A
Project Report
on
"Region Based Image Segmentation"

Prepared by

Rahul Suhagiya(17EC091)

Under the guidance of

Dr. Brijesh N. Shah

Submitted to

Charotar University of Science & Technology

for Partial Fulfillment of the Requirements for the

Degree of Bachelor of Technology

in Electronics & Communication

EC448 - Project

of 8th Semester of B.Tech

Submitted at

DEPARTMENT OF ELECTRONICS & COMMUNICATION

Faculty of Technology & Engineering, CHARUSAT

Chandubhai S. Patel Institute of Technology

At: Changa, Dist: Anand – 388421

April 2021

CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CERTIFICATE

This is to certify that the report entitled "**Region Based Image Segmentation**" is a bonafide work carried out by **Rahul Suhagiya(17EC091)** under the guidance and supervision of **Dr. Brijesh N. Shah** for the subject **Project (EC448)** of 8th Semester of Bachelor of Technology in Electronics & Communication at Faculty of Technology & Engineering (C.S.P.I.T.) – CHARUSAT, Gujarat.

To the best of my knowledge and belief, this work embodies the work of candidate himself, has duly been completed, and fulfills the requirement of the ordinance relating to the B.Tech. Degree of the University and is up to the standard in respect of content, presentation and language for being referred to the examiner.

Under the supervision of,

Dr. Brijesh N. Shah
Assistant Professor,
Department of EC Engineering,
C.S.P.I.T., CHARUSAT-Changa.

Dr. Trushit K. Upadhyaya
Head of Department,
Department of Electronics & Communication
C.S.P.I.T., CHARUSAT- Changa, Gujarat.

Chandubhai S Patel Institute of Technology (C.S.P.I.T.) Faculty of Technology & Engineering, CHARUSAT

At: Changa, Ta. Petlad, Dist. Anand, Gujarat - 388421

ABSTRACT

Image Processing is necessary for different types of works like land use study, numerical weather prediction, mapping etc. Digital Image Processing needs for digital image like space based and remote sensing data. It includes data operation which normally precedes for interpretation and further manipulation for analysis of the image data to extract specific information of interest. These operations aim to correct distorted or degraded image data to create a more faithful representation of the original scene which helps the user or analyst to detect information easily in a faithful manner.

The tradeoff between data compression remains one of the difficult problems. Maintaining high compression ratios with good image quality is possible at a more or less high computational cost. One of the main goals for image data compression is to reduce redundancy in the image block as much as possible.

ACKNOWLEDGEMENT

I would like to express my sincere thanks to my internal guide **Dr. Brijesh N. Shah** for his valuable guidance, enthusiastic attitude and encouragement throughout the period of Project and Thesis work. His guidance, suggestion and very constructive appreciation have contributed immensely to the evolution of the project.

I would also like to express my sincere gratitude and sincere thanks to **Dr. Trushit Upadhyaya** HoD, Department of Electronics and Communication Engineering, Charotar University of Science and Technology, Changa for providing me the opportunity to undertake such a challenging and intellectual work.

Name of Student (17ECXXX)
Department of EC Engineering,
CSPIT, CHARUSAT

TABLE OF CONTENS

CHAPTER 1:

INTRODUCTION OF DIGITAL IMAGE PROCESSING

1.1 Motivation Behind Digital Image Processing:

- Due to two principals:

1) Improvement of pictorial information for human interpretation
2) Processing of image data for strong, transmission, and representation for autonomous machine perception

1.2 What is image?

- Projection of 3D scene in 2D plane.

- A two dimensional function f(x,y), where x and y are spatial co-ordinates and f at any pair co-ordinates (x,y) is called the intensity or gray level of the image at any point.

- Two types of image:
  1)Analog image
  2)Digital image

1) Analog image:

- Analog Image contain mathematical representation has continuous range of values representing position and intensity.
  Ex: Image produce on the screen of CRT monitor

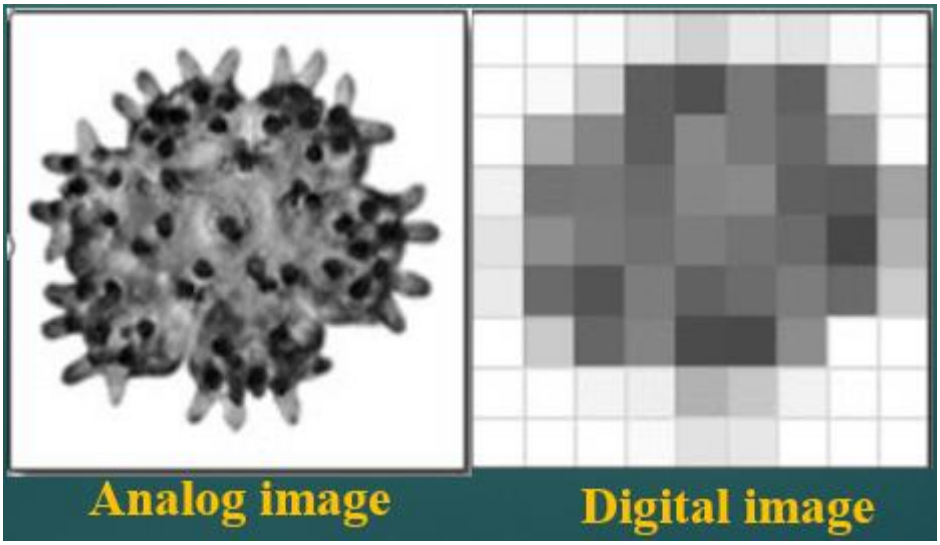
2) Digital image:

- When x,y and f are all finite , discrete quantities , image is a digital image.
- Contain finite number of elements , each of which has a particular location and value.

