n-1
2. For instance, consider the matrix
   A= A=[167 133 111
   144 140 135
   159 154 148] and the respective bit format

10100111	10000101	01101111
10010000	10001100	10000111
10011111	10011010	10010100

3. Combine the 8 bit plane and 7 bit plane.

For 10100111, multiply the 8 bit plane with 128 and 7 bit plane with 64.\
(1x128) + (0x64) + (1x0) + (0x0) + (0x0) + (1x0) + (1x0) + (1x0) = 128

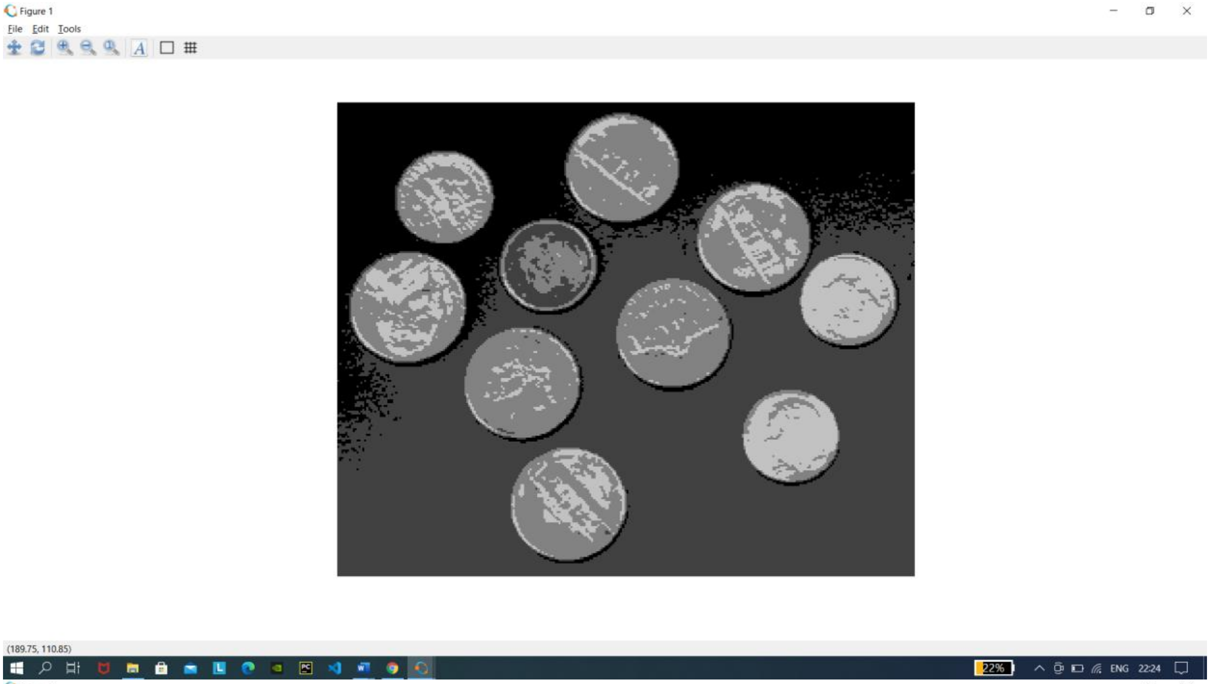
4. Repeat this process for all the values in the matrix and the final result will be

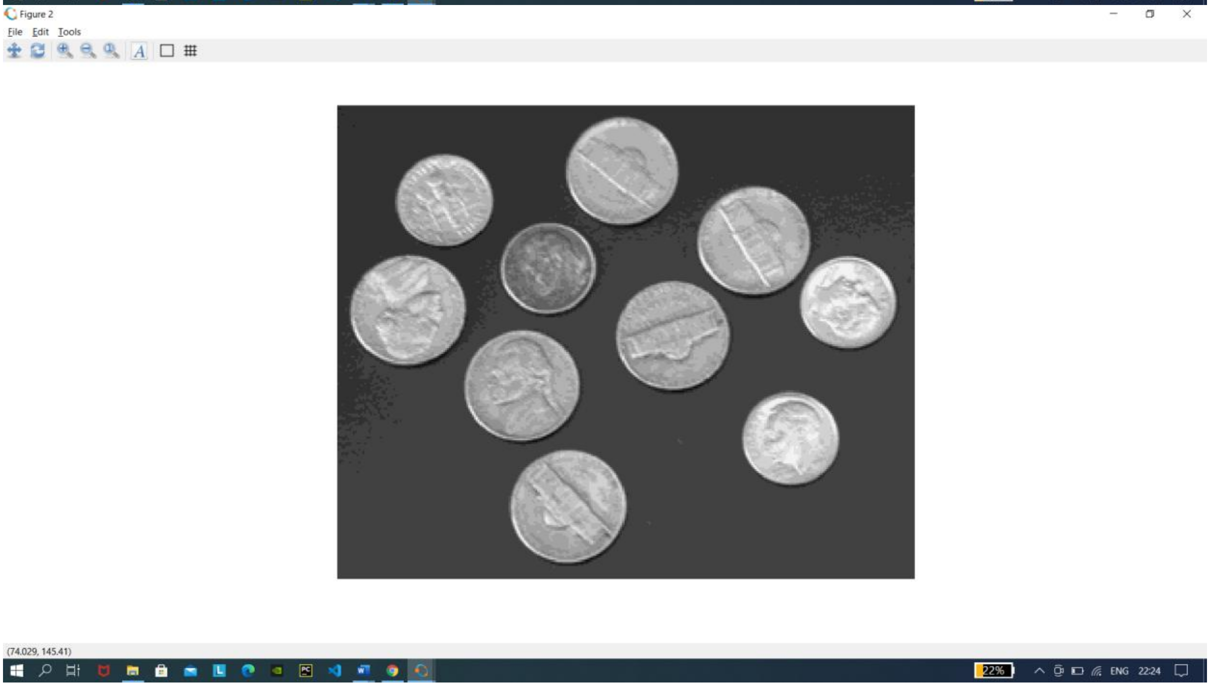
[128 128 64
128 128 128
128 128 128]

Code:

```
pkg load image;
%Image reconstruction by combining 8 bit plane and 7 bit plane
A=imread('coins.png');
B=zeros(size(A));
B=bitset(B,7,bitget(A,7));
B=bitset(B,8,bitget(A,8));
B=uint8(B);
figure,imshow(B);

%Image reconstruction by combining 8,7,6 and 5 bit planes
A=imread('coins.png');
B=zeros(size(A));
B=bitset(B,8,bitget(A,8));
B=bitset(B,7,bitget(A,7));
B=bitset(B,6,bitget(A,6));
B=bitset(B,5,bitget(A,5));
B=uint8(B);
figure,imshow(B);
```

OutPut:





biget():

Get bit at specified position

Syntax

- **C = bitget(A, *bit*)**

Description

C = bitget(A, *bit*) returns the value of the bit at position *bit* in A. Operand A must be an unsigned integer or an array of unsigned integers, and *bit* must be a number between 1 and the number of bits in the unsigned integer class of A (e.g., 32 for the uint32 class).

bitset():
Set bit at specified position

Syntax

- **C = bitset(A, *bit*)**
- **C = bitset(A, *bit*, v)**

Description

C = bitset(A, *bit*) sets bit position *bit* in A to 1 (on). A must be an unsigned integer or an array of unsigned integers, and *bit* must be a number between 1 and the number of bits in the unsigned integer class of A (e.g., 32 for the uint32 class).

C = bitset(A, *bit*, v) sets the bit at position *bit* to the value v, which must be either 0 or 1.

Practical-3

Histogram equalization without using histeq() function.

