

INDIAN INSTITUTE OF TECHNOLOGY  
KHARAGPUR

IMAGE PROCESSING LABORATORY

A REPORT ON  
EXPERIMENT 05

**Morphological Operations**

Name:	Prerana Priyadarshini	Sattenapalli Homa Surya Sagar
Roll. No.:	17EC35019	17EC35021

08.03.2021

Group No. 21

**DEPT OF ELECTRONICS AND ELECTRICAL COMMUNICATION  
ENGINEERING**

**VISUAL INFORMATION AND EMBEDDED SYSTEMS**

## Table of Contents

Sl. No.	Topic	Page No.
1.	Introduction	3
2.	Algorithm	7
3.	Results	8
4.	Analysis	15
5.	References	16

# Introduction

## Binary Image :

An Image consisting of pixels that have only two possible intensity values (generally 0 and 255) is called a Binary Image.

## Morphology :

The concept of processing existing images with respect to shapes is Morphology. A structuring element is applied to the input image and then the output image is created maintaining the original size of the image. The value of every pixel in an input image is weighed up with its neighbor pixel values and accordingly the value of the corresponding pixel in the output image is computed.

Noise removal, skeletonization, contrast enhancement, segmentation, filling and thinning are some of the above mentioned image processing tasks.

## Morphological Dilation and Erosion :

Dilation and Erosion are two very primitive morphological operations. In order to make prominent boundaries, we add layers of pixels around the boundaries of objects in an image. This process is called Dilation.

On the contrary, sometimes there is a need to have thinner boundaries than already existing. To achieve this, layers of pixels are removed around the boundaries of objects in an image. This process is called Erosion.

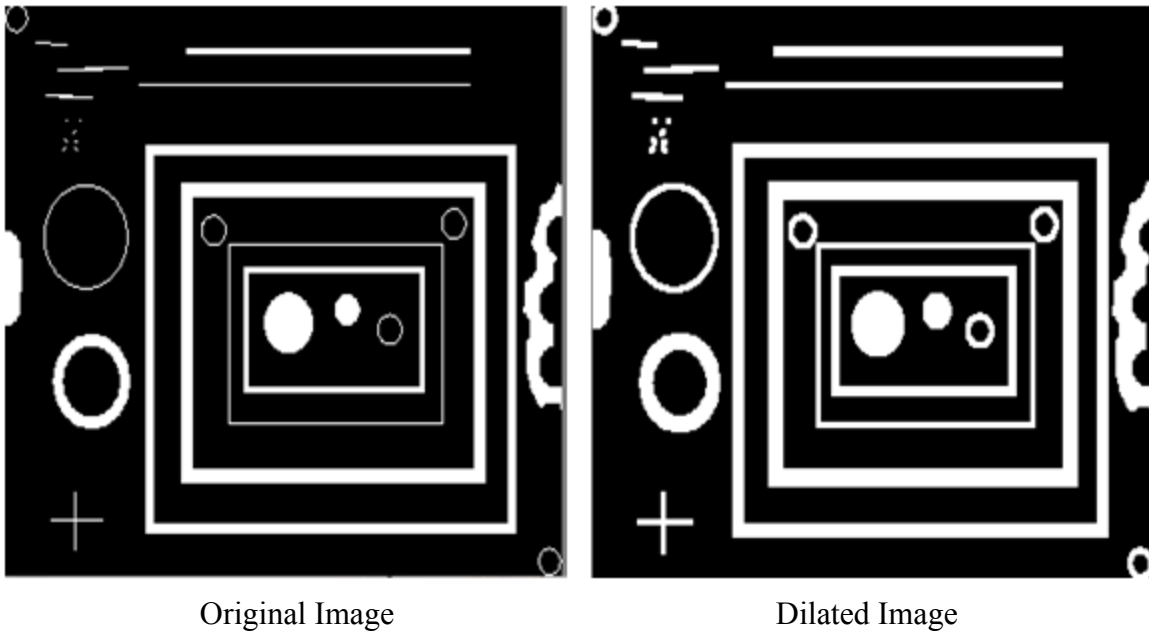
With regard to the shape and size of the structuring element that is used to process the image, the addition or removal number of pixels varies. Computing of the value of any pixel in the output image is dependent on the value of the corresponding pixel in the input image and also its neighbors. The set of instructions we choose to apply to the input image to thicken or erode the boundaries of object(s) in a given image will determine whether it is a dilation process or an erosion process.