- **Advantages:**
  - Fast processing , effective storage, effective transmission.

- **Disadvantages:**
  - High memory for good quality image and fast processor.

1.3 How to get digital image:



1.4 What is Digital Image Processing :

- The analysis and manipulation of digitalized image, especially in order to improve its quality or in another words we can say that processing of digital image by means of a digital computer.

- The production and development of digital imaging processing is mainly influenced by three factors: first, computer technology; second, the development of mathematics (especially the practice and improvement of alternative mathematical teaching); third, the demand for a wide range of applications in environmental, agricultural, military, industrial and medical sciences has increased.

- **Advantages:**
  - People are limited to the visible bench of the electric spectrum.
  - Machines But imaging machines cover almost every EM, from gamma to radio waves.
  - Thus operate on images generated by sources that human are not capable to sense.
  - This includes ultra-sound, electron microscopy, and computer-generated images.

1.5 Scope of digital image processing:

- There is no general agreement when image processing ceases with other related areas, such as image analysis and computer recognition.
- Distinction sometimes is made as a discipline in which both the input and output of a process are images.
- But this is limiting and somewhat artificial boundary.
- There are areas such as computer vision that use computers to simulate human perception, including reading and theoretical process and to take action according to visual effects.
- Thus is a branch of artificial intelligence whose objective is to emulate human intelligence.

1.6 The origins of digital image processing :

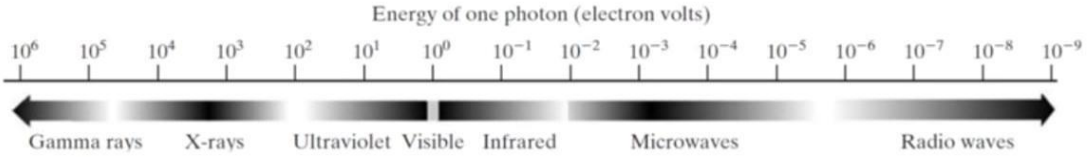
- One of the first digital photographic applications was in the newspaper industry when photographs were first sent via a submarine cable between London and New York.
- The Bratland cable transmission system in the early 1920s reduced the time required to move an image across the Atlantic from more than a week to less than three hours.
- Special printing equipment with cable transmission codes and rebuild at the end. initial problems in improving the visual quality of the original digital image are sometimes related to the selection of printing processes and the distribution of durability levels.

- A digital photo produced in 1921 from a coded tape is a telephone printer with a special type of face.

- A digital picture made in 1922 from a tape perforated at the telegraph receiving terminal punched after the signals had crossed the Atlantic twice.
- The improvements over previous picture are evident, both in tonal quality and in resolution.

1.7 Application of digital image processing :

- One of the easiest ways to improve the basic understanding of image processing systems is to classify images according to their source (e.g. visual, X-ray, etc.)
- The main energy source for images used today is the electrical energy spectrum.
- Other important energy sources include acoustic, ultrasonic and electronic (In the form of electron beams used in electron microscopy).
- Synthetic images, used for modeling and visualization, are computer-generated Electric waves can be considered as unimaginable in a stream of weightless particles, each moving in a wavel-like pattern and moving at the speed of light
- Weightless particles contain a certain amount of energy (or mass). Each energy bundle is called a photon.
- When spectral bands are grouped according to the strength of each photon. we get a spectrum as:

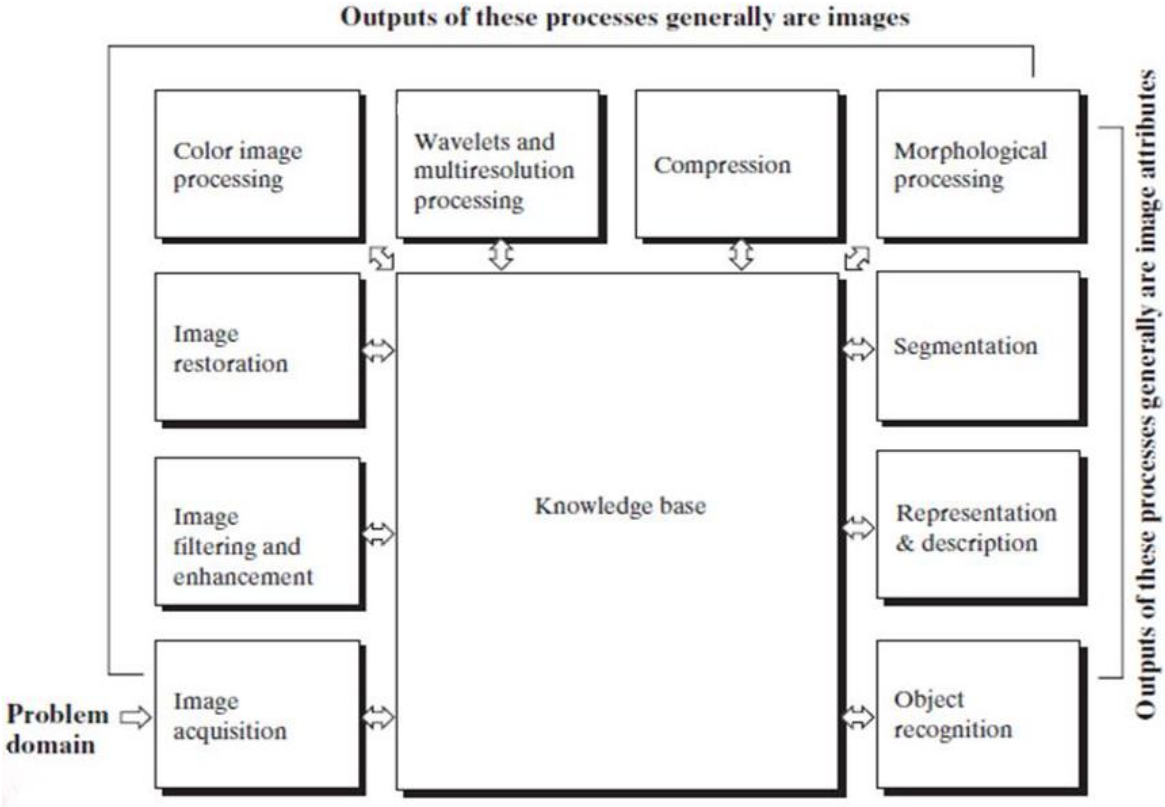


CHAPTER 2:

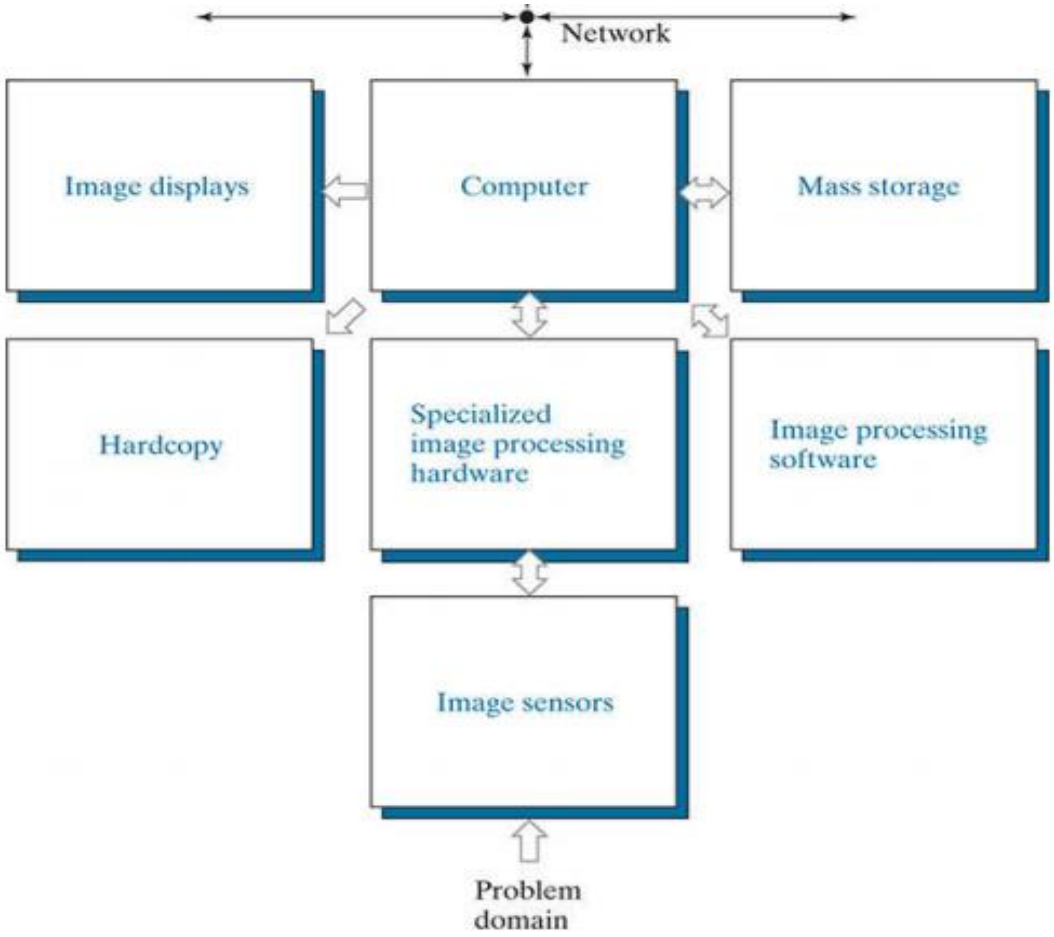
FUNDAMENTAL STEPS OF DIGITAL IMAGE PROCESSING

2.1Block diagram of fundamental steps :

- It is helpful to divide the material of digital image processing into the two broad categories.
  - 1) methods whose input and output are images.
  - 2) methods whose input may be images but whose output are attributes extracted from those images.



Components of an Image Processing System



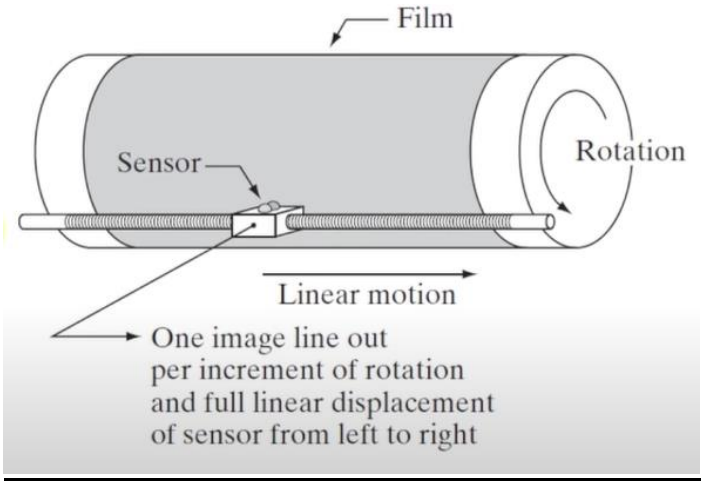
2.2 Image Sensing and Acquisition :

- For image sensing we require sensors which is sense the image data and information. Basically,sensors are not down continuous value that's why we require image sensing and acquisition.