The following steps are performed to obtain histogram equalization:

1. Find the frequency of each pixel value.
   Consider a matrix A= $\begin{bmatrix} 1 & 4 & 2 \\ 5 & 1 & 3 \\ 1 & 2 & 4 \end{bmatrix}$ with no of bins =5.
   The pixel value 1 occurs 3 times.
   Similarly the pixel value 2 occurs 2 times and so on.
2. Find the probability of each frequency.
   The probability of pixel value 1's occurrence = frequency (1)/no of pixels.
   i.e 3/9.
3. Find the cumulative histogram of each pixel:
   The cumulative histogram of 1 = 3.
   Cumulative histogram of 2 = cumulative histogram of 1 + frequency of 2=5.
   Cumulative histogram of 3 =
   cumulative histogram of 2+frequency of 3 = 5+1=6.
4. Find the cumulative distribution probability of each pixel
   cdf of 1= cumulative histogram of 1/no of pixels= 3/9.
5. Calculate the final value of each pixel by multiplying cdf with (no of bins);
   cdf of 1= (3/9)*(5)=1.6667. Round off the value.
6. Now replace the final values : $\begin{bmatrix} 2 & 4 & 3 \\ 5 & 2 & 3 \\ 2 & 3 & 4 \end{bmatrix}$

The final value for bin 1 is 2. It is placed in the place of 1 in the matrix.

angeljohnsy@blogspot.com

Code:

```
pkg load image;
a=imread('fields.jpg');
#a=rgb2gray(a);
#a=a(1:10,1:10)
r=size(a,1);
c=size(a,2);
```

```
ah=uint8(zeros(r,c));
n=r*c;
f=zeros(256,1);
pdf=zeros(256,1);
cdf=zeros(256,1);
cumm=zeros(256,1);
out=zeros(256,1);

for i=1:r
  for j=1:c
    values=a(i,j);
    f(values+1)=f(values+1)+1;
    pdf(values+1)=f(values+1)/n;

  endfor
endfor

sum=0; L=255; size(pdf);
for i=1:size(pdf)
  sum=sum+f(i);
  cum(i)=sum;
  cdf(i)=cum(i)/n;
  out(i)=round(cdf(i)*L);
endfor
for i=1:r
  for j=1:c
  ah(i,j)=out(a(i,j)+1);
endfor
endfor
```

figure,

subplot(2,2,1), imshow(a); title('original image');

subplot(2,2,2), imhist(a); title('original hist');

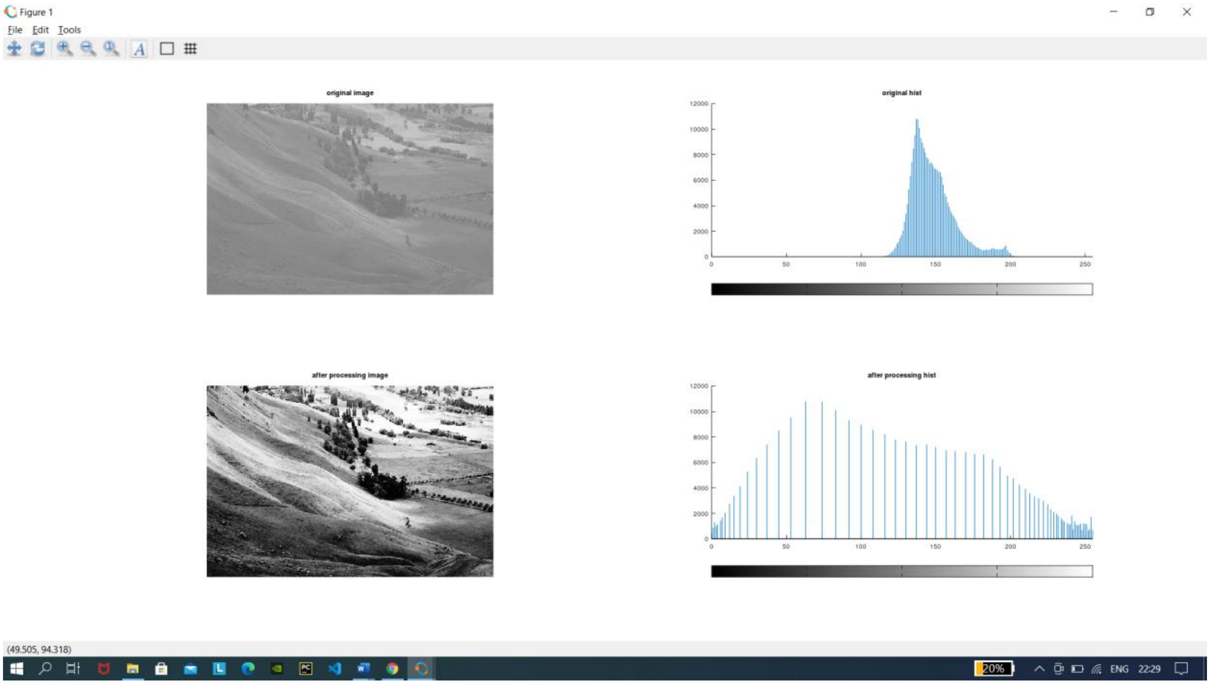
#he=histeq(a);

subplot(2,2,3), imshow(ah); title('after processing image');

subplot(2,2,4), imhist(ah); title('after processing hist');

#imhist(he);

Output:



round():

`Y = round(X)` rounds each element of `X` to the nearest integer. In the case of a tie, where an element has a fractional part of exactly `0.5`, the `round` function rounds away from zero to the integer with larger magnitude.

`Y = round(X,N)` rounds to `N` digits:

- `N > 0`: round to `N` digits to the *right* of the decimal point.
- `N = 0`: round to the nearest integer.
- `N < 0`: round to `N` digits to the *left* of the decimal point.

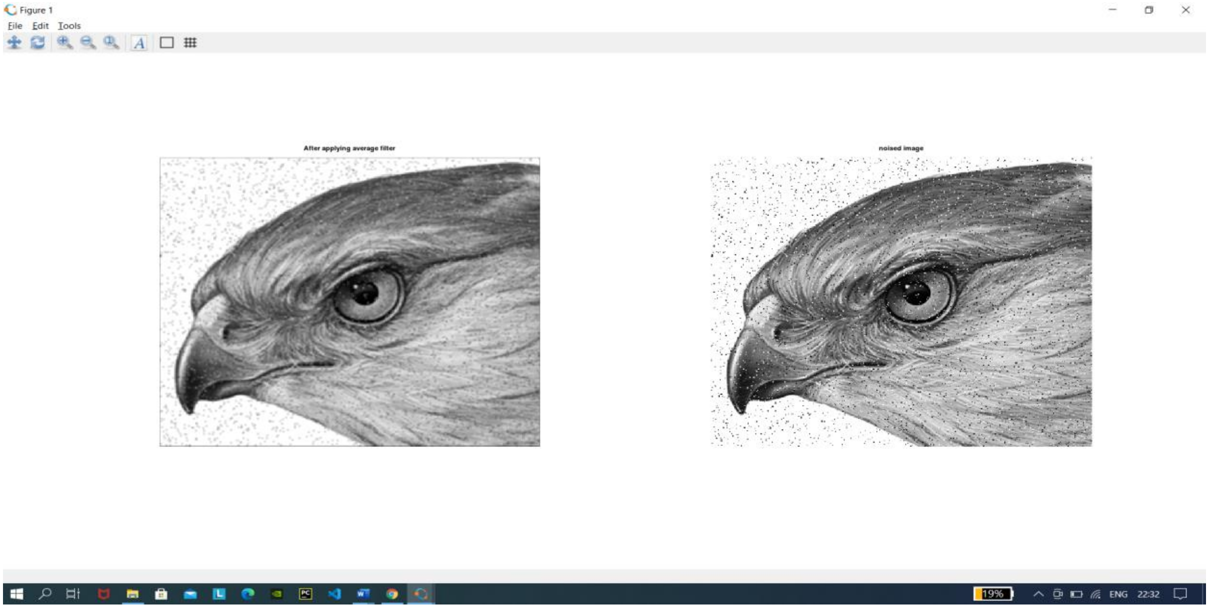
Practical 4

(Low Pass-Average filter using inbuilt functions)

Code:

```
clear all;

close all;

pkg load image;

a=imread('hawk1.png');

#a=rgb2gray(a);

#imwrite(a,'hawk1.png');

a=im2double(a);

r=imnoise(a,'salt & pepper' );

f=ones(3,3)/9;

af=filter2(f,r);

figure

#imshow(a); title('original');

subplot(1,2,1);imshow(af); title('After applying average filter');

subplot(1,2,2)

 imshow(r); title('noised image');
```

OutPut:



imnoise():
Add noise to an image

Syntax

- **J = imnoise(I,type)**
- **J = imnoise(I,type,parameters)**

Description

J = imnoise(I,type) adds noise of a given type to the intensity image I. type is a string that can have one of these values.

Value	**Description**
'gaussian'	Gaussian white noise with constant mean and variance
'localvar'	Zero-mean Gaussian white noise with an intensity-dependent variance
'poisson'	Poisson noise
'salt & pepper'	On and off pixels
'speckle'	Multiplicative noise

filter2():
Perform two-dimensional linear filtering.
Y = filter2 (B, X)
Y = filter2 (B, X, SHAPE)
Apply the 2-D FIR filter B to X.
If the argument SHAPE is specified, return an array of the desired shape. Possible values are:

"full"
pad X with zeros on all sides before filtering.

"same"
unpadded X (default)

"valid"
trim X after filtering so edge effects are no included.