## Dilation

All the values of the input pixel and its neighbors are compared and the maximum is picked out. This maximum value is allotted to the corresponding output pixel. So, if an image is in binary, the output pixel is assigned 1 if the corresponding pixel or any of its neighboring pixels in the input image have the value of 1.

Morphological dilation thickens the boundaries of objects in a given image and thereby increases the visibility. Also it fills the gaps and tiny discontinuities in the object if any.

Example



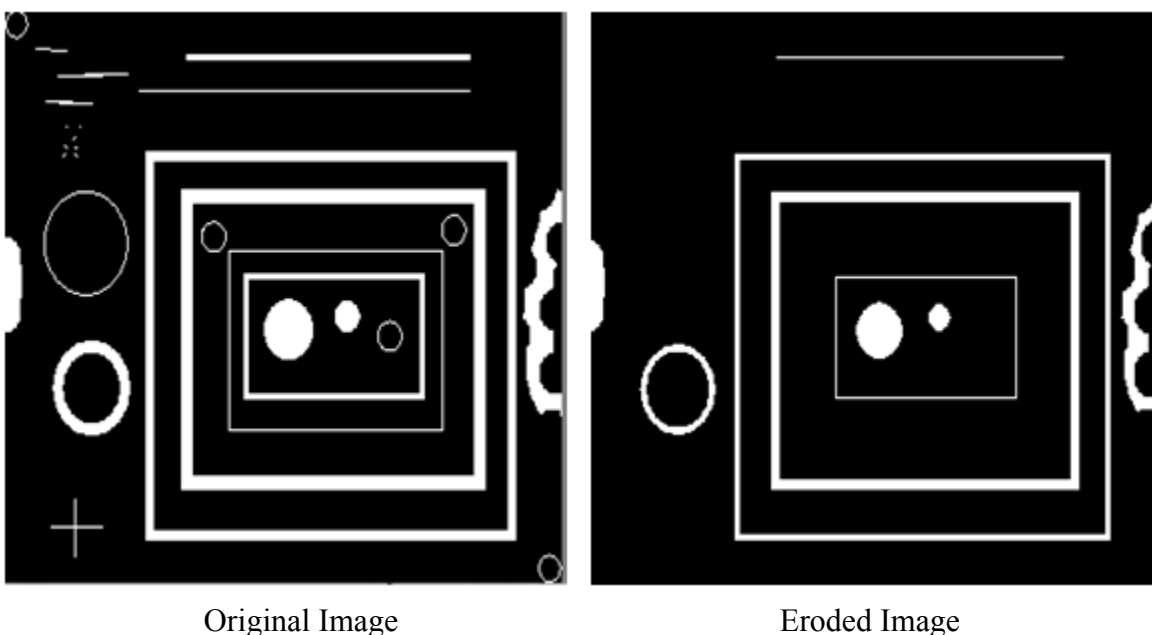
It can be observed that after dilation the boundaries of the shapes are more thick and prominent. Also, vague details become more visible.

### **Erosion :**

All the values of the input pixel and its neighbors are weighed up amongst them and the minimum is picked out. This minimum value is allotted to the corresponding output pixel. So, if an image is in binary, the output pixel is assigned 0 if the corresponding pixel or any of its neighboring pixels in the input image have the value of 0.

In certain cases, there is some noise and also few tiny insignificant objects. In such cases, Morphological erosion is used to get rid of these unwanted noise and thereby making the image more specific towards only the significant objects.

Example :



It can be observed that after erosion, the boundaries of the shapes are thinner and less prominent. Also, unnecessary details and already thin or faint shapes are completely removed making the image more specific towards the significant objects.

### **Morphological Opening :**

The input image is first eroded to get rid of the unwanted noise and then the fine tuned image is dilated to make the shapes more prominent and smoothen the border to increase the visibility. This is called morphological opening of an image. The dilation and erosion operations in this process are done using the same structuring element.

Tiny unwanted objects can be gotten rid of from an input image using morphological opening. Also, this process does not affect the shape and size of larger objects as the layers that are removed in the erosion process are re-added in the dilation process.

### **Morphological Closing :**

The image is first dilated to fill discontinuities and then the fine tuned image is eroded to remove the excess padding around the boundaries of objects. This is called morphological closing of an image. The dilation and erosion operations in this process are done using the same structuring element.