- Image acquisition done with Three types of sensors :- 1) Single sensor
  2) Multiple sensor
  3) Sensor strips

- Image acquisition using single sensor : Sensor of this type is the photodiode. In order to generate a 2D image using a single sensor, there has to be relative displacements in both the x and y directions between the sensor and area of the image.

- Image acquisition using multiple sensor :

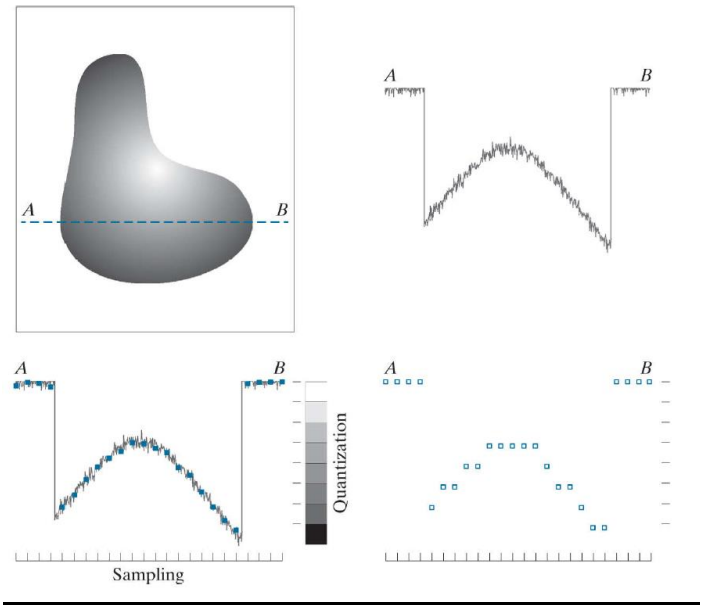


- Image acquisition using sensor strips :

- Geometry used more often than single nerves contains linear arrangement of nerves in the form of sensory fibers, such as above.
- The strip provides imaging elements in uni-direction.
- Motion perpendicular to the strip providing imaging in the one direction.

2.3 Image Sampling and Quantization:

- The image can be developed in terms of x- and y-coordinates, and also in amplitude. To install it on a computer, we have to simulate the work on both links and amplitude. Capturing link values is called a sample. Photographing amplitude values is called quantization.
- The output of most sensors is a continuous voltage waveform whose amplitude and spatial behavior are related to the physical phenomenon being sensed.
- To create a digital image, we need to convert continuous sensory data into a digital format. This requires two processes: sampling and quantization.



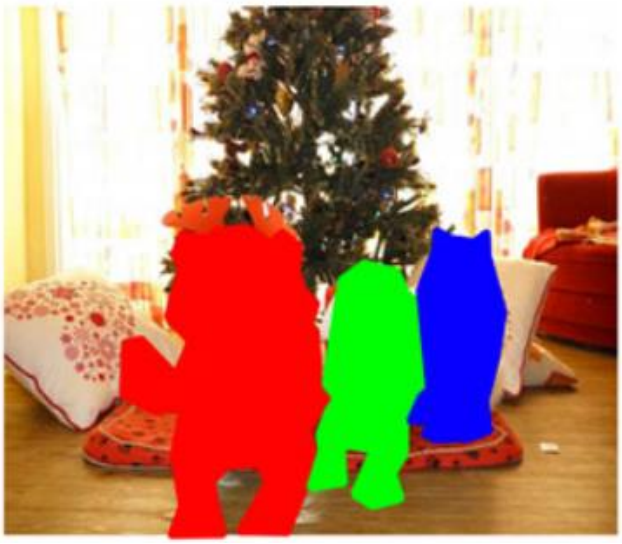
- A plot of amplitude (intensity level) values of the continuous image along the line segment AB.
- The spatial location of each sample is indicated by a vertical mark in the bottom part of the figure.
- The sample shown as small white squares superimposed on the function.
- However, the value of the samples still span (vertically) a continuous range of intensity values.
- Figure shows the intensity scale divided into eight discreate intervals, ranging from black to white.

CHAPTER 3:

IMAGE SEGMENTATION

- Image segregation is the process of separating digital image into multiple categories. The purpose of the separation is to simplify and / or transform the representation of the image into something more meaningful and easier to analyze.

Original Image



Segmented Image

3.1 Approaches Of Image Segmentation:

- Image segmentation divided into two main approaches.
- Two approaches:
  1) Discontinuity Based:
     - ✓ Isolated Points
     - ✓ Line Based
     - ✓ Edge Based
  2) Similarity Based:
     - ✓ Thresholding
     - ✓ Region Based

3.2 Discontinuity Based Image Segmentation:

- Isolated Points : The most common way to look for discontinuities is tun the mask through the image.

- For the 3 * 3 mask shown in figure, this procedure involves computing the sum of the products of the coefficients with the gray level contained in the region encompassed by the mask.
- The mask response at any time in the image is provided by,
  R = w1z1 + w2z2 +……+ w9z9
  R= $\sum_{i=1}^{9} wizi$

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

A general 3*3 Mask

- Using the mask shown in figure, we can say that a point has been detected at the location on which the mask centred if |R| >= T
- Where T is nonnegative threshold. Basically, this formulation measures the weighted differences between the centre points and it's neighbour.

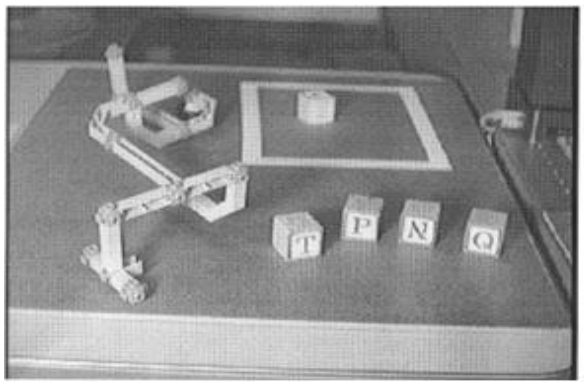
3.2.1 Line Detection:

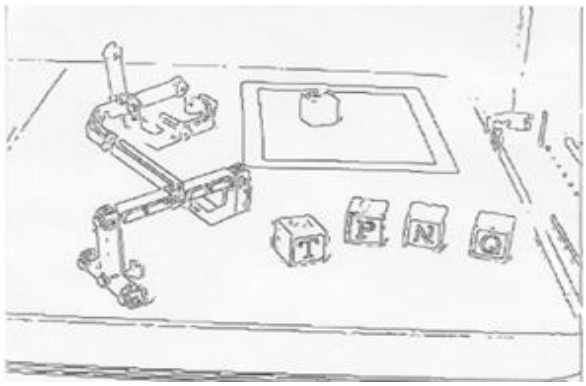
- Line detection: When a discontinuity takes place throughout the image which can be present in horizontal, +45°, vertical, -45° of pattern. Which is present in a line format the change in pixel value of the image that making a line and make it different from the image is called as a line detection in an image.
- Line detection in image can be present as follows.

−1	−1	−1	2	−1	−1	−1	2	−1	−1	−1	2
2	2	2	−1	2	−1	−1	2	−1	−1	2	−1
−1	−1	−1	−1	−1	2	−1	2	−1	2	−1	−1
Horizontal			+45°			Vertical			−45°		

3.2.2 Edge Detection:

- Edge detection: The concept of edge detection is used to determine the location and presence of edges by making changes to image intensity. A different function is used to process the image to find the edges. It can detect variations in pixels matter but provides immediate response to noise.
- In image processing, finding the edge is a very important task. Edge detection is a key tool for pattern detection, image classification and scene analysis. It is a type of filter that is used to extract the edge points from an image. Sudden changes in the image occur when the edge of the image looks at the light of the image.





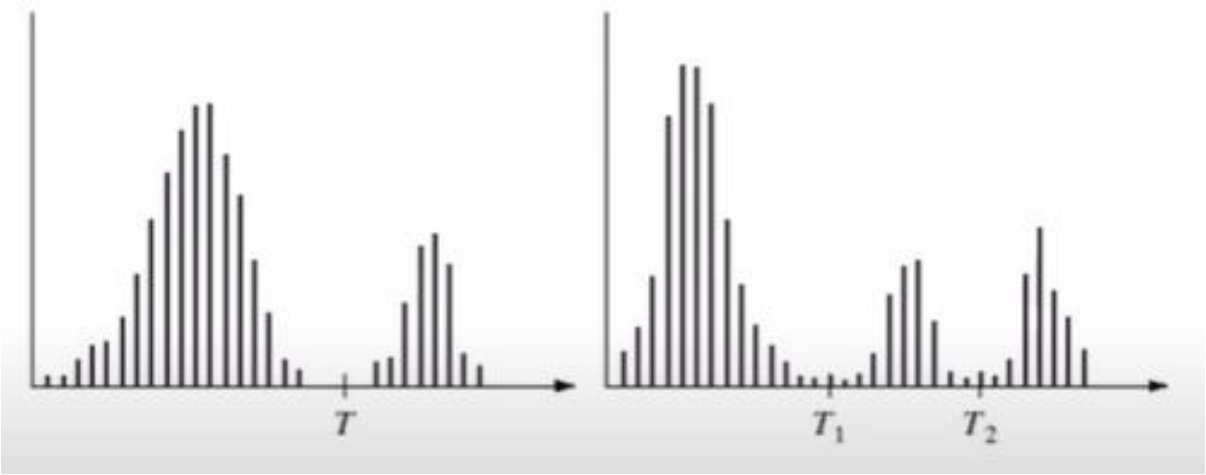
Original Image Edge Detected Image

3.3 Similarity Based Image Segmentation:

- Thresholding: There are Three types of thresholding technique.
  - Global Threshold
  - Dynamic or adaptive Threshold
  - Local Threshold
- Basically, thresholding mainly have two types :-

  1)Single level Thresholding

  2)Multi level Thresholding

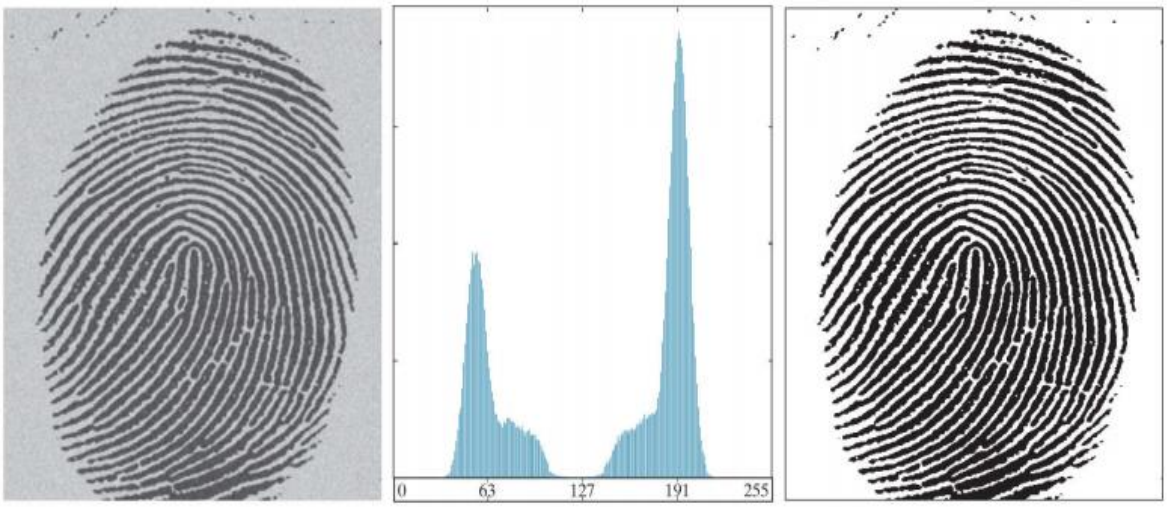


3.3.1 Global Thresholding:

A Global Thresholding follow algorithm,

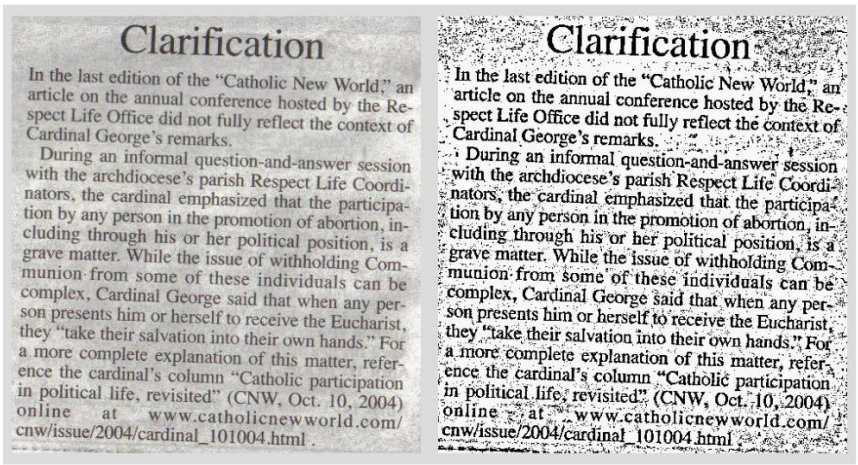
1. Select an initial estimate for threshold T
2. Segment the image using T
   - G1 is all pixels with intensities > T
   - G2 is all pixels with intensities <= T
3. Compute averages m1 and m2 for the pixels in G1 and G2.
4. Let T=(m1+m2)/2

5. Repeat steps 1-4 until no more change.



3.3.2 Dynamic Or Adaptive Thresholding:

- Adaptive thresholding typically takes a grayscale or color image as input and, in the simplest implementation, outputs a binary image representing the segmentation. For each pixel in the image, a threshold has to be calculated. If the pixel value is below the threshold it is set to the background value, otherwise it assumes the foreground value.



3.3.3 Local Thresholding:

- Local thresholding is used to convert an image consisting of gray scale pixels to just black and white scale pixels.
- Unlike the global thresholding technique, local adaptive thresholding chooses different threshold values for every pixel in the image based on an analysis of its neighboring pixels.
- This is to allow images with varying contrast levels where a global thresholding technique will not work satisfactorily. There are a number of different forms of adaptive thresholding algorithm reported in the image processing literature.

3.4 Region Growing Image Segmentation:

- Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points.
- This approach to segmentation examines neighboring pixels of initial seed points and determines whether the pixel neighbors should be added to the region.
- The basic formulation is shown in figure,

$(a)\ \bigcup_{i=1}^{n} R_i = R.$

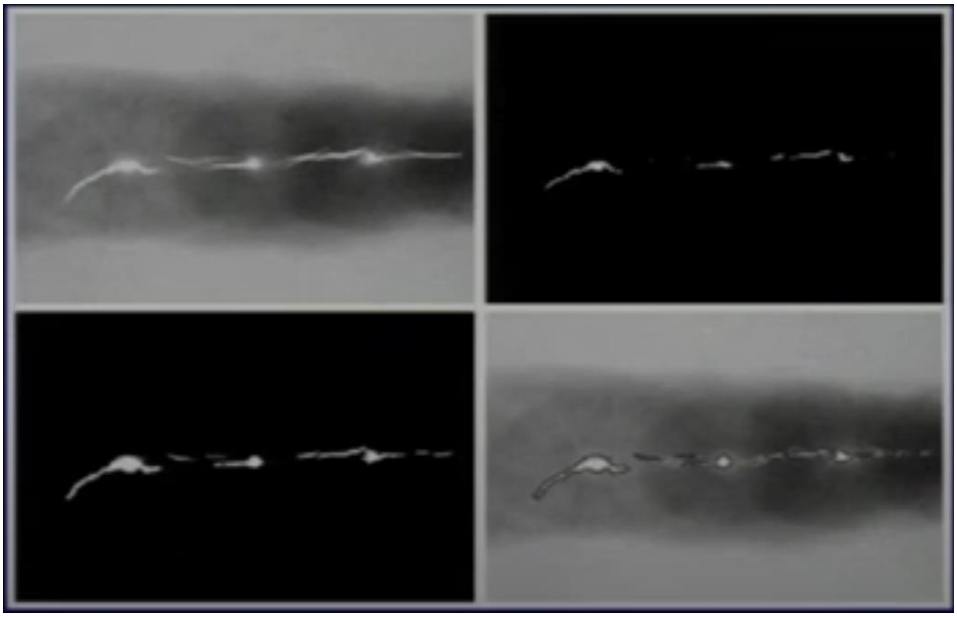
$(b)\ R_i$ is a connected region, $\mathrm{i} = 1,\ 2,\ \ldots, \mathrm{n}$

$(c)\ R_i \bigcap R_j = \varnothing, i \neq j$

$(d)\ P(R_i) = \text{TRUE for } i = 1, 2, \ldots, n.$

$(e)\ P(R_i \bigcup R_j) = \text{FALSE for any adjacent region } R_i \text{ and } R_j.$

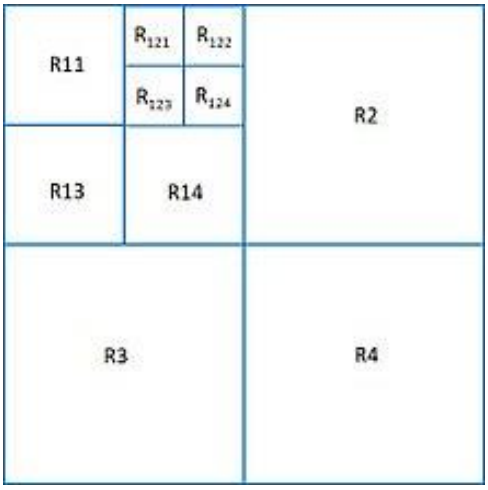
$P(R_i)$ is a logical predicate defined over the points in set R_i and $\varnothing$ is the null set.



Output of region growing segmentation

3.4.1 Region Splitting and Merging:

- Region merging operations eliminate false boundaries and spurious regions by merging adjacent regions that belong to the same object.
- It is combination of splitting and merging take place at the same time is called as region splitting and merging segmentation.
- In this part, you can do image partition till you can't get same pixel of an Image.



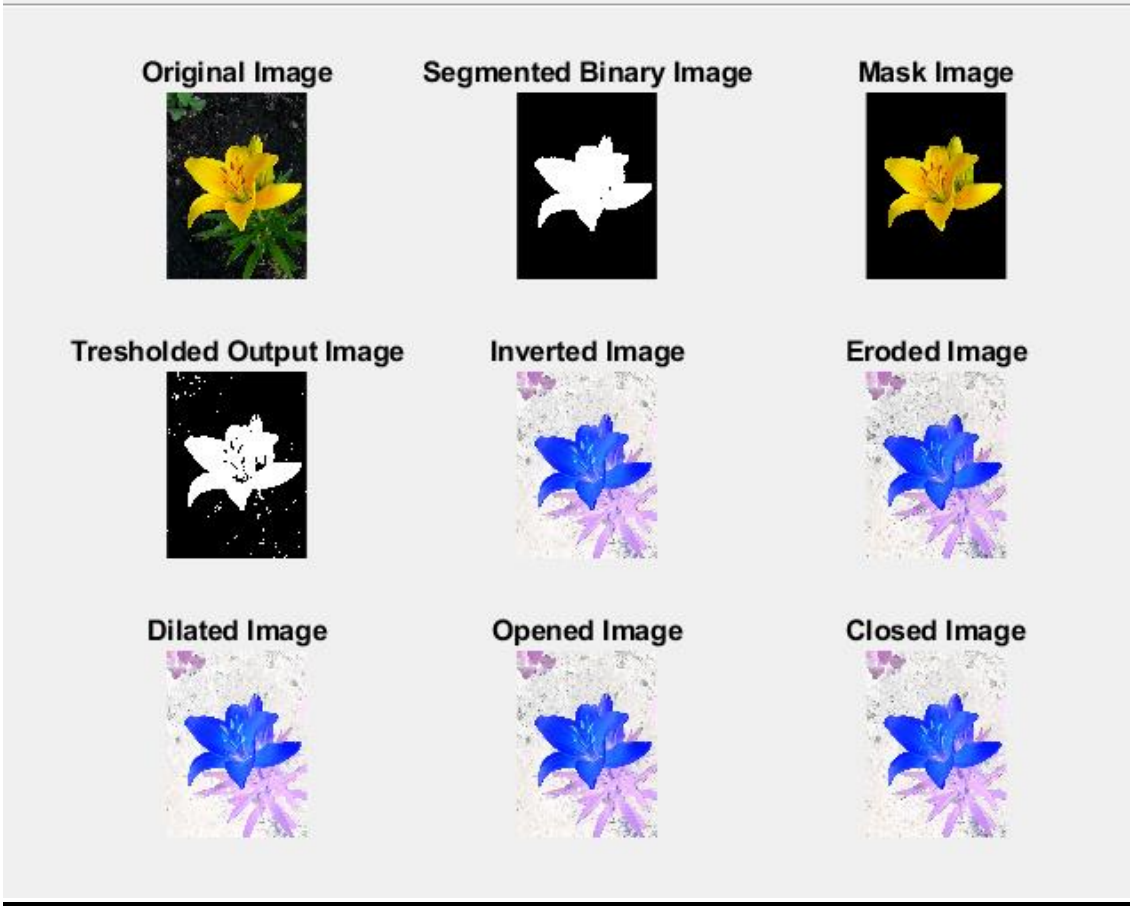
CHAPTER 4:

MATLAB CODE FOR IMAGE SEGMENTATON

4.1 MATLAB CODE:

```
clc
clear all
close all
warning off
RGB=imread('yellowlily.jpg');
subplot(3,3,1);
imshow(RGB);
title('Original Image');
[BW,maskedImage] = segmentImage(RGB)
subplot(3,3,2);
imshow(BW);
title('Segmented Binary Image');
subplot(3,3,3);
imshow(maskedImage);
title('Mask Image');
level=graythresh(RGB);
c=im2bw(RGB,level);
subplot(3,3,4)
imshow(c);
title('Tresholded Output Image');


% object in the image is represented by white colour
% background is represented by black colour
I = 255 - RGB;              % Invert the image
subplot(3,3,5),imshow(I),title('Inverted Image');
SE = strel('square',3);     % generate the structuring element
E = imerode(I,SE);          % Perform Erosion Operation
subplot(3,3,6),imshow(E),title('Eroded Image');
D = imdilate(I,SE);         % Perform Dilation Operation
subplot(3,3,7),imshow(D),title('Dilated Image');
O = imopen(I,SE);           % Perform Opening Operation
subplot(3,3,8),imshow(O),title('Opened Image');
C = imclose(I,SE);          % Perform Closing Operation
subplot(3,3,9),imshow(C),title('Closed Image');
```

4.1.1 OUTPUT:

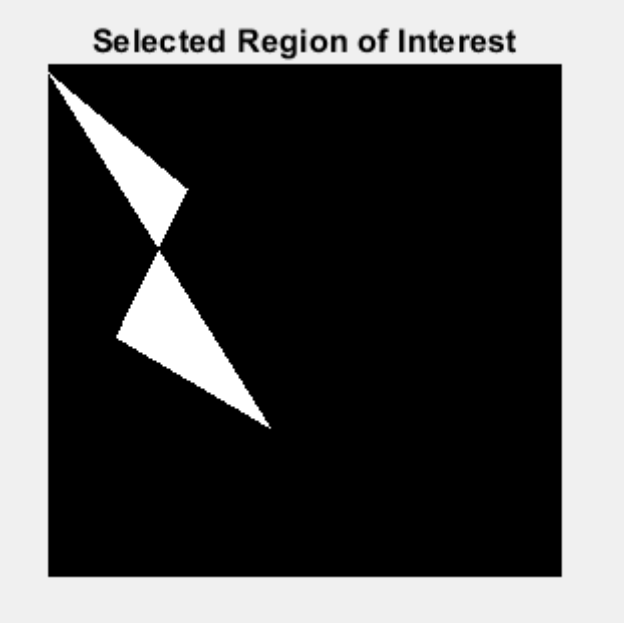


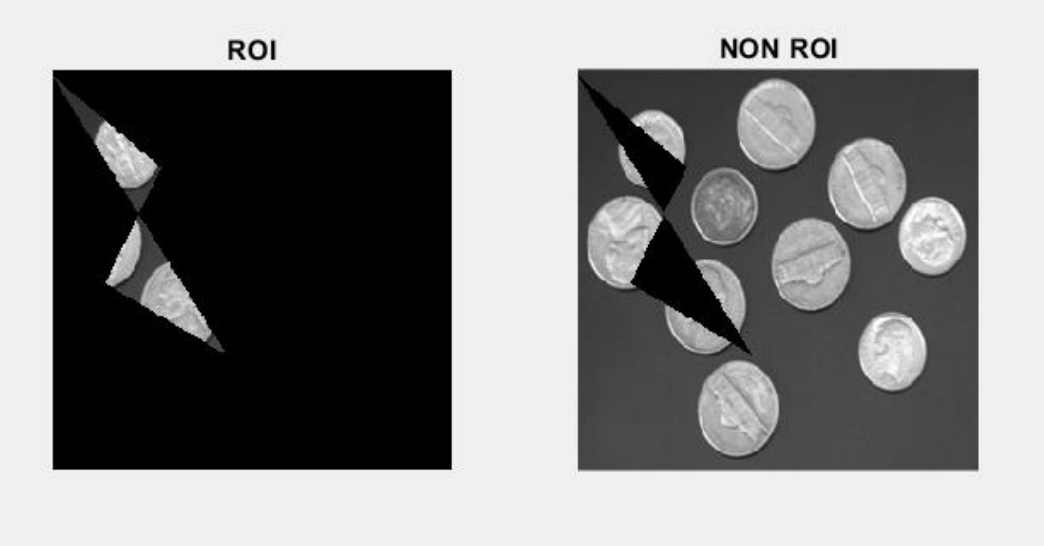
4.2 MATLAB CODE FOR REGION GROWING SEGMENTATION:

```
clc;
clear;
close all;
% Read Input Image

InputImage=imread('coins.png');

%Resize the Image

InputImage=imresize(InputImage,[256 256]);

% Display the Image

imshow(InputImage);
```

```
% Get graphical Inputs from Mouse,Select 4 Seed Points in Image

[Col Row]=ginput(4);

c =Col;
r =Row;

% Select polygonal region of interest
BinaryMask = roipoly(InputImage,c,r);
figure, imshow(BinaryMask);title('Selected Region of Interest');

%Create Buffer for ROI
ROI=zeros(256,256);

%Create Buffer for NONROI
NONROI=zeros(256,256);
for i=1:256

for j=1:256

if BinaryMask(i,j)==1
ROI(i,j)=InputImage(i,j);

else
NONROI(i,j)=InputImage(i,j);
end

end

end

%Display ROI and Non ROI
figure;
subplot(1,2,1);imshow(ROI,[]);title('ROI');
subplot(1,2,2);imshow(NONROI,[]);title('NON ROI');
```

4.2.2 OUTPUT :





CONCLUSION

- In this subject I learnt about fundamental of digital image processing. Also, some type of image segmentation like edge detection, line detection. Also, go through morphology and region growing image segmentation.
- In MATLAB, I do some basic codes of image segmentation after that I understand how practically use of segmentation. Also, I know new MATLAB function which is not our part of collage curriculum.
- In addition, I learnt about how we can use shortcut function in segmentation.

REFERENCE

1) https://www.youtube.com/watch?v=j3_Ck5oP5oI&feature=youtu.be

2)https://www.youtube.com/c/Ekeeda

3) https://www.analyticsvidhya.com/blog/2019/04/introduction-image-segmentation-techniques-python/

4)https://www.slideshare.net/mobile/kalyanacharjya/fundamental-steps-of-digital-image-processing-image-components

5)https://en.wikipedia.org/wiki/Region_growing#:~:text=Region%20growing%20is%20a%20simple%20region%2Dbased%20image%20segmentation%20method.&text=This%20approach%20to%20segmentation%20examines,as%20general%20data%20clustering%20algorithms