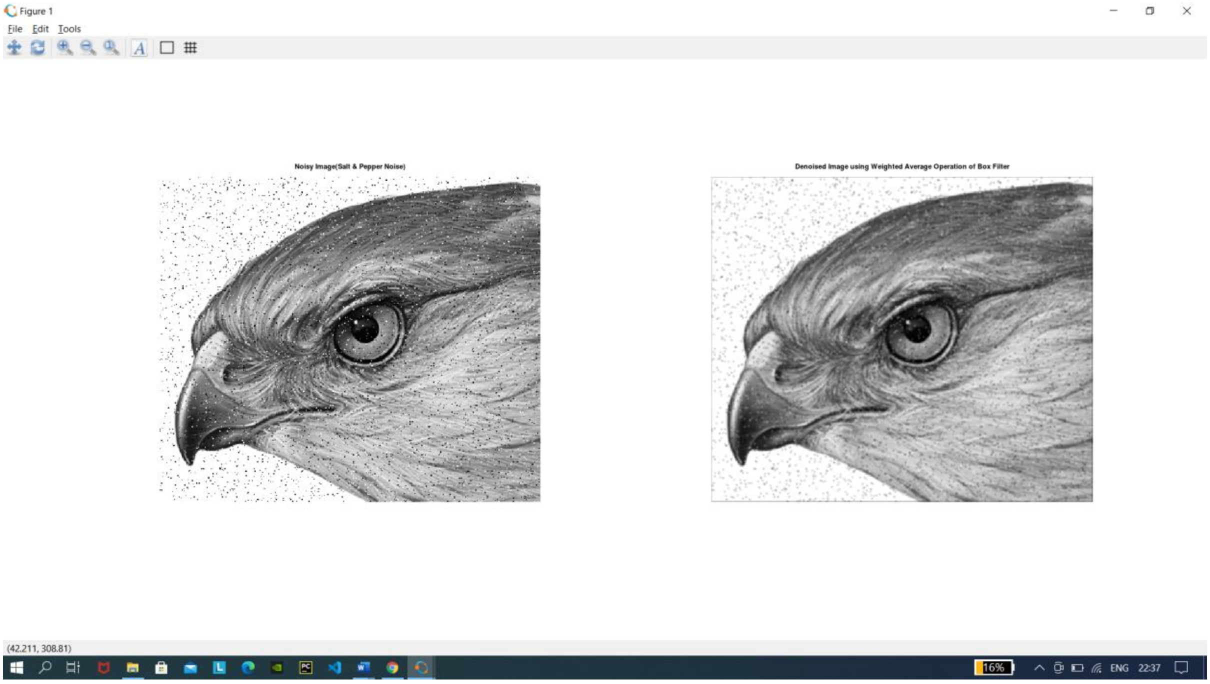
(Low Pass Average filter without using inbuilt functions)

Code:

```
close all;
pkg load image;
im=imread('hawk1.png'); % To read image
#f=rgb2gray(CIm); % To convert RGB to Grayimage
Nim=imnoise(im,'salt & pepper'); % Adding salt & pepper noise to image
w=(1/16)*[1 2 1;2 4 2;1 2 1]; % Defining the box filter mask
% get array sizes
[ma, na] = size(Nim)
[mb, nb] = size(w)
% To do convolution
c = zeros( ma+mb-1, na+nb-1 );
size_c=size(c)
for i = 1:mb
for j = 1:nb
r1 = i
r2 = r1 + ma - 1
c1 = j
c2 = c1 + na - 1
c(r1:r2,c1:c2) = c(r1:r2,c1:c2) + w(i,j) * (Nim);
end
end
% extract region of size(a) from c
r1 = floor(mb/2) + 1;
r2 = r1 + ma - 1;
c1 = floor(nb/2) + 1;
c2 = c1 + na - 1;
c = c(r1:r2, c1:c2);
```

```
figure
subplot(1,2,1)
imshow(Nim);
title('Noisy Image(Salt & Pepper Noise)');
subplot(1,2,2)
imshow(uint8(c));
title('Denoised Image using Weighted Average Operation of Box Filter');
```

OutPut:



floor():

`Y = floor(X)` rounds each element of `X` to the nearest integer less than or equal to that element.

`Y = floor(t)` rounds each element of the `duration` array `t` to the nearest number of seconds less than or equal to that element.

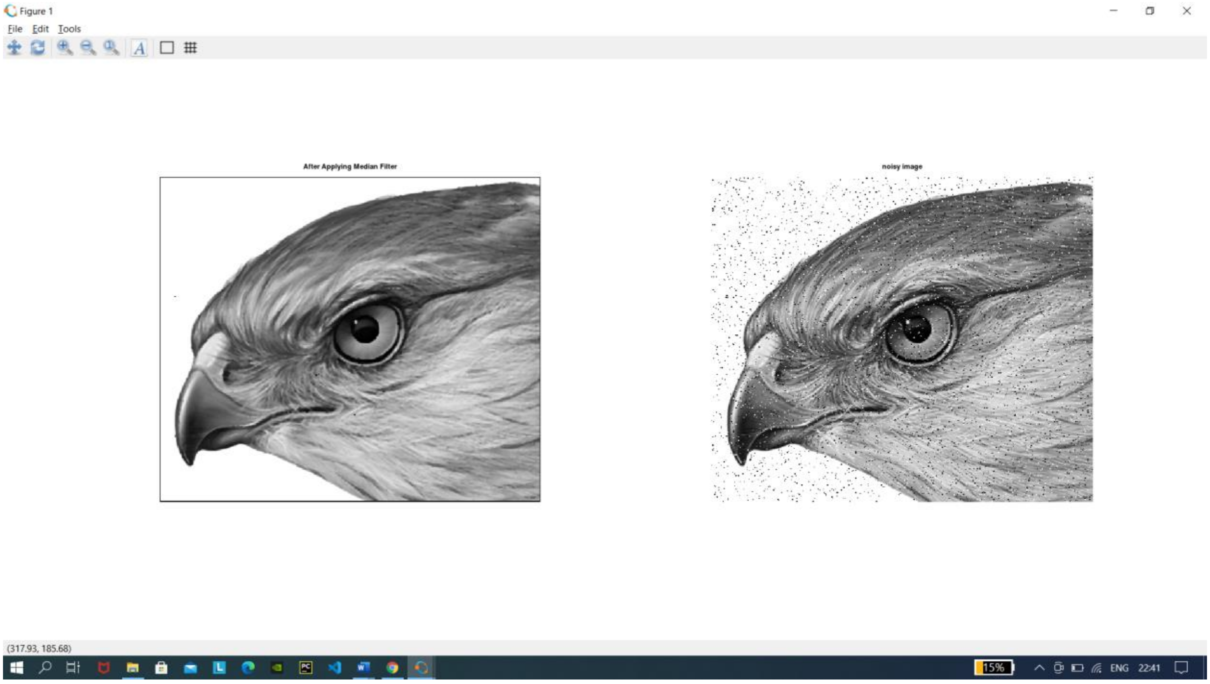
`Y = floor(t,unit)` rounds each element of `t` to the nearest number of the specified unit of time less than or equal to that element.

low Pass Filter(Median Filter)#Meadian Spatial Domain Filtering

Code:

```
 pkg load image;
# Read the image
 a=imread('hawk1.png');
 img_noisy1=imnoise(a,'salt & pepper' );
# Obtain the number of rows and columns of the image
[m, n] = size(img_noisy1)
# Traverse the image. For every 3X3 area,
# find the median of the pixels and
# replace the center pixel by the median
img_new1 = zeros(m, n);

for i=2: m-1
      for j =2: n-1
        temp = [img_noisy1(i-1, j-1),
               img_noisy1(i-1, j),
               img_noisy1(i-1, j + 1),
               img_noisy1(i, j-1),
               img_noisy1(i, j),
               img_noisy1(i, j + 1),
                 img_noisy1(i + 1, j-1),
               img_noisy1(i + 1, j),
               img_noisy1(i + 1, j + 1)] ;
        temp = sort(temp);
        img_new1(i, j)= temp(4);
  endfor
  endfor
img_new1 = uint8(img_new1);
figure
subplot(1,2,1); imshow(img_new1); title('After Applying Median Filter');
subplot(1,2,2); imshow(img_noisy1);title('noisy image');
```

OutPut:



sort():

Sort array elements in ascending or descending order

Syntax

- **B = sort(A)**
- **B = sort(A,dim)**
- **B = sort(...,mode)**
- **[B,IX] = sort(...)**

Description

B = sort(A) sorts the elements along different dimensions of an array, and arranges those elements in ascending order.

