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**Purpose of the Project:**

The main purpose of the project is getting the knowledge of morphological operations like dilation, erosion, opening and closing operations and their application on the images

And all these methods, implementations and results are explained in the below section

**Programs required environment setup and Running the Programs:**

There are 1 program file in this zipped file

**project.cpp**

**Required Environment setup:**

* Opencv 3.4
* Linux based system with g++ compiler for compiling the c++ programs

**Running the program:**

Select the above program required and compile the program in the terminal with above environment

**For compiling:**

g++ -ggdb filename.cpp -o filename ‘pkg-config –cflags –libs opencv’

**For running:**

./filename image

**Programming Design**

**1. Obtain image I, and convert it into binary image F for display**

**Methods used:**

1. Algorithm used for the threshold value **(Global threshold Value)**

* First assume a threshold value of an image is around 128 or the mean value of the pixel intensities of an image
* Now divide the intensities values into two groups called group1 for the intensity values less than the threshold value and group2 greater and equal intensity values
* And do the mean of the group1 and group2 and in each group mean denominator I have additionally taken all the zero intensities values and added to the denominator of the mean in each group for better thresholding value
* And do the mean again now for the group1 and group2 and we get the new threshold value
* Now compare the new threshold value with the old threshold value and if they are same taking the new threshold value as the final threshold value
* If the threshold value is not equal do this procedure again with the new threshold value is the assumption value. Do this until we get the same threshold values.

1. Binary Image conversion

* First load the image in to the program
* From the above threshold algorithm get the threshold value
* Now for the all the pixels above the threshold value are converted to 255 and all the pixels below the threshold value are converted to 0

**2. Design your algorithm to separate the objects in the given image**

**Methods used:**

1. Binary morphological erosion method

* First take a structing element for the erosion. I have taken the below structing element

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

* Now take the binary image values form the previous question and apply the structing element to each pixel in the binary image.
* For applying the structing element to each pixel we will do an AND operation of all the structuring element values and the pixel values and if the value is 1 then we replace the pixel value of the image with 1 or if the value is 0 then we replace with zero
* We do this process for all the pixel values in the binary image and we get the new shrieked binary image

1. Binary morphological dilation method

* First take a structing element for the erosion. I have taken the below structing element

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

1 1 1 1 1

* Now take the binary image values form the previous method erosion image and apply the structing element to each pixel in the binary image.
* For applying the structing element to each pixel we will do an OR operation of all the structuring element values and the pixel values and if the value is 1 then we replace the pixel value of the image with 1 or if the value is 0 then we replace with zero
* We do this process for all the pixel values in the binary image and we get the new expanded binary image
* The process of applying the erosion and then dilation is called as the opening

**3. Apply the morphological operations on the original grey scale image directly**

**Methods used:**

1. Grayscale morphological erosion method

* First take a structing element for the erosion. I have taken the below structing element

180 180 180 180 180

180 180 180 180 180

180 180 180 180 180

180 180 180 180 180

180 180 180 180 180

* Now take the grayscale image values form the original image and apply the structing element to each pixel in the binary image.
* For applying the structing element to each pixel we will do a Subtraction operation of all the structuring element values form the original pixel values and we select the minimum values from the set and replace the original pixel value with the new minimum value
* We do this process for all the pixel values in the original image and we get the new darker image and reduce small and bright image

1. Grayscale morphological dilation method

* First take a structing element for the erosion. I have taken the below structing element

50 50 50 50 50

50 50 50 50 50

50 50 50 50 50

50 50 50 50 50

50 50 50 50 50

* Now take the grayscale image values form the previous method erosion image and apply the structing element to each pixel in the binary image.
* For applying the structing element to each pixel we will do an Addition operation of all the structuring element values form the original pixel values and we select the maximum values from the set and replace the original pixel value with the new maximum value
* We do this process for all the pixel values in the original image and we get the new bright image and reduce small and dark image
* The process of applying the erosion and then dilation is called as the opening

**Results:**

1. **Binary Image**

**A close up of text on a black background

Description automatically generated**

1. **Binary erosion image**

**A screenshot of a cell phone

Description automatically generated**

**Binary opening image**

**A close up of a logo

Description automatically generated**

1. **Grayscale erosion image**

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**Grayscale opening image**

**A screen shot of a social media post

Description automatically generated**

**5. Bug Report**

* No, bugs we detected to my knowledge