CENG466-Take Home Exam 3

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***Abstract*—This document is a report for Ceng466-Fundamentals of Image Processing course's Take Home Exam 3. This homework is given to learn doing morphological operations and segmentation processes. The answers of each question can be found in subsections respectively. In order to implement algorithms, matlab is used for object counting and python is used for segmentation.**

***Index Terms*—morphological operations, object counting, segmentation