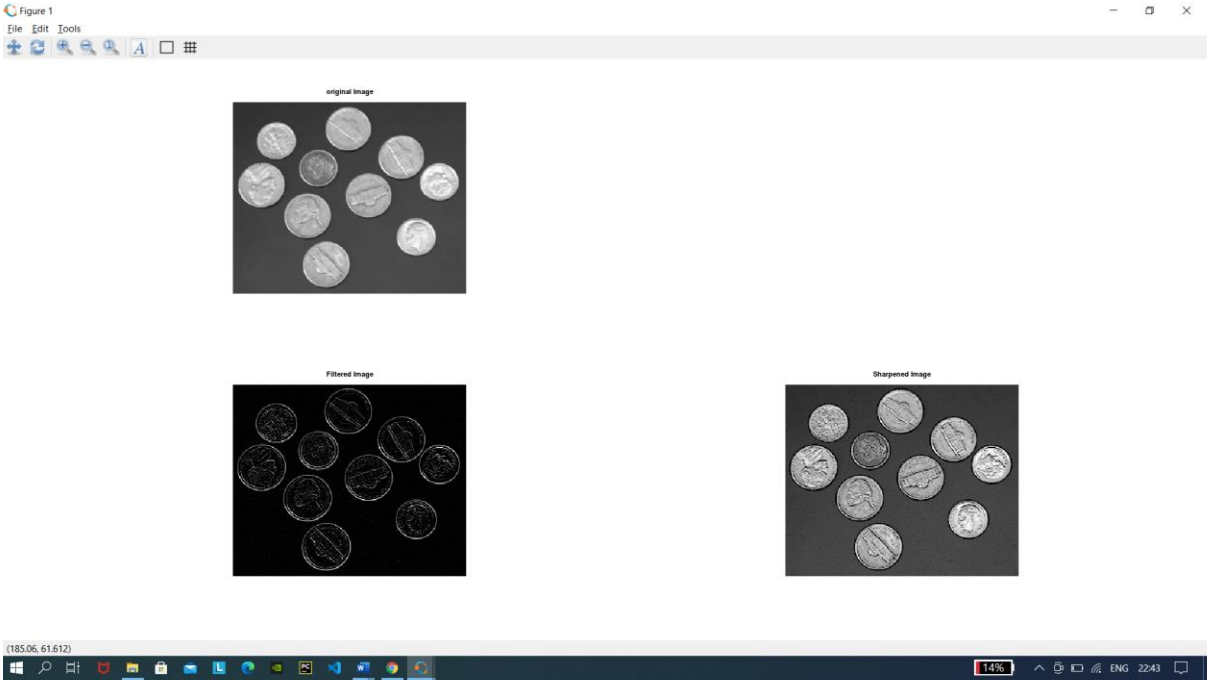
If A is a ...	**sort(A) ...**
Vector	Sorts the elements of A.
Matrix	Sorts each column of A.
Multidimensional array	Sorts A along the first non-singleton dimension, and returns an array of sorted vectors.
Cell array of strings	Sorts the strings in ASCII dictionary order.

Second order derivative-The Laplacian Filter

Code:

```
%Input Image
clear all;
A=imread('coins.png');
size(A);
figure,
subplot(2,2,1);imshow(A); title('original Image');
%Preallocate the matrices with zeros
I1=A;
I=zeros(size(A));
I2=zeros(size(A));
%Filter Masks
F1=[0 2 0;2 -8 2; 0 2 0];
#F2=[1 1 1;1 -8 1; 1 1 1];
%Padarray with zeros
A=padarray(A,[1,1]);
A=double(A);
size(A);
%Implementation of the equation in Fig.D
for i=1:size(A,1)-2
   for j=1:size(A,2)-2

      I(i,j)=sum(sum(F1.*A(i:i+2,j:j+2)));

   end
end

I=uint8(I);


subplot(2,2,3);imshow(I);title('Filtered Image');
%Sharpenend Image
B=I1-I;
subplot(2,2,4); imshow(B);title('Sharpened Image');
```

OutPut:



padarray():
B = padarray(A,padsize) pads array A with an amount of padding in each dimension specified by padsize. The padarray function pads numeric or logical images with the value 0 and categorical images with the category <undefined>. By default, paddarray adds padding before the first element and after the last element of each dimension.
uint8():
8-bit unsigned integer arrays
y = uint8(10);

<u>First Order Derivative-Sobel Operator for edge detection without using edge function</u>

Code:

```
 clear all;
A=imread('peppers.jfif');
figure,
subplot(1,2,1); imshow(A); title('Original');
C=double(A);
size(C)

for i=1:size(C,1)-2
```

```
    for j=1:size(C,2)-2
      %Sobel mask for x-direction:
      Gx=((C(i+2,j)+2*C(i+2,j+1)+C(i+2,j+2))-(C(i,j)+2*C(i,j+1)+C(i,j+2)));
      %Sobel mask for y-direction:
      Gy=((C(i,j+2)+2*C(i+1,j+2)+C(i+2,j+2))-(C(i,j)+2*C(i+1,j)+C(i+2,j)));
      %The gradient of the image
      # B(i,j)=abs(Gx)+abs(Gy);
      A(i,j)=sqrt(Gx.^2+Gy.^2);

    end
end
subplot(1,2,2); imshow(A); title('Sobel gradient');
```

OutPut:

First Order Derivative -Sobel Operator for edge detection using edge function

Code:

```
#load package of image
pkg load image;
#Take input image
img=imread("peppers.jfif");

#function to find edge using sobel filter
sobel = edge(img,'Sobel');
figure 1,
```

```
subplot(1,2,1)
imshow(img);
title('Original Image');
subplot(1,2,2)
imshow(sobel);
title("Edge detection using sobel filter");
#function to find edge using sobel filter
robert = edge(img,'Roberts');
prewitt = edge(img,'Prewitt');
figure 2,
subplot(1,2,1)
imshow(robert);
title('Edge detection using robert filter');
subplot(1,2,2)
imshow(prewitt);
title("Edge detection using prewitt filter");
```

OutPut:

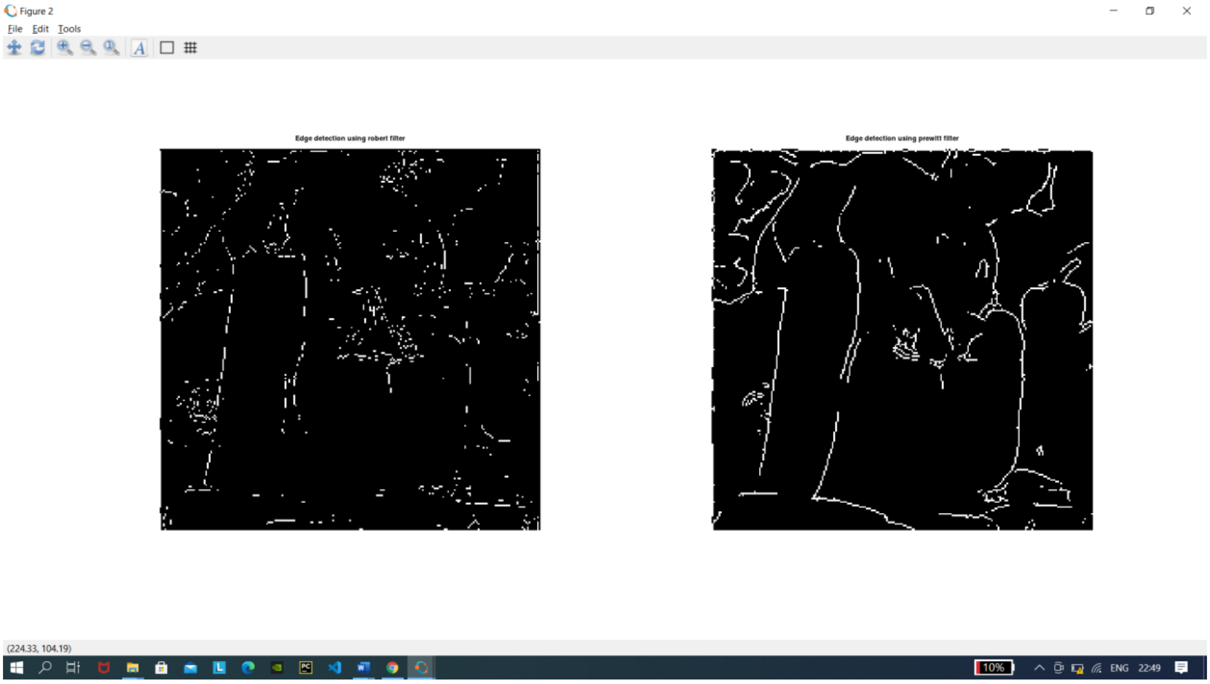


Figure 2
File Edit Tools
Edge detection using robert filter
Edge detection using prewitt filter
(224.33, 104.19)
10%
ENG 22:49

Practical -6

Color Image Processing

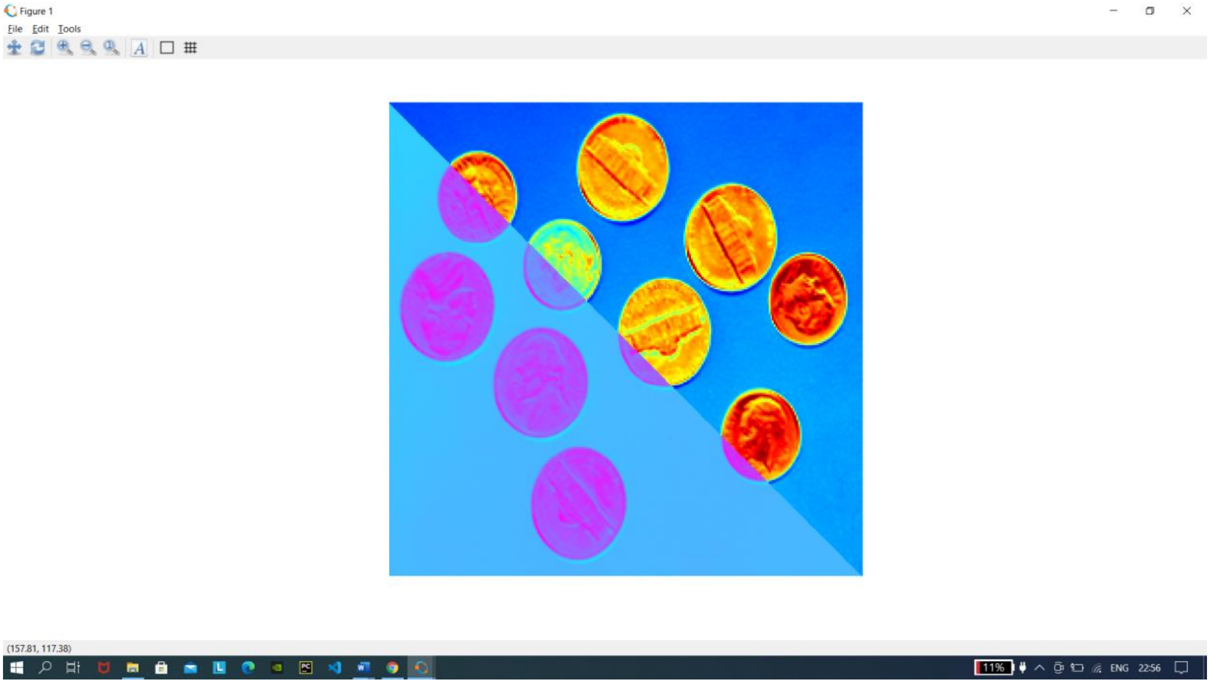
A) Pseudocoloring

Code:

```
pkg load image;
close all;
clear all;
%READ INPUT IMAGE
A = imread('coins.png');
%RESIZE IMAGE
A = imresize(A,[256 256]);
%PRE-ALLOCATE THE OUTPUT MATRIX
Output = ones([size(A,1) size(A,2)]);

%COLORMAPS
#maps={'jet(256)';'hsv(256)';'cool(256)';'spring(256)';'summer(256)';'parula(256)';'hot(256)'};
%COLORMAP 1
map = colormap(jet(256));
Red = map(:,1);
Green = map(:,2);
Blue = map(:,3);

R1 = Red(A);
G1 = Green(A);
B1 = Blue(A);

%COLORMAP 2
map = colormap(cool(256));
Red = map(:,1);
Green = map(:,2);
Blue = map(:,3);

%RETRIEVE POSITION OF UPPER TRIANGLE
[x,y]=find(triu(Output)==1);
Output(:,:,1) = Red(A);
Output(:,:,2) = Green(A);
Output(:,:,3) = Blue(A);
for i=1:numel(x)
        Output(x(i),y(i),1)=R1(x(i),y(i));
       Output(x(i),y(i),2)=G1(x(i),y(i));
       Output(x(i),y(i),3)=B1(x(i),y(i));
end
Output = im2uint8(Output);
%FINAL IMAGE
```

imshow(Output);

OutPut:

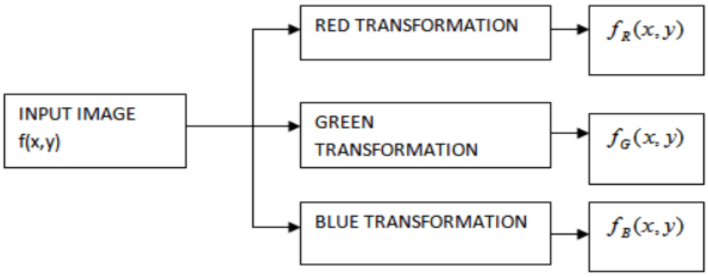


colormap():

the purpose of colormap is to define the colors of the graphics objects like image, surface and patch objects. A colormap is basically a matrix with values between 0 & 1. Colormaps can have any length, but width-wise they must have 3 columns. Each row of the matrix defines one color by using an RGB triplet.

B) Separating the RGB Channels

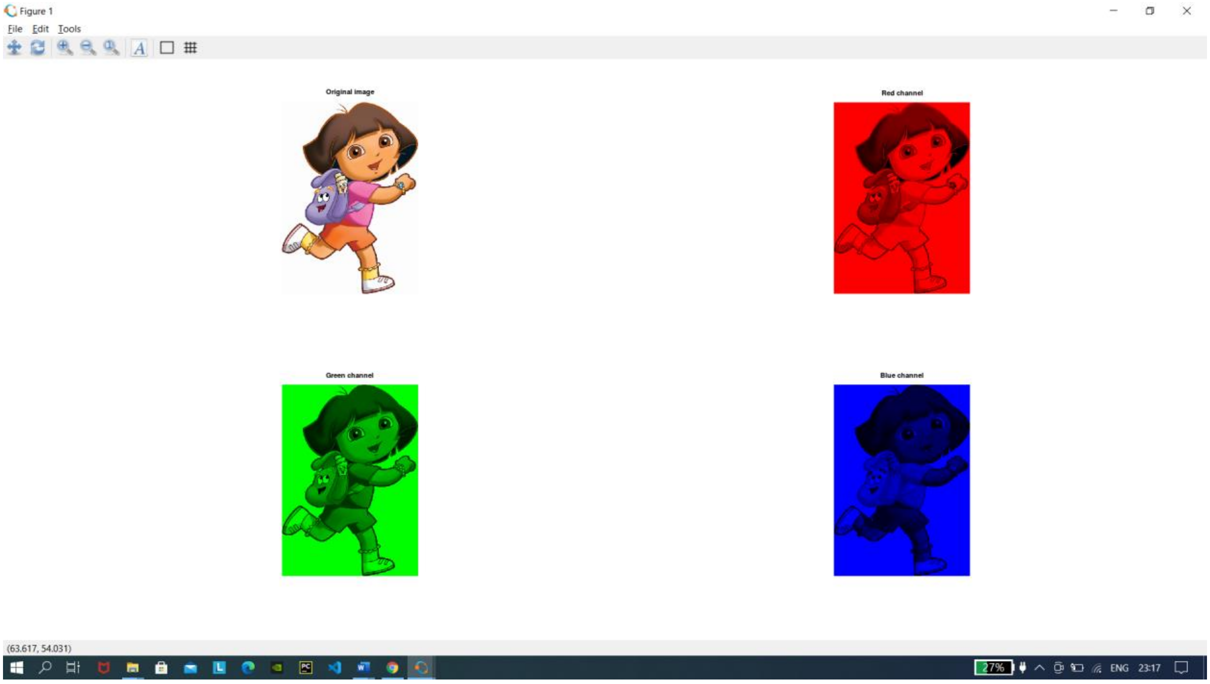
Functional Block Diagram



Code:

```
pkg load image;
clear all;
close all;
img1 = imread('cartoon.jpg');
img_r=img1;
img_r(:,:,2)=0;
img_r(:,:,3)=0;

img_g=img1;
img_g(:,:,1)=0;
img_g(:,:,3)=0;


img_b=img1;
img_b(:,:,1)=0;
img_b(:,:,2)=0;

subplot(2,2,1);imshow(img1);title("Original image");
subplot(2,2,2);imshow(img_r);title("Red channel");
subplot(2,2,3);imshow(img_g);title("Green channel");
subplot(2,2,4);imshow(img_b);title("Blue channel");
```

OutPut:



C) <u>Intensity Slicing</u>

Code:

```
clear all;
pkg load image;
#im=input('Enter the file name);
input_image=imread('hawk.png');
k=rgb2gray(input_image);
[x y z]=size(k);
% z should be one for the input image
k=double(k);
for i=1:x
for j=1:y
if k(i,j)>=0 && k(i,j)<50
m(i,j,1)=k(i,j,1)+25;
m(i,j,2)=k(i,j)+50;
m(i,j,3)=k(i,j)+60;
end
if k(i,j)>=50 && k(i,j)<100
m(i,j,1)=k(i,j)+55;
m(i,j,2)=k(i,j)+68;
m(i,j,3)=k(i,j)+70;
end
if k(i,j)>=100 && k(i,j)<150
m(i,j,1)=k(i,j)+52;
m(i,j,2)=k(i,j)+30;
```

```
m(i,j,3)=k(i,j)+15;
end
if k(i,j)>=150 && k(i,j)<200
m(i,j,1)=k(i,j)+50;
m(i,j,2)=k(i,j)+40;
m(i,j,3)=k(i,j)+25;
end
if k(i,j)>=200 && k(i,j)<=256
m(i,j,1)=k(i,j)+120;
m(i,j,2)=k(i,j)+60;
m(i,j,3)=k(i,j)+45;
end
end
end
figure,
imshow(uint8(k),[]);
title('Original Image');
figure,
imshow(uint8(m),[]);
title(''Pseudo filtred image'');
```

OutPut:

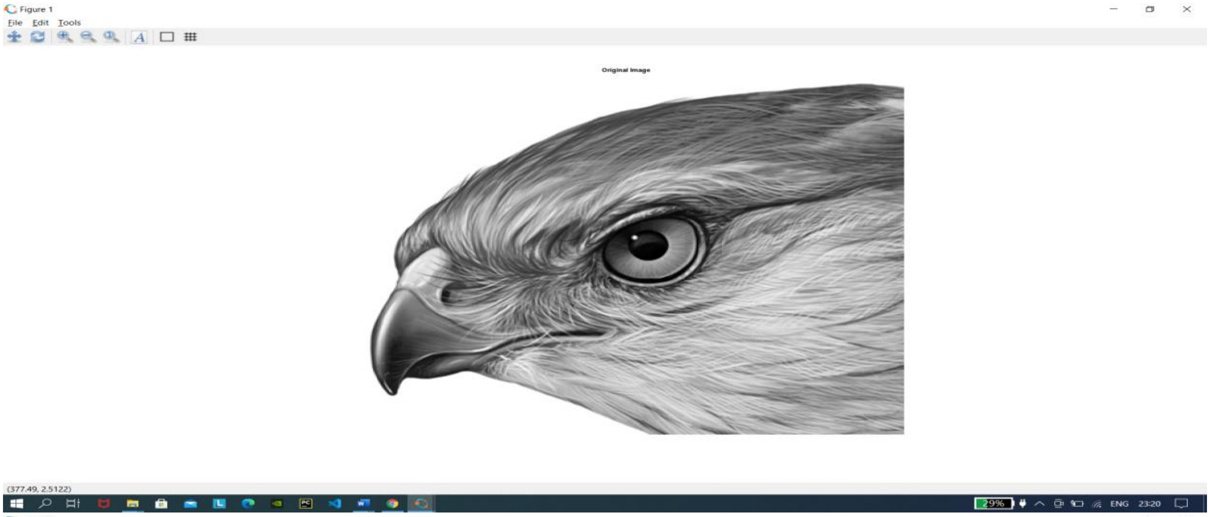


Figure 1
File Edit Tools
Original Image
(377.49, 2.5122)
29%
ENG 23:20

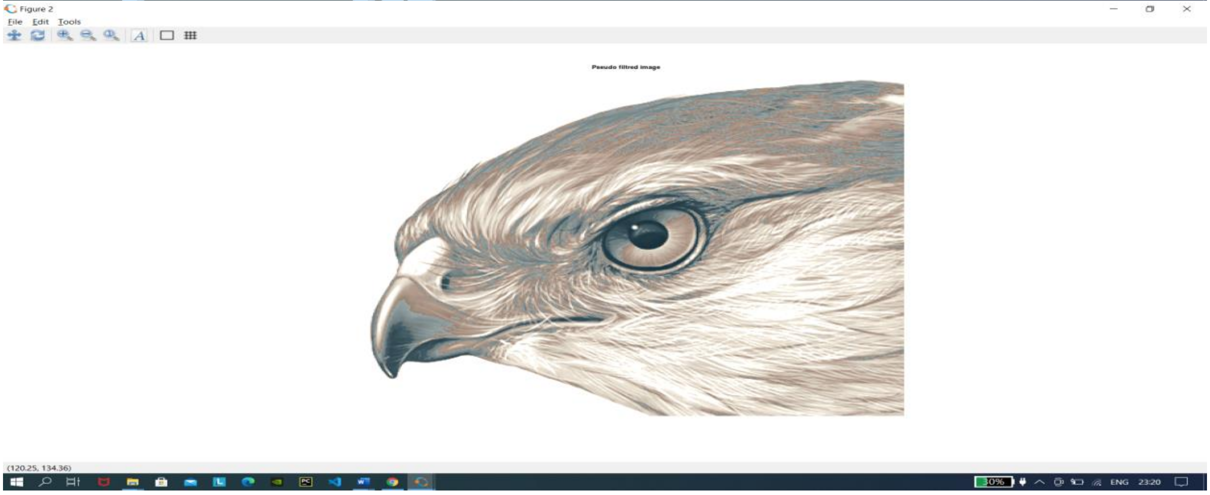


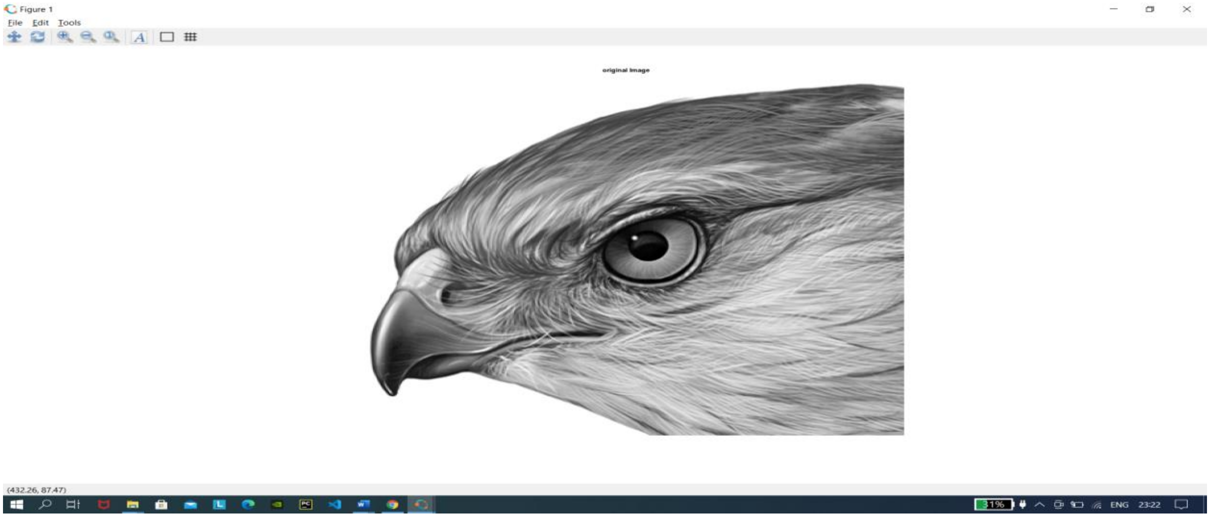
Figure 2
File Edit Tools
Pseudo filtred image
(120.25, 134.36)
30%
ENG 23:20

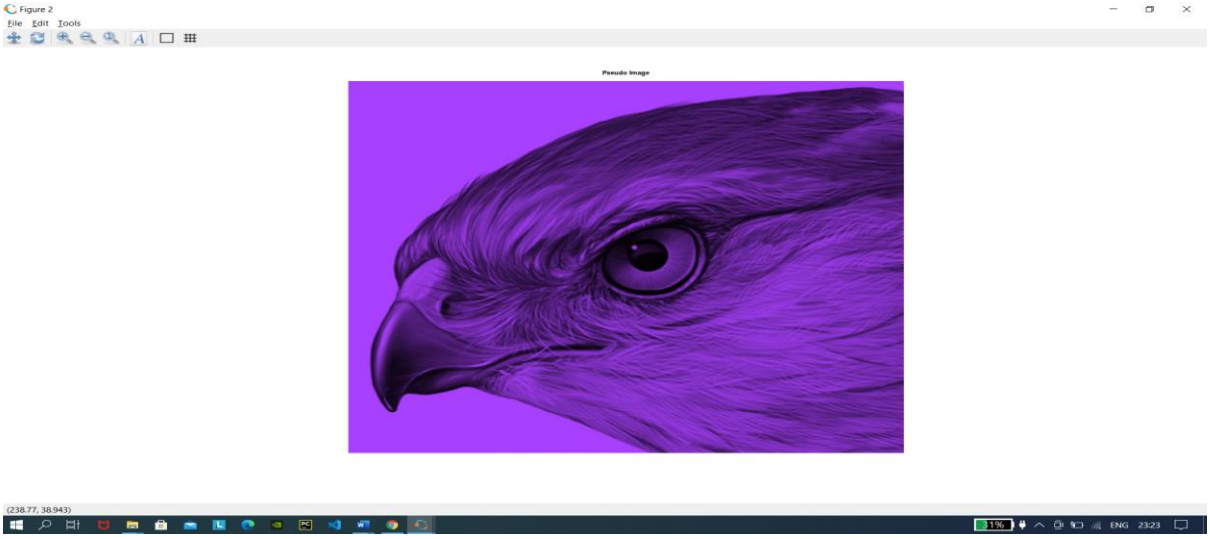
Pseudo Image:

Code:

```
pkg load image;
clear all;
img = imread('hawk1.png'); % Read image
figure, imshow(img);title("original Image");
red = 0.66*img;
green=0.25*img;
blue = img;
pseudo_img = cat(3, red, green, blue);
figure, imshow(pseudo_img), title('Pseudo Image');
```

OutPut:





<u>Practical -7</u>

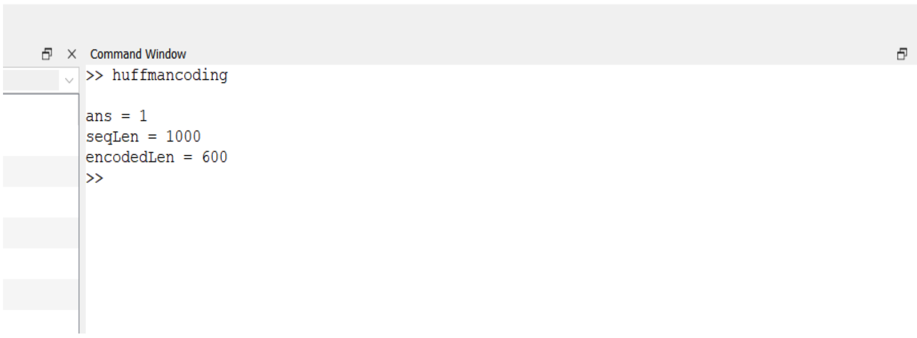
Image Compression Techniques and watermarking

A) Implement Huffman Coding

Code:

```
pkg load communications
sig = repmat([3 3 1 3 3 3 3 3 2 3],1,50);
symbols = [1 2 3];
p = [0.1 0.1 0.8];
dict = huffmandict(symbols,p);
hcode = huffmanenco(sig,dict);
dhsig = huffmandeco(hcode,dict);
isequal(sig,dhsig)
binarySig = de2bi(sig);
seqLen = numel(binarySig)
binaryhcode = de2bi(hcode);
encodedLen = numel(binaryhcode)
```

OutPut:



repmat():

Repmat command repeats the elements of an array in output. Repetition is depended on parameter list, therefore every time we need to declare parameters within a bracket after repmat command.

Syntax:

Repmat(number,number of times)

Huffmandict():

Generate Huffman code dictionary for source with known probability model.

SYNTAX:

[dict,avglen] = huffmandict(symbols,prob)

huffmandict(symbols,prob) generates a binary Huffman code dictionary, dict, for the source symbols, symbols, by using the maximum variance algorithm. The input prob specifies the probability of occurrence for each of the input symbols. The length of prob must equal the

length of symbols. The function also returns average codeword length avglen of the dictionary, weighted according to the probabilities in the input prob.

Huffmanenco():

Encode sequence of symbols by Huffman encoding

SYNTAX:

code = huffmanenco(sig,dict)

code = huffmanenco(sig,dict) encodes input signal sig using the Huffman codes described by input code dictionary dict. sig can have the form of a vector, cell array, or alphanumeric cell array. If sig is a cell array, it must be either a row or a column. dict is an N-by-2 cell array, where *N* is the number of distinct possible symbols to encode. The first column of dict represents the distinct symbols and the second column represents the corresponding codewords. Each codeword is represented as a row vector, and no codeword in dict can be the prefix of any other codeword in dict. You can generate dict using the huffmandict function.

Huffmandeco():

Decode binary code by Huffman decoding.

SYNTAX:

sig = huffmandeco(code,dict)

sig = huffmandeco(code,dict) decodes the numeric Huffman code vector, code, by using the Huffman codes described by input code dictionary dict. Input dict is an *N*-by-2 cell array, where *N* is the number of distinct possible symbols in the original signal that encodes code. The first column of dict represents the distinct symbols, and the second column represents the corresponding codewords. Each codeword is represented as a numeric row vector, and no codeword in dict can be the prefix of any other codeword in dict. You can generate dict by using the huffmandict function and code by using the huffmanenco function. If all symbols in dict are numeric, output sig is a vector. If any symbol in dict is alphabetic, sig is a one-dimensional cell array.

de2bi():

Convert decimal numbers to binary vectors.

SYNTAX:

b = de2bi(d)

converts a nonnegative decimal integer d to a binary row vector. If d is a vector, the output b is a matrix in which each row is the binary form of the corresponding element in d.

numel():

Number of elements in array or subscripted array expression

Syntax

- **n = numel(A)**
- **n = numel(A,varargin)**

Description

n = numel(A) returns the number of elements, n, in array A.

n = numel(A,varargin) returns the number of subscripted elements, n, in A(index1,index2,...,indexn), where varargin is a cell array whose elements are index1, index2, ..., indexn.

B)Watermarking:

Code:

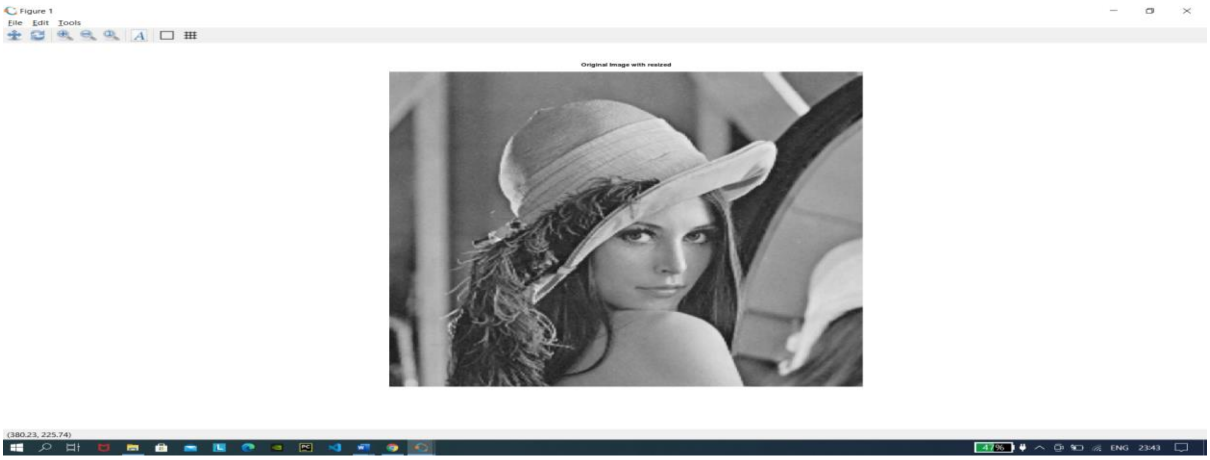
```
pkg load image;

clear all;

close all;

#Input Image where we want to apply watermark

f=imread('lena_gray_256.tif');


#For watermarking, size of inputimage and watermarking image should be same

#there for we changed the size of image using imresize and dispalyed


fr=imresize(f,[560 560]);

figure;imshow(fr);

title('Original Image with resized');


#Watermarking Image

w=imread('Sample1.png');

#Again Resized the Watermarking Image

wr=imresize(w,[560 560]);

figure;imshow(wr);

title('watermark');


#Applied watermarking

alpha=0.7;

fw=(1-alpha)*fr + alpha.*wr;
```

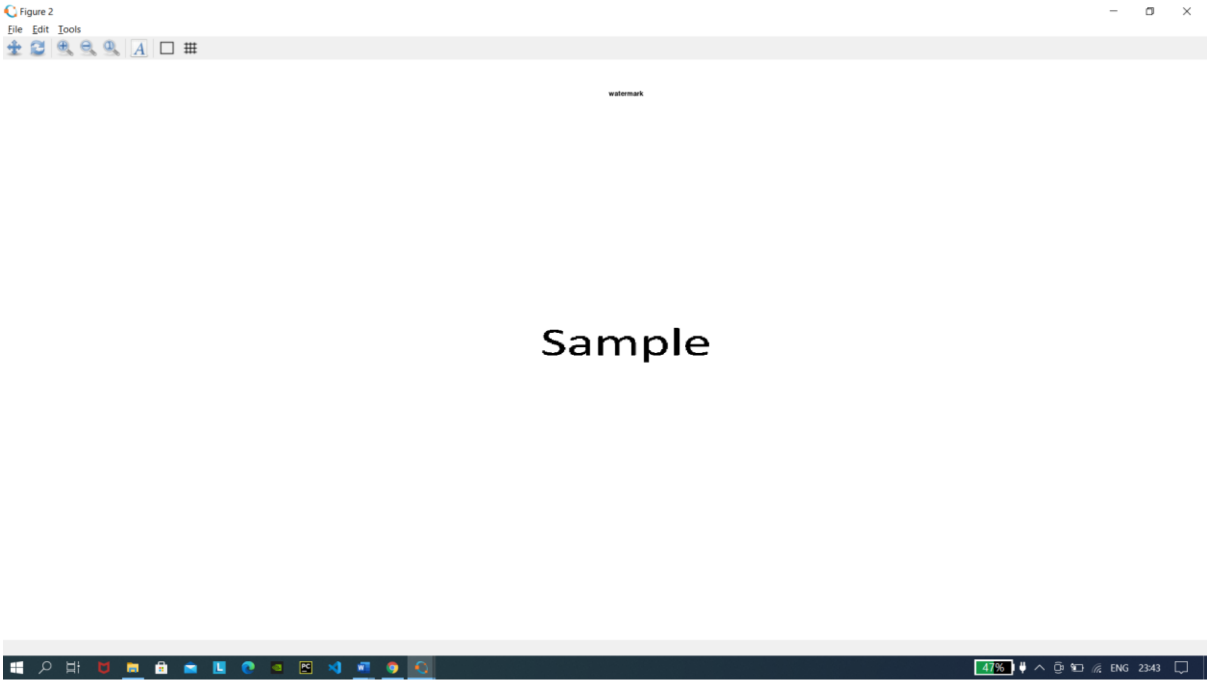
#Display the watermarked Image

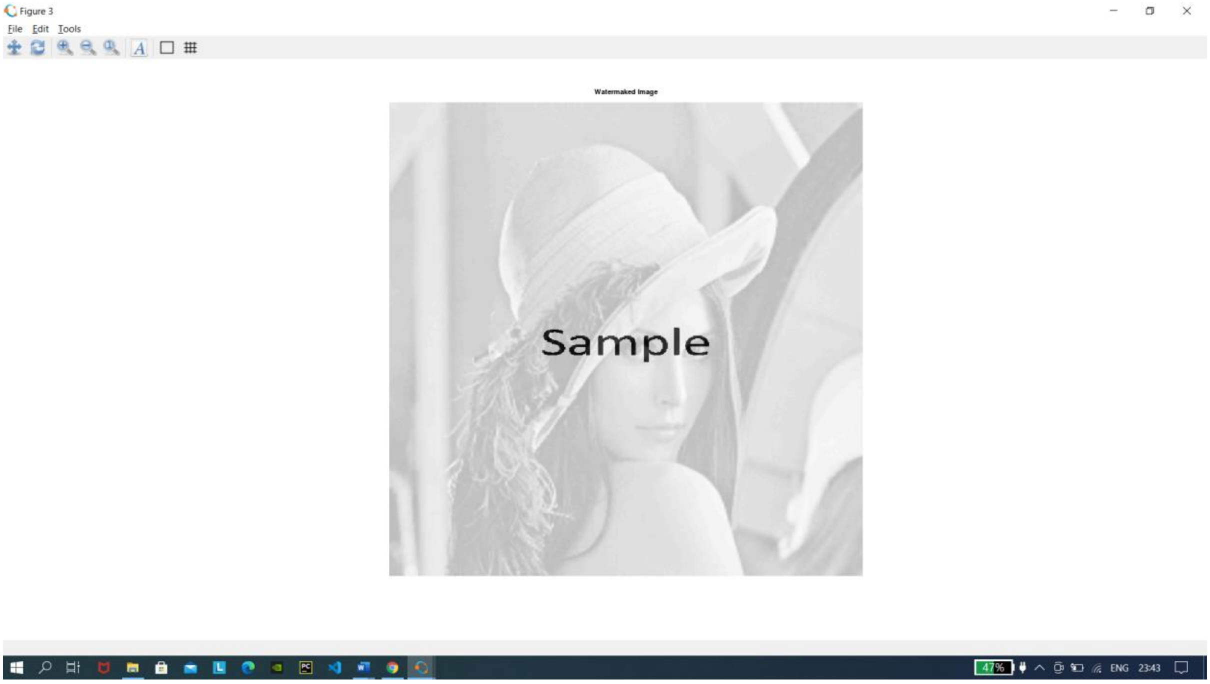
figure;imshow(fw);

title('Watermaked Image');

OutPut:







Imresize():

Resize image

B = imresize(A,scale) returns image B that is scale times the size of A. The input image A can be a grayscale, RGB, or binary image. If A has more than two dimensions, imresize only resizes the first two dimensions. If scale is in the range [0, 1], B is smaller than A. If scale is greater than 1, B is larger than A. By default, imresize uses bicubic interpolation.

Practical 8

Basic Morphological Transformations

A) Boundary Extraction

Extracting the boundary is the important process to gain the information and understand the feature of an image. Boundary extraction is the first process in preprocessing in order to present the features of the image. This process can help the researcher to gain the data from the image.

Boundary Extraction in Octave
Let A be an Image matrix and B be a structuring element.

Formula for Boundary Extraction:

$$\beta(A) = A - (A \ominus B)$$

Steps to be followed:

- Convert the image into binary image.
- Perform Erosion:

  Erode binary image A by structuring element B. (i.e) $(A \ominus B)$

- Subtraction:

  Subtract the binary image A from the Eroded image.(i.e) $A - (A \ominus B)$

imerode():
erodes the image.
J = imerode(I,SE) erodes the grayscale, binary, or packed binary image I, returning the eroded image, J. SE is a structuring element object or array of structuring element objects, returned by the strel or offsetstrel functions.

Code:

```
pkg load image;

clear all;

close all;

A=imread('giraffe.png');

C=rgb2gray(A);



C(C<225)=0;
```

```
s=strel('disk',4,0);%Structuring element

D=~im2bw(C);%binary Image

F=imerode(D,s);%Erode the image by structuring element


figure,imshow(A);title('Original Image');

figure,imshow(D);title('Binary Image');

%Difference between binary image and Eroded image

figure,imshow(D-F);title('Boundary extracted Image');
```

OutPut:

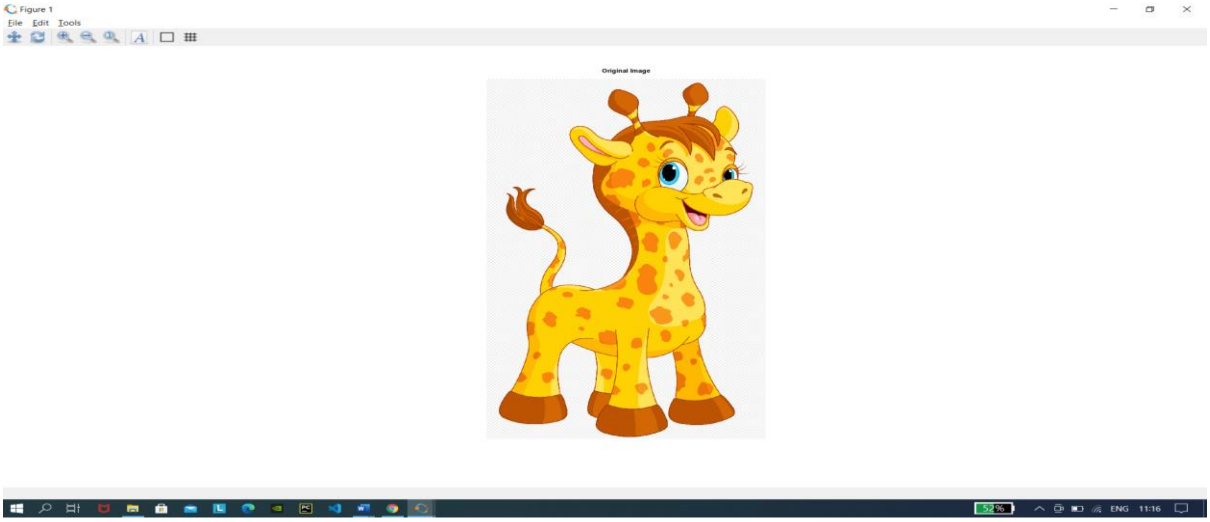


Figure 1
File Edit Tools
Original Image


Figure 2
File Edit Tools
Binary Image


Figure 3
File Edit Tools
Boundary extracted Image
(91.79, 104.43)

B) Thining and thicking

Code:

```
org_im=imread("img.jfif");

subplot(2,2,1),

imshow(org_im);title("Original image");

binary=im2bw(org_im);

subplot(2,2,2),

imshow(binary);title("Binary image");


thin=bwmorph(binary,'thin');

subplot(2,2,3),

imshow(thin);title("Thinning ");

thick=bwmorph(binary,'thicken');

subplot(2,2,4),

imshow(thick);title("Thicking");
```

OutPut:

bwmorph():
Morphological operations on binary images

SYNTAX:

<u>**BW2 = bwmorph(BW,operation)**</u>

Operations can be ‘skel’ ,’thin’ ,’thicken’, ‘fill’, etc.

C) Hole filling and sketoning

Code:

```
A=imread("coins.png");

B=im2bw(A);

subplot(2,2,1)

imshow(B);title("original image");

hole=bwfill(B,'holes');

subplot(2,2,2),
```

imshow(hole);title("Binary image");

skel=bwmorph(B,'skel',8);

subplot(2,2,3),

imshow(skel);title("Skeleton");

OutPut: