POORNIMA COLLEGE OF ENGINEERING
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Digital Image Processing Lab Manual

(Lab Code: 6AID4-21)

6rd Semester, 3nd Year

Department of Advance Computing

Session: 2024-25

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INSTITUTE VISION & MISSION

VISION

To create knowledge based society with scientific temper, team spirit and dignity of labor to face the global competitive challenges.

MISSION

To evolve and develop skill-based systems for effective delivery of knowledge so as to equip young professionals with dedication & commitment to excellence in all spheres of life

DEPARTMENT VISION & MISSION

VISION

Become most preferred department for the latest advanced computing programs through creating appropriate teaching-learning and skill up gradation environment that fulfill current industry needs.

MISSION

1. To create experiential learning environment that will enable students to compete globally in advanced computing domain.To contribute significantly to the research and the discovery of new.
2. To adapt latest technological tools and contribute significantly for the advancement of knowledge in computer engineering application in industry, society and environment.
3. To inculcate essential characteristic in the students for their all-round professional development, interaction with industry and society and lifelong learning.
4. To create R & D infrastructure and center of excellence in various advanced computing sub domains.

RTU SYLLABUS AND MARKING SCHEME

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EVALUATION SCHEME

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DISTRIBUTION OF MARKS FOR EACH EXPERIMENT

Attendance	Record	Performance	Total
2	3	5	10

LAB OUTCOME AND ITS MAPPING WITH PO & PSO

LAB OUTCOMES

After completion of this course, students will be able to –

6AID4-21.1	To demonstrate the basic concept of MATLAB programming tools for Digital Image processing.
6AID4-21.2	To plot and compare various image enhancement operations.
6AID4-21.3	To apply linear and non-linear filters on image and transform techniques on images.
6AID4-21.4	To perform morphological operations on images for segmentation.

LO-PO-PSO MAPPING MATRIX OF COURSE

LO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6AID4-21.1	-	-	-	-	3	-	-	-	-	-	-	3	2	-	-
6AID4-21.2	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-
6AID4-21.3	-	-	-	3	-	-	-	-	-	-	-	-	-	2	-
6AID4-21.4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	2

PROGRAM OUTCOMES (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineeringproblems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	The ability to understand and apply knowledge of mathematics, system analysis & design, Data Modelling, Cloud Technology, and latest tools to develop computer based solutions in the areas of system software, Multimedia, Web Applications, Big data analytics, IOT, Business Intelligence and Networking systems
PSO2	The ability to understand the evolutionary changes in computing, apply standards and ethical practices in project development using latest tools & Technologies to solve societal problems and meet the challenges of the future.
PSO3	The ability to employ modern computing tools and platforms to be an entrepreneur, lifelong learning and higher studies

RUBRICS FOR LAB

Laboratory Evaluation Rubrics:

S. No.	Criteria	Sub Criteria and Marks Distribution			Outstanding (>90%)	Admirable (70-90%)	Average (40-69%)	Inadequate (<40%)
		Mid-Term	End-Team	Continues Evaluation				
A	PERFORMANCE (PO1, PO8, PO9)	Procedure Followed M.M. 100 = 6	Procedure Followed M.M. 100 = 6	Procedure Followed M.M. 100 = 2	• All possible system and Input/ Output variables are taken into account • Performance measures are properly defined • Experimental scenarios are very well defined	•Most of the system and Input/ Output variables are taken into account • Most of the Performance measures are properly defined • Experimental scenarios are defined correctly	• Some of the system and Input/ Output variables are taken into account • Some of the Performance measures are properly defined • Experimental scenarios are defined but not sufficient	•System and Input/ Output variables are not defined • Performance measures are not properly defined • Experimental scenarios not defined
		Individual/Team Work M.M. 100 = 6	Individual/Team Work M.M. 100 = 6	Individual/Team Work M.M. 100 = 2	•Coordination among the group members in performing the experiment was excellent	•Coordination among the group members in performing the experimentwas good	•Coordination among the group members in performing the experiment was average	•Coordination among the group members in performing the experiment was very poor
		Precision in data collection M.M. 100 = 6	Precision in data collection M.M. 100 = 6	Precision in data collection M.M. 100 = 4	•Data collected is correct in size and from the experiment performed	•Data collected is appropriate in size and butnot from proper sources.	•Data collected is not so appropriate in size and but from proper sources.	•Data collected is neither appropriate in size and norfrom proper sources
B	LAB RECORD/WRITTEN WORK (PO1, PO8, PO10)	NA	NA	Timing of Evaluation of Experiment M.M. 100 = 6	• On the Same Date of Performance	• On the Next Turn from Performance	• Before Dead Line	• On the Dead Line
		Data Analysis M.M. 100 = 6	Data Analysis M.M. 100 = 6	Data Analysis M.M. 100 = 4	•Data collected is exhaustively analyzed & appropriate featuresare selected	•Data collected is analyzed& but appropriate features are not selected	•Data collected is not analyzed properly. •Features selected arenot appropriate	•Data collected is not analyzed & the features are not selected

		Results and Discussion M.M. 100 = 6	Results and Discussion M.M. 100 = 6	Results and Discussion M.M. 100 = 4	•All results are very well presented with all variables • Well prepared neat diagrams/plots/ tables for all performance measured • Discussed critically behavior of the system with reference to performance measures • Very well discussed pros n cons of outcome	•All results presented but not all variables mentioned • Prepared diagrams /plots/ tables for all performance measured but not so neat • Discussed behavior of the system with reference to performance measures but not critical • Discussed pros n cons of outcome in brief	•Partial results are included • Prepared diagrams /plots/ tables partially for the performance measures • Behavior of the system with reference to performance measures has been superficially presented • Discussed pros n cons of outcome but not so relevant	•Results are included but not as per experimental scenarios • No proper diagrams /plots/ tables are prepared • Behavior of the system with reference to performance measures has not been presented • Did not discuss pros n cons of outcome
C	**VIVA (PO1, PO10)**	Way of presentation M.M. 100 = 5	Way of presentation M.M. 100 = 5	Way of presentation M.M. 100 = 4	•Presentation was very good	•Presentation was good	•Presentation was satisfactory	•Presentation was poor
		Concept Explanation M.M. 100 = 5	Concept Explanation M.M. 100 = 5	Concept Explanation M.M. 100 = 4	•Conceptual explanation was excellent	•Conceptual explanation was good	•Conceptual explanation was somewhat good	•Conceptual explanation was Poor
D	**ATTENDANCE**	NA	NA	**A**ttendance M.M. 100 =10	•Present more than 90% of lab sessions	•Present more than 75% of lab sessions	•Present more than 60% of lab sessions	•Present in less than 60% lab sessions

LAB CONDUCTION PLAN

Total number of Experiments -07
Total numbers of turns required – 08
Number of turns required for: -