Gaps and discontinuities in an objects can be filled using morphological closing. Also, this process does not affect the shape and size of larger objects as the additional layers that are added in the dilation process are removed in the erosion process.

## **Algorithm**

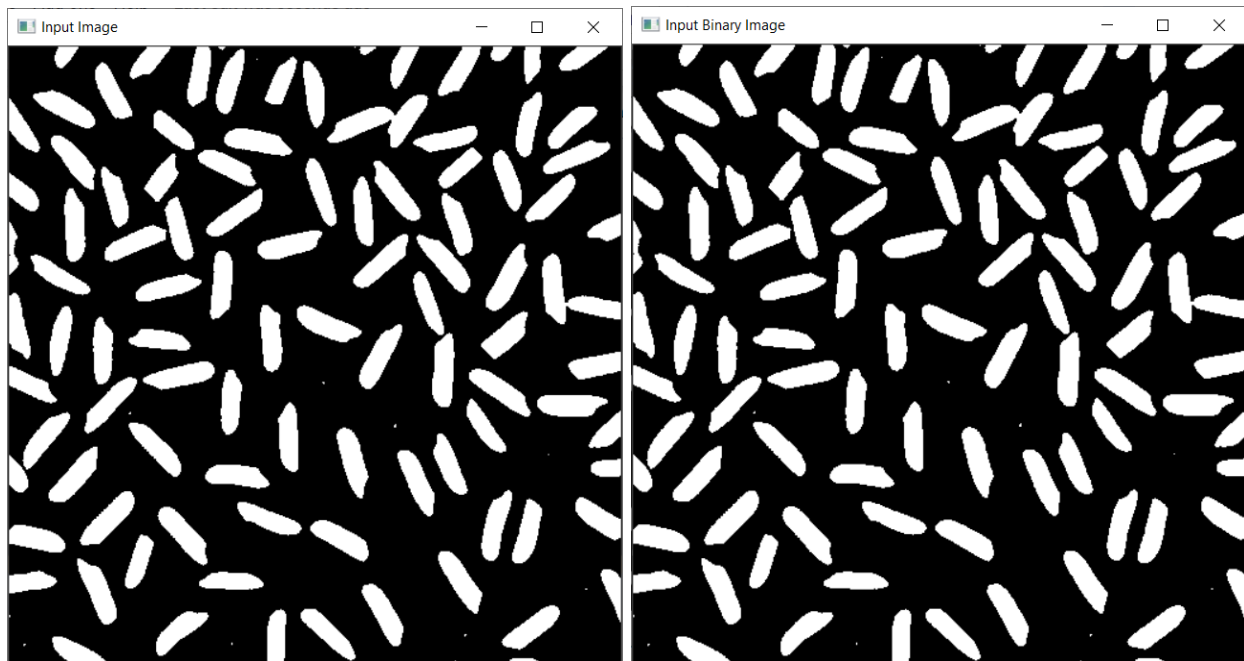
**Problem Statement:** Write C++/Image-J modular functions to perform the following operations on the given test image, ricegrains.bmp. All functions must support binary images.

Functions:

1. createBinaryImage: Creates a binary image from the input image. The binary threshold was set to 127. Any value greater or equal to it was assigned 255 and any value below was assigned 0.
2. callStructure: Handles the cell type option selected. It in turn calls the cellType functions for the different types.
3. cellType: Functions to create different structuring elements. The function checks for the flag if it is Dilate or Erode. In either case it assigns appropriate value to the intensity and creates an output image.
4. In case of 9x9 square structuring element the function cellType2 (A diamond with all 1 3x3) is called 4 times. Similarly, in case of 15x15 square structuring element the function cellType2 (A diamond with all 1 3x3) is called 7 times.
5. For opening and closing output of the first operation is fed to another operation