Experiment Number	Scheduled Week
Experiment -1	Week 1
Experiment -2	Week 2
Experiment -3	Week 3
I Mid Term	**Week 4**
Experiment -4	Week 5
Experiment-5	Week 6
Experiment-6 (Beyond Syllabus)	Week 7
Experiment-7 (Beyond Syllabus)	Week 08
II Mid Term	**Week 09**

DISTRIBUTION OF LAB HOURS

S. No.	Activity	Distribution of Lab Hours	
		Time (180 minute)	Time (120 minute)
1	Attendance	5	5
2	Explanation of Experiment & Logic	30	30
3	Performing the Experiment	60	30
4	File Checking	40	20
5	Viva/Quiz	30	20
6	Solving of Queries	15	15

LAB ROTAR PLAN

ROTOR-1

Ex. No.	NAME OF EXPERIMENTS
1	Point-to-point transformation. This laboratory experiment provides for thresholding an image and the evaluation of its histogram. Histogram equalization. This experiment illustrates the relationship among the intensities (gray levels) of an image and its histogram.
2	Geometric transformations. This experiment shows image rotation, scaling, and translation. Two-dimensional Fourier transform
3	Linear filtering using convolution. Highly selective filters

ROTOR-2

Ex. No.	NAME OF EXPERIMENTS
7	Ideal filters in the frequency domain. Non Linear filtering using convolutional masks. Edge detection. This experiment enables students to understand the concept of edge detectors and their operation in noisy images
8	Morphological operations: This experiment is intended so students can appreciate the effect of morphological operations using a small structuring element on simple binary images. The operations that can be performed are erosion, dilation, opening, closing, open-close, close-open.
9	To perform the following operations in an image. (a) erosion, (b) dilation. (Beyond Syllabus).
10	To perform the following operations in an image. (a) opening, (b) closing. (Beyond Syllabus).

GENERAL LAB INSTRUCTIONS

DO'S

1. Enter the lab on time and leave at proper time.
2. Wait for the previous class to leave before the next class enters.
3. Keep the bag outside in the respective racks.
4. Utilize lab hours in the corresponding.
5. Turn off the machine before leaving the lab unless a member of lab staff has specifically told you not to do so.
6. Leave the labs at least as nice as you found them.
7. If you notice a problem with a piece of equipment (e.g., a computer doesn't respond) or the room in general (e.g., cooling, heating, lighting) please report it to lab staff immediately. Do not attempt to fix the problem yourself.

DON'TS

1. Don't abuse the equipment.
2. Do not adjust the heat or air conditioners. If you feel the temperature is not properly set, inform lab staff; we will attempt to maintain a balance that is healthy for people and machines.
3. Do not attempt to reboot a computer. Report problems to lab staff.
4. Do not remove or modify any software or file without permission.
5. Do not remove printers and machines from the network without being explicitly told to do so by lab staff.
6. Don't monopolize equipment. If you're going to be away from your machine for more than 10 or 15 minutes, log out before leaving. This is both for the security of your account, and to ensure that others are able to use the lab resources while you are not.
7. Don't use internet, internet chat of any kind in your regular lab schedule.
8. Do not download or upload of MP3, JPG or MPEG files.
9. No games are allowed in the lab sessions.
10. No hardware including USB drives can be connected or disconnected in the labs without prior permission of the lab in-charge.
11. No food or drink is allowed in the lab or near any of the equipment. Aside from the fact that it leaves a mess and attracts pests, spilling anything on a keyboard or other piece of computer equipment could cause permanent, irreparable, and costly damage. (and in fact

has) If you need to eat or drink, take a break and do so in the canteen.

12. Don't bring any external material in the lab, except your lab record, copy and books.
13. Don't bring the mobile phones in the lab. If necessary, then keep them in silence mode.
14. Please be considerate of those around you, especially in terms of noise level. While labs are a natural place for conversations of all types, kindly keep the volume turned down.
15. If you are having problems or questions, please go to either the faculty, lab in-charge or the lab supporting staff. They will help you. We need your full support and cooperation for smooth functioning of the lab.

LAB SPECIFIC SAFETY RULES

Before entering in the lab

1. All the students are supposed to prepare the theory regarding the next experiment/ Program.
2. Students are supposed to bring their lab records as per their lab schedule.
3. Previous experiment/program should be written in the lab record.
4. If applicable trace paper/graph paper must be pasted in lab record with proper labeling.
5. All the students must follow the instructions, failing which he/she may not be allowed in the lab.

While working in the lab

1. Adhere to experimental schedule as instructed by the lab in-charge/faculty.
2. Get the previously performed experiment/ program signed by the faculty/ lab in charge.
3. Get the output of current experiment/program checked by the faculty/ lab in charge in the Lab copy.
4. Each student should work on his/her assigned computer at each turn of the lab.
5. Take responsibility of valuable accessories.

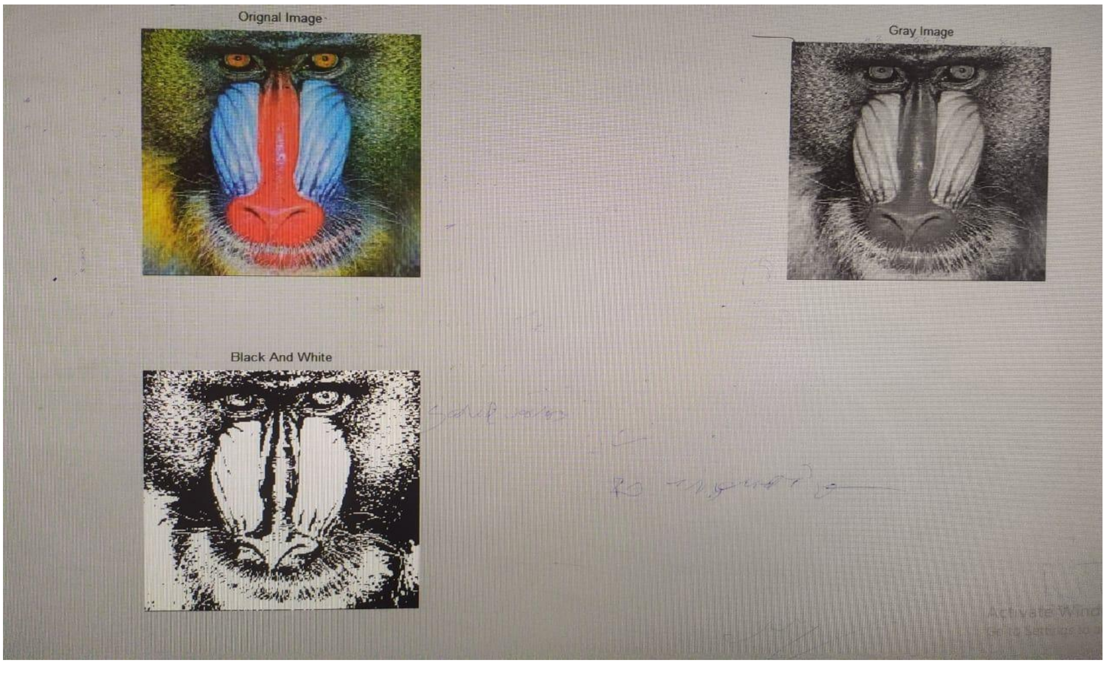
Zero Lab

Objective: 1.Write a program to read an image and convert it in grey and binary and show all the images on a single plot.
2. Write a program to add, subtract and multiply values from the image and also fuse them.

Answer 1:

```
I=imread(‘monkey.jpg’);
G=rgb2gray(I);
B=im2bw(I);
whos
subplot(2,2,1);
imshow(I);
title(‘Orignal image’);
subplot(2,2,2);
imshow(G);
title(‘Grey image’);
subplot(2,2,3);
imshow(B);
title(‘Black and White’);
```

Output:



Answer 2:

```
I=imread(‘monkey.jpg’);
C=imread(‘cat.jpg’);
F=imfuse(I,C);
G=rgb2gray(I);
Z=imadd(I,50);
M=imultiply(I,2);
```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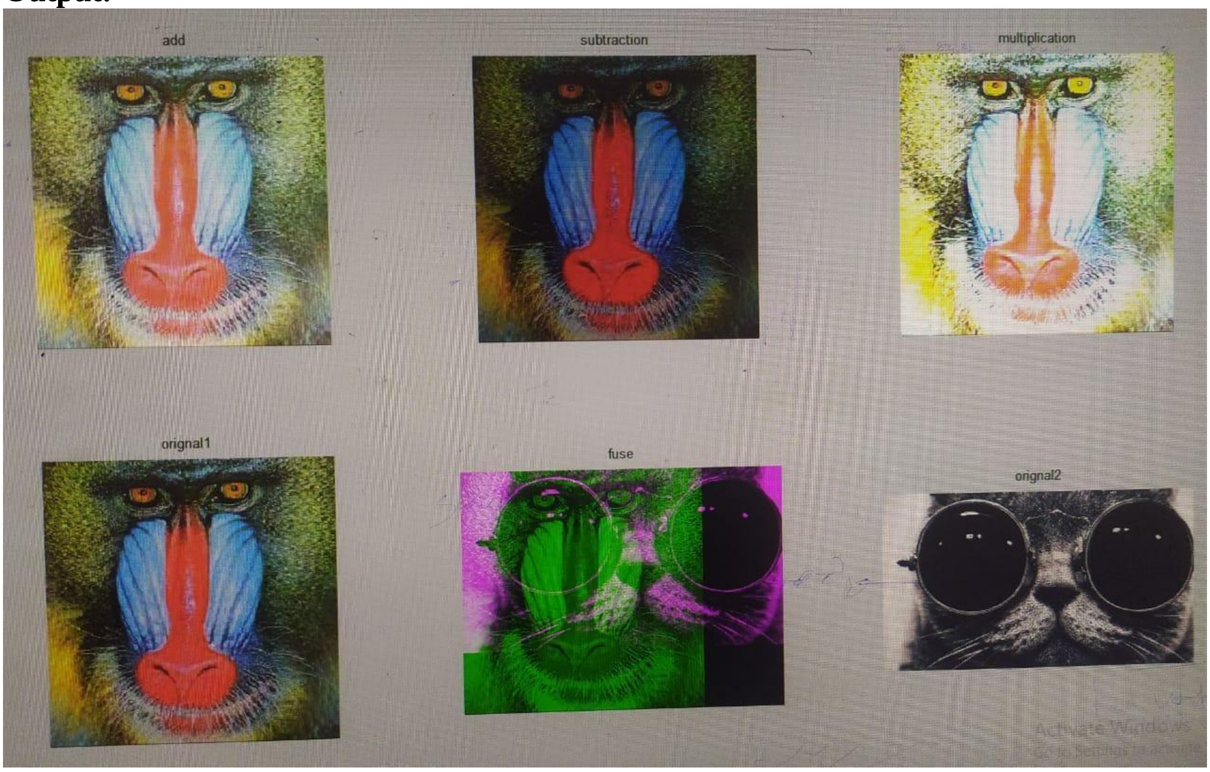
```
subplot(2,3,1);
imshow(Z);
title('add');
subplot(2,3,2);
imshow(S);
title('Substraction');
subplot(2,3,3);
imshow(M);
title('Multiplication');
subplot(2,3,4);
imshow(I);
title('Orignal');
subplot(2,3,5);
imshow(F);
title('Fuse');
subplot(2,3,6);
imshow(C);
title('Orignal2');
```

Output:



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Experiment–1

Object: To provides the thresholding an image and the evaluation of its histogram using histogram equalization and illustrates the relationship among the intensities (gray levels) of an image and its histogram.

Software: MATLAB -2014

Theory:

Histogram is a graphical representation of the intensity distribution of an image. In simple terms, it represents the number of pixels for each intensity value considered.

Histogram Equalization is a computer image processing technique used to improve contrast in images. It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image. This method usually increases the global contrast of images when its usable data is represented by close contrast values. This allows for areas of lower local contrast to gain a higher contrast.

A color histogram of an image represents the number of pixels in each type of color component. Histogram equalization cannot be applied separately to the Red, Green and Blue components of the image as it leads to dramatic changes in the image's color balance. However, if the image is first converted to another color space, like HSL/HSV color space, then the algorithm can be applied to the luminance or value channel without resulting in changes to the hue and saturation of the image.

Adaptive Histogram Equalization

Adaptive Histogram Equalization differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of an image.

Contrastive Limited Adaptive Equalization

Contrast Limited AHE (CLAHE) differs from adaptive histogram equalization in its contrast limiting. In the case of CLAHE, the contrast limiting procedure is applied to each neighborhood from which a transformation function is derived. CLAHE was developed to prevent the over amplification of noise that adaptive histogram equalization can give rise to.

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Program:

```
clc; clearall;

closeall; imgetfile;

u=imread(ans);

o=rgb2gray(u);

imshow(o);

figure; imhist(o);

i=histeq(o);

figure;

imshow(i);figure;

imhist(i);
```

Program 1.1(Histogram Manually)

```
I = imread('parrot.jpg'); J =
rgb2gray(I);
[r, c] = size(J);
h = zeros(1, 256); for i
= 1:r
for  j = 1:c
t = J(i,j);
h(t) = h(t)+1;
end end

disp(h);
bar(h);

subplot(2,2,1), imshow(I);
title('RGB image'); subplot(2,2,2),
imshow(J); title('Gray image');
subplot(2,2,3), imhist(J);
title('Histogram using imhist');
subplot(2,2,4), bar(h, 'b');
title('Histogram calculated');
```


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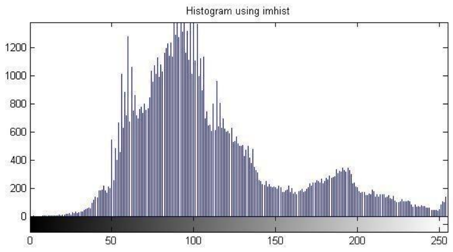

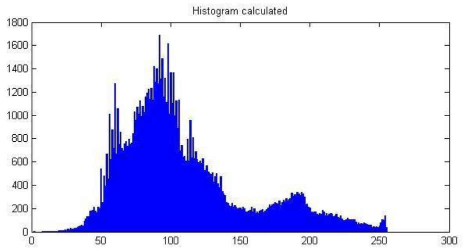

Program 1.2(Histogram Equalization Manually)

```
clc;  clear
all;

I = imread('parrot.jpg');
J = rgb2gray(I);

[r, c] = size(J); s =
r*c;

h = zeros(1, 256); z =
zeros(1, 300);


for i = 1:r for
j = 1:c
t = J(i,j);
h(t) = h(t)+1; end
end

pdf = h/s; cdf(1) =
pdf(1);

for i = 2:256
cdf(i) = cdf(i-1)+pdf(i) end

new = round(cdf*256);
new = new+1;

for i=1:r
```


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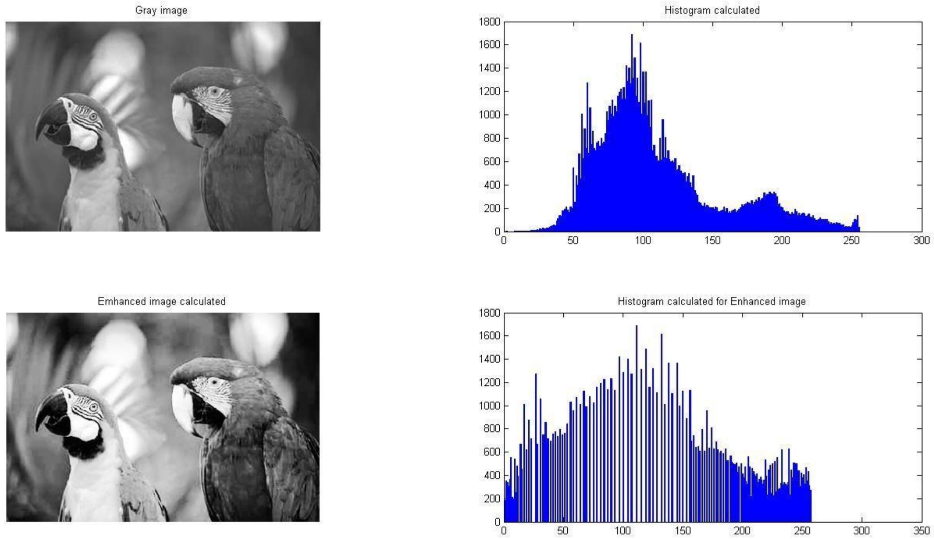
```
for  j=1:c temp =
J(i,j);
b(i,j) = new(temp); t
= b(i,j);
z(t) = z(t)+1; end
end b=b-

1;

subplot(2,2,1), imshow(J);
title('Gray image'); subplot(2,2,2),
bar(h, 'b'); title('Histogram
calculated'); subplot(2,2,3),
imshow(uint8(b));
title('Emhanced image calculated');
subplot(2,2,4), bar(z, 'b');
title('Histogram calculated for Enhanced image');
```

OUTPUT: -



Result: In this experiment provides for thresholding an image and the evaluation of its histogram using Histogram equalization. This experiment illustrates the relationship among the intensities (gray levels) of an image and its histogram.

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Viva Questions:

Q. 1 What is thresholding in image processing?

Ans. Thresholding is a technique used to segment an image by converting a grayscale image into a binary image. It works by selecting a threshold value and setting all pixel intensities above this value to one (white) and those below to zero (black).

Q.2 How do you choose an appropriate threshold value for an image?

Ans. The threshold value can be chosen:

- Manually by visual inspection.
- Automatically using methods like Otsu's method, which finds an optimal threshold by analyzing the image histogram.

Q. 3 How does the histogram of an image help in understanding image characteristics?

Ans. • A histogram shows the brightness and contrast of an image.

- A narrow histogram indicates low contrast, while a wide histogram suggests high contrast.
- Peaks in the histogram can indicate dominant intensity levels in an image.

Q. 4 What are the steps involved in histogram equalization?

Ans.

1. Compute the histogram of the image.
2. Calculate the cumulative distribution function (CDF).
3. Normalize the CDF.
4. Map the old pixel intensities to new values based on the CDF.
5. Construct the enhanced image using the new intensity values.

Q.5 How does histogram equalization improve image contrast?

Ans. Histogram equalization spreads out the pixel intensity values over a wider range, increasing the distinction between different intensity levels, thus improving the contrast of the image.

Q. 6 What is the relationship between an image and its histogram?

Ans. • The histogram represents the frequency of intensity values in the image.

- A dark image has more pixels in lower intensity values (left side of the histogram).
- A bright image has more pixels in higher intensity values (right side of the histogram).
- A well-contrasted image has a spread-out histogram across all intensity levels.

Q. 7 What are the limitations of histogram equalization?

Ans.

- It may enhance noise in the image.
- It does not work well for images with already well-distributed intensity values.
- It can sometimes cause loss of details in certain regions.

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Experiment–2

Object: To shows image rotation, scaling, and translation using Geometric transformations.

Software: MATLAB

Theory:

Perform generic geometric transformations using the imwarp workflow. Geometric transformations map pixel coordinates in the output image to coordinates in the input image. The mapping process then interpolates the value of output pixels from the input image. Use these functions to perform general 2-D, 3-D, and N-D geometric transformations. To perform a 2-D or3-D geometric transformation, first create a geometric transformation object that stores information about the transformation. Then, pass the image to be transformed and the geometric transformation object to the imwarp function.

Functions

imwarp	Apply geometric transformation to image
affineOutputView	Create output view for warping images
fitgeotrans	Fit geometric transformation to control point pairs
findbounds	Find output bounds for spatial transformation
fliptform	Flip Input and output roles of spatial transformation structure
makeresampler	Create resampling structure
maketform	Create spatial transformation structure (TFORM)
tformarray	Apply spatial transformation to N-D array
tformfwd	Apply forward spatial transformation
tforminv	Apply inverse spatial transformation

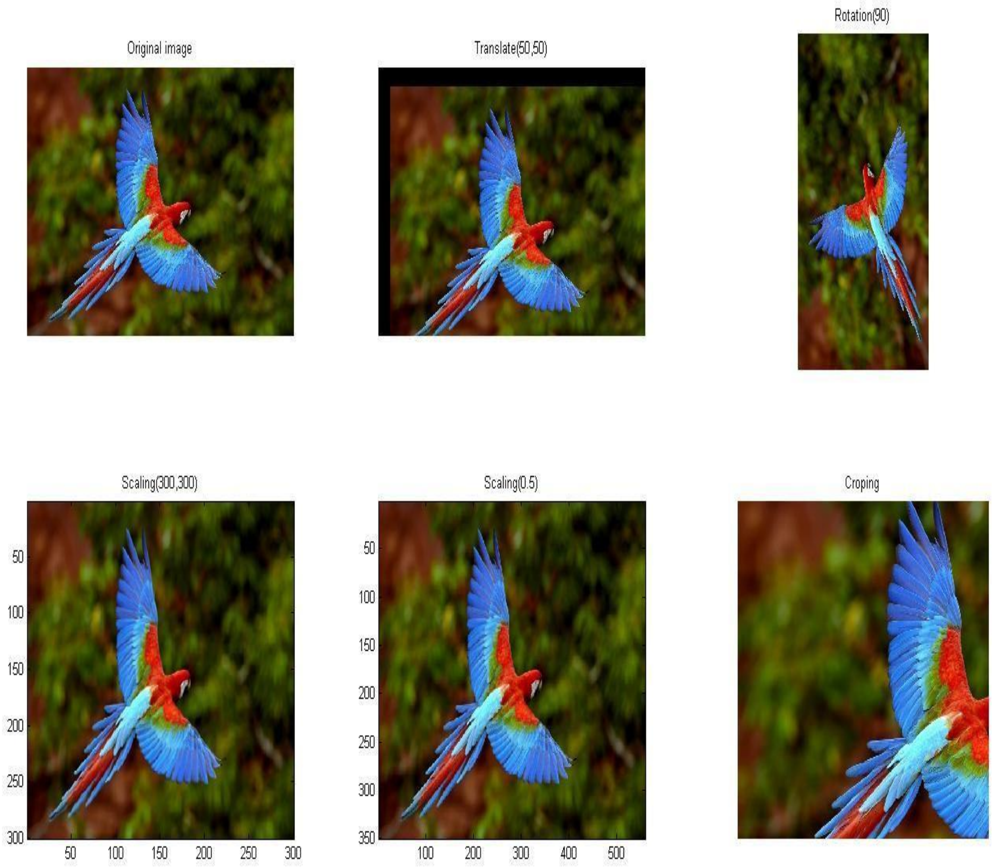
Program:

```
clc; clearall;
imgetfile;
I = imread(ans);
```

```
T = imtranslate(I,[50 50]); O =
imrotate(I,90);
S1 = imresize(I,[300,300]); S2
= imresize(I,0.5);
C = imcrop(I,[15 68 600 500]);
subplot(2,3,1), imshow(I), title('Original image'); subplot(2,3,2),
imshow(T), title('Translate(50,50)');

subplot(2,3,3), imshow(O), title('Rotation(90)');
subplot(2,3,4), image(S1), title('Scaling(300,300)');
subplot(2,3,5), image(S2), title('Scaling(0.5)');
subplot(2,3,6), imshow(C), title('Croping');
```

Output:



Result: We have done the operation on digital Image and shown image rotation, scaling, and translation using Geometric transformations.

Viva Questions:

Q. 1 What are geometric transformations in image processing?

Q.2 How does the 2D Fourier Transform differ from the 1D Fourier Transform?

Q.3 How noise removal is performed using Fourier Transform techniques?

Q. 4 What is the Fourier Transform, and why is it used in image processing?

Q.5 How can multiple transformations be combined into a single matrix?

Q.6 What is image scaling? How does it affect pixel values?

Q. 7 What happens if we rotate an image by 180 degrees?

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Experiment–3

Object: To perform the Two-dimensional Fourier transform operation in an image.

Software: MATLAB

Theory:

The Fourier Transform is an important image processing tool which is used to decompose an image into its sine and cosine components. The output of the transformation represents the image in the Fourier or frequency domain, while the input image is the spatial domain equivalent. In the Fourier domain image, each point represents a particular frequency contained in the spatial domain image.

The Fourier Transform is used in a wide range of applications, such as image analysis, image filtering, image are construction and image compression.

Program:

```
clc; clearall;
imgetfile;
I = imread(ans); G
= rgb2gray(I); F =
fft2(G);
T = ifft2(F);
subplot(2,2,1), imshow(I), title('Original image'); subplot(2,2,2),
imshow(G), title('Greyscale image'); subplot(2,2,3), imshow(F),
title('Fourier Transformed Image'); subplot(2,2,4),
imshow(uint8(T)), title('Retrieve from FT');
```

Result: Performed the Two-dimensional Fourier transform operation in an image.

Experiment–3

Viva Questions:

Q. 1 What is the purpose of applying the Fourier Transform to an image?

Q. 2 How do high-frequency and low-frequency components affect an image?

Q. 3 What is frequency domain filtering, and how is it performed?

Q. 4 How does rotating an image affect its Fourier Transform?

Q. 5 How can the Fourier Transform be used for edge detection?

Q. 6 What is the relationship between the Fourier Transform and Convolution Theorem?

Q. 7 What is the difference between Continuous Fourier Transform and Discrete Fourier Transform?

Experiment–4

Object: To perform the Linear filtering using convolution in an image.

Software: MATLAB

Theory:

Linear filtering of an image is accomplished through an operation called *convolution*. Convolution is a neighborhood operation in which each output pixel is the weighted sum of neighboring input pixels. The matrix of weights is called the convolution kernel, also known as the filter. A convolution kernel is a correlation kernel that has been rotated 180 degrees.

For example, suppose the image is:

A=[17 24 18 15
23 57 14 16
46 13 20 22
10 12 19 21
31 11 82 52]

And the convolution kernel is

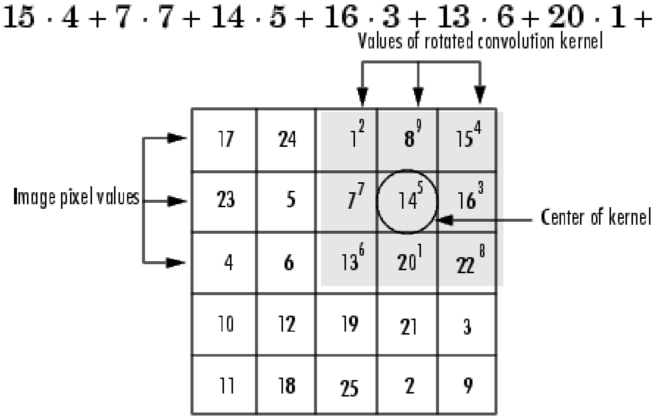
h=[8 1 6
3 5 7
4 9 2]

The following figures how show to compute the (2,4) output pixel using the steps:

1. Rotate the convolution kernel 180 degrees about its center element.
2. Slide the center element of the convolution kernel so that it lies on top of the (2,4) element of A.
3. Multiply each weight in the rotated convolution kernel by the pixel of A underneath.
4. Sum the individual products from step 3.

Hence the (2,4) output pixel is

$$1 \cdot 2 + 8 \cdot 9 + 15 \cdot 4 + 7 \cdot 7 + 14 \cdot 5 + 16 \cdot 3 + 13 \cdot 6 + 20 \cdot 1 + 22 \cdot 8 = 575$$



Program:

```
clc;

clear all;

closeall; imgetfile;
u=imread(ans);imsh ow(u);
Hm=fspecial('motion',20,45);
MotionBlur=imfilter(u,Hm,'replicate'); figure;
imshow(MotionBlur); Hb=fspecial('disk',10);
blurred=imfilter(u,Hb,'replicate'); figure;
imshow(blurred);
```

Result: We perform the Linear filtering using convolution in an image.


Figure 1
File Edit View Insert Tools Desktop Window Help

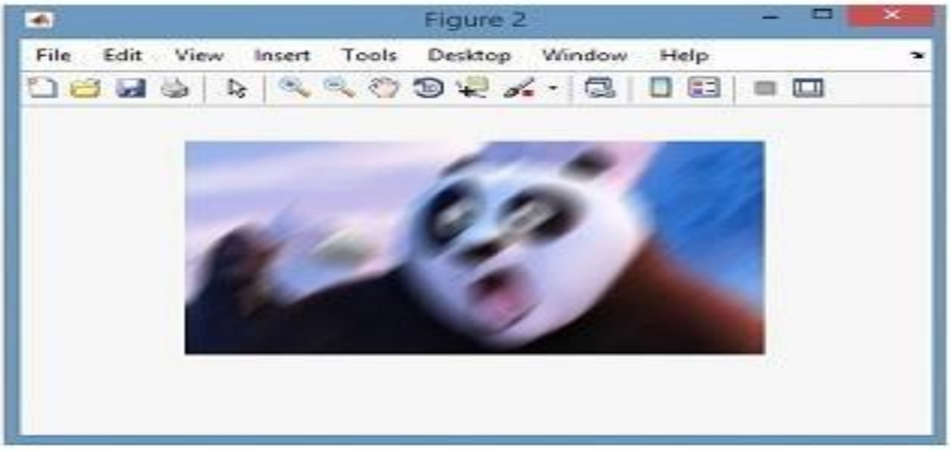


Figure 2
File Edit View Insert Tools Desktop Window Help


Figure 3
File Edit View Insert Tools Desktop Window Help

Viva Questions:

Q. 1 What is linear filtering in image processing?

Q. 2 How does a sharpening filter enhance an image?

Q. 3 What is the difference between spatial domain filtering and frequency domain filtering?

Q. 4 How is convolution performed in MATLAB/Python/OpenCV?

Q. 5 How can convolution be used for noise reduction?

Q. 6 What is the difference between linear and non-linear filtering?

Q. 7 How does convolution relate to image restoration?

Experiment–5

Object: Image Edge Detection Using Sobel Filtering and Canny Filtering.

Software: MATLAB

Theory:

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in are as such as image processing, computer vision, and machine vision. Common edge detection algorithms include Sobel, Canny, Prewitt, Roberts, and fuzzy logic methods.

Edge detection method, specified as one of the following.

Method	Description
'Sobel'	Finds edges at those points where the gradient of the image I is maximum, using the Sobel approximation to the derivative.
'Prewitt'	Finds edges at those points where the gradient of I is maximum, using the Prewitt approximation to the derivative.
'Roberts'	Finds edges at those points where the gradient of I is maximum, using the Roberts approximation to the derivative.
'log'	Finds edges by looking for zero-crossings after filtering I with a Laplacian of Gaussian (LoG) filter.
'zero cross'	Finds edges by looking for zero-crossings after filtering I with a filter that you specify, h
'Canny'	Finds edges by looking for local maxima of the gradient of I. The edge function calculates the gradient using the derivative of a Gaussian filter. This method uses two thresholds to detect strong and weak edges, including weak edges in the output if they are connected to strong edges. By using two thresholds, the Canny method is less likely than the other methods to be fooled by noise, and more likely to detect true weak edges.

'approx canny'	Finds edges using an approximate version of the Canny edge detection algorithm that provides faster execution time at the expense of less precise detection. Floating point images are expected to be normalized in the range[01].

Program:

```
clc;
clearall; closeall;
po=imgetfile;
I=imread(po);
%select coin imshow(I)
BW1=edge(I,'sobel');
BW2=edge(I,'canny'); figure;
imshowpair(BW1,BW2,'montage');
title('SobelFilter,CannyFilter');
```

Result: we have perform the Image Edge Detection Using Sobel Filtering and Canny Filtering.

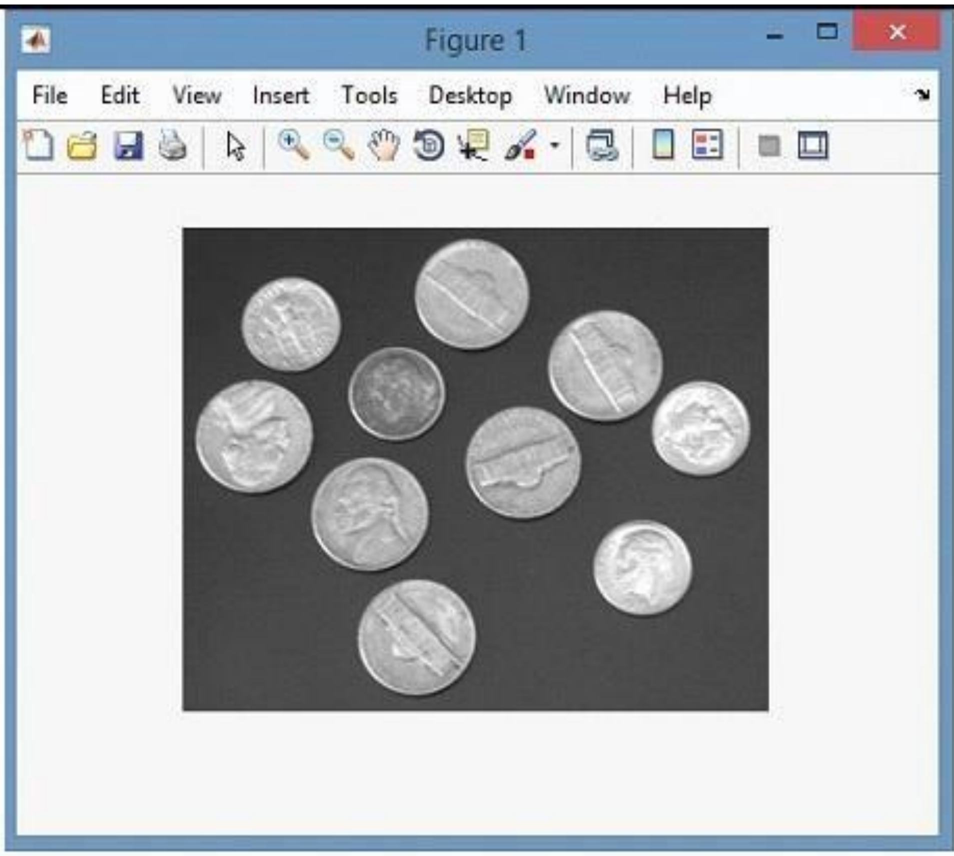


Figure 1
File Edit View Insert Tools Desktop Window Help

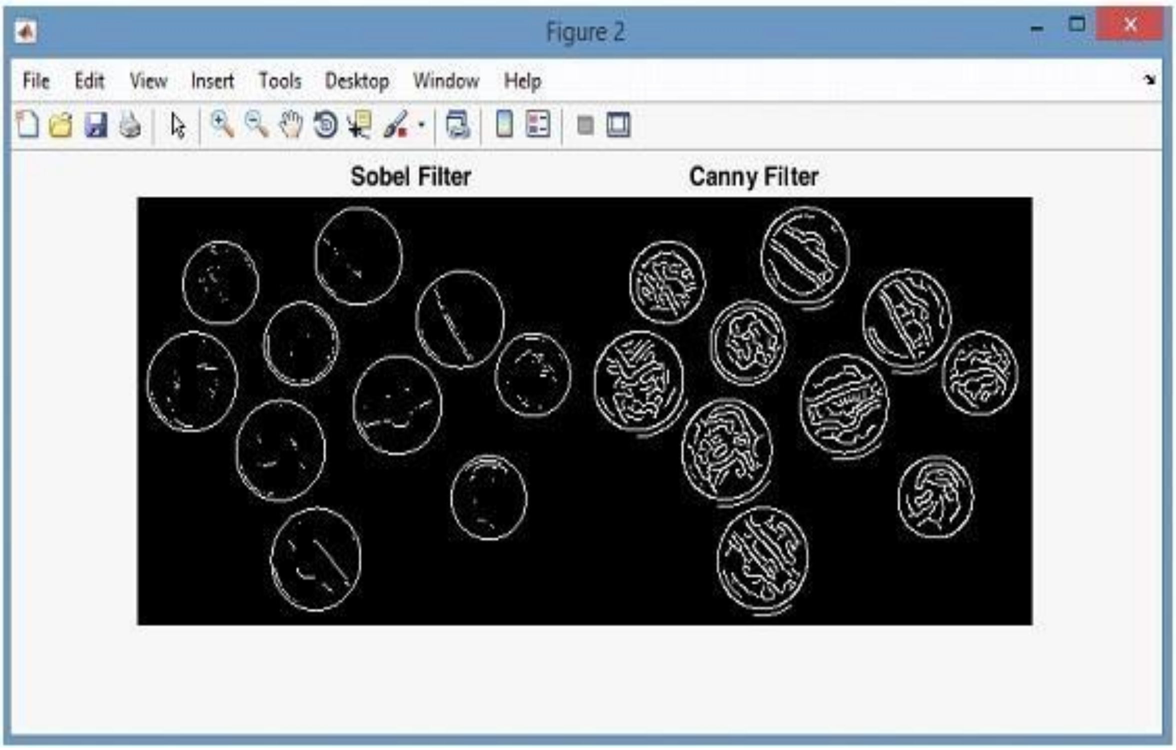


Figure 2
File Edit View Insert Tools Desktop Window Help
Sobel Filter
Canny Filter

Viva Questions:

Q. 1 What is the **edge detection** in image processing?

Q. 2 How does the **Sobel filter detect edges in both horizontal and vertical directions**?

Q. 3 What are the advantages and disadvantages of the Sobel filter?

Q. 4 How does **Canny edge detection handle noise** in an image?

Q. 5 In what scenarios would you **prefer Sobel over Canny** or vice versa?

Q. 6 Which parameters must be adjusted in **Sobel and Canny filtering** for best results?

Q. 7 Which preprocessing techniques can improve edge detection results?

Beyond the Syllabus Experiment-1

Object: To perform the following operations in an image.

(a) erosion,

(b) dilation.

Software: MATLAB

Theory:

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as a dilation or an erosion. This table lists the rules for both dilation and erosion.

Dilation and erosion are often used in combination to implement image processing operations. For example, the definition of a morphological opening of an image is an erosion followed by a dilation, using the same structuring element for both operations. We can combine dilation and erosion to remove small objects from an image and smooth the border of large objects.

Program:

- **Erosion**

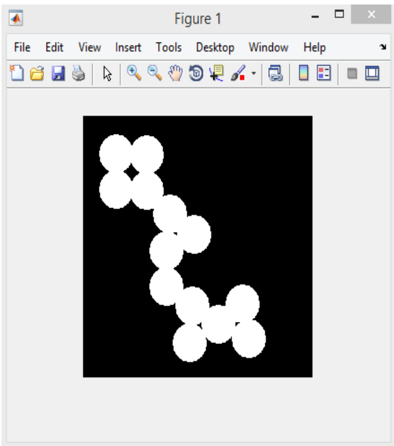
```
clc;

clear all;

closeall; po=imgetfile;
I=imread(po);
```

```
originalBW=I; se=strel('disk',11);
erodedBW=imerode(originalBW,se);

imshow(originalBW),figure,imshow(erodedBW)
```

- **Dilation**

```
clc;clear   all;close
all;
po=imgetfile; I=imread(po);
se=strel('ball',5,5);

I2=imdilate(I,se); imshow(I),title('Original')
figure,imshow(I2),title('Dilated')
```

Result: We have performed the erosion and dilation operations in an image.



Original Image

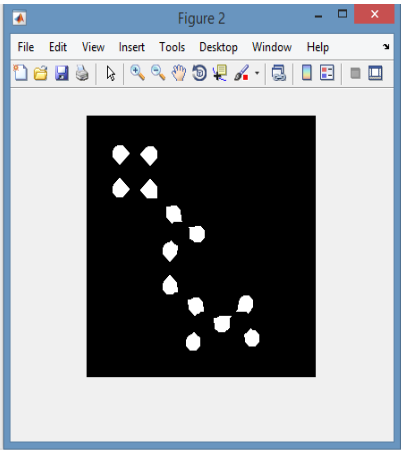
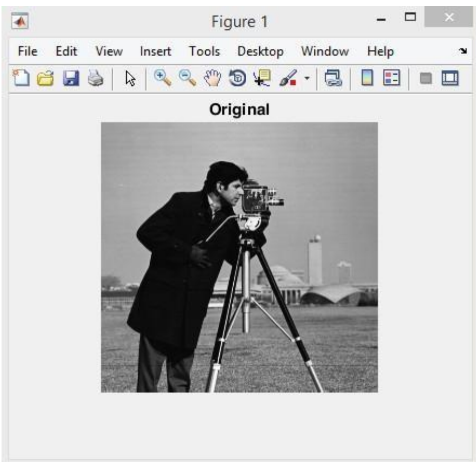
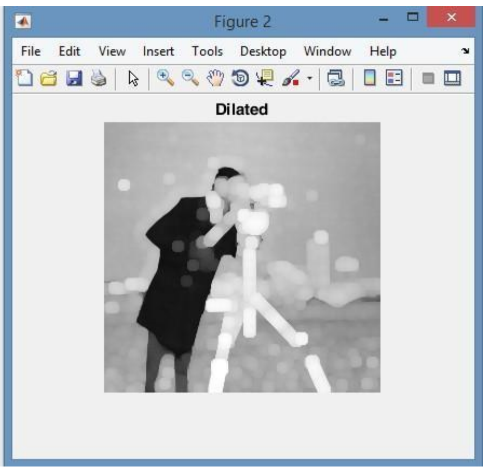


Image After erosion operation





Beyond the Syllabus Experiment-2

Object: To perform the following operations in an image.

(a) opening,

(b) closing.

Software: MATLAB

Theory:
Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. According to Wikipedia, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to grey scale images such that their light transfer functions are unknown and therefore their absolute pixel values are of norm in or interest.
Morphological techniques probean image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels. Some operations test whether the element "fits" within the neighborhood, while others test whether it "hits" or intersects the neighborhood:

Program:

(a) Opening

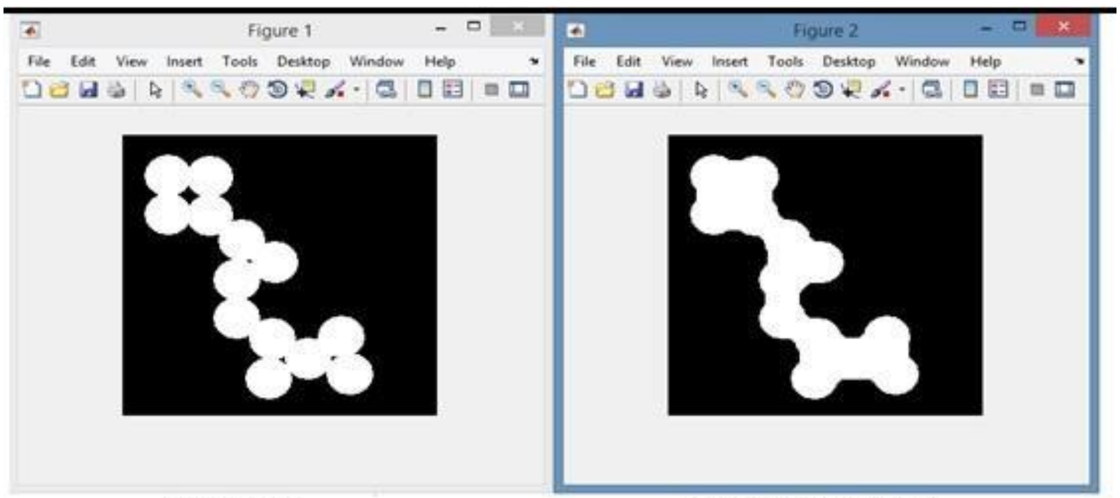
```
clc;

clear all;

closeall; po=imgetfile;
I=imread(po);

figure,imshow(I);

se=strel('disk',5);
```

```
afterOpening=imopen(I,se); figure,imshow(afterOpening,[]);
```

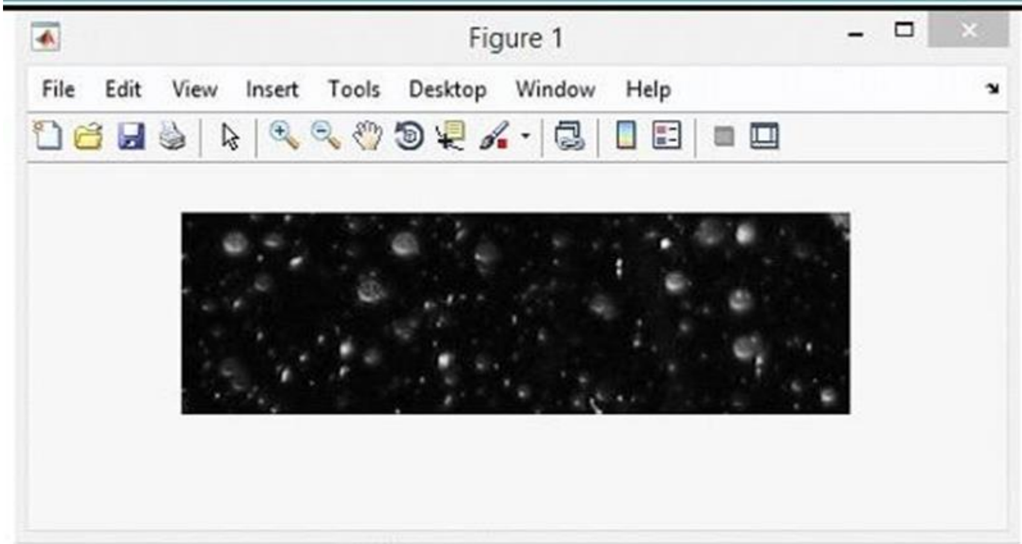
(b) Closing

```
clc; clearall; closeall;

po=imgetfile;
I = imread(po); originalBW=I;
imshow(originalBW); se=strel('disk',10);
closeBW=imclose(originalBW,se); figure,imshow(closeBW);
```

Result: We have performed the opening and closing operations in an image.



Original Image Image After Close Operation



Original Image

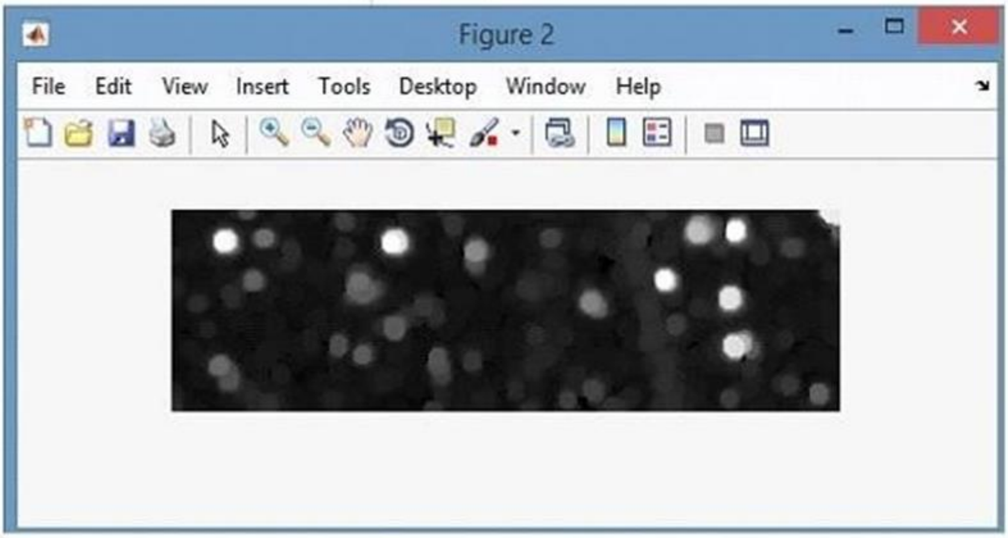


Image After Open operatrion