## Results

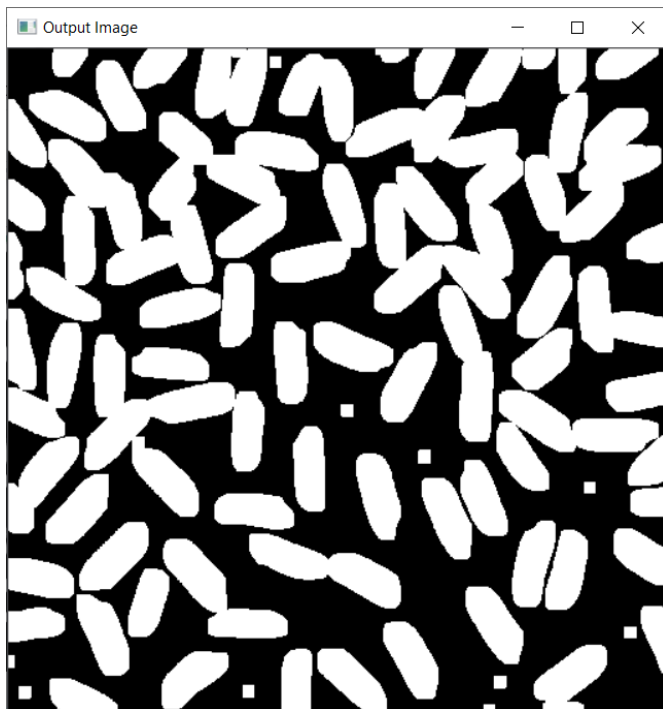
Applying some of the structural elements



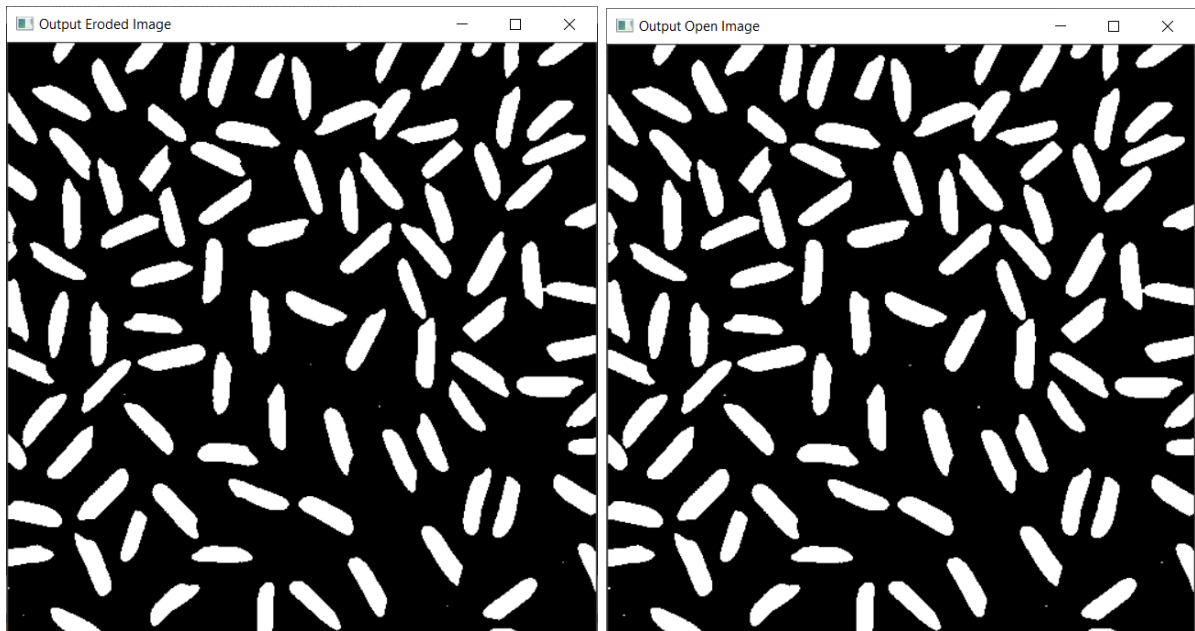
1. Erode Binary: ( A diamond with all 1 3x3)



2. Dilate Binary (A Square with all 1 9x9)



3. Open Binary (A rectangle with of 1x2)



4. Close Binary (A Square with all 1 15x15)



## Analysis

1. Morphological operations can be used as shape filters. The structuring element defines the shape. The image sections that contain within the shape are passed and rest of the smaller sections are filtered out.
2. Morphological image processing helps in correcting the imperfections in binary images with regard to noise and texture. It removes these imperfections by accounting for the form and structure of the image.
3. It is very important to wisely select the size and shape of the structuring element as in some cases it might produce a blank image which isn't the expected result and the required task of noise elimination won't be achieved.
4. In case of opening, first erosion is applied which sharpens the boundaries and deletes the noise, then dilation is applied which smoothens the boundaries.
5. In the case of closing, first dilation is applied which fills in the gaps for smoothing, then erosion is applied which performs sharpening by noise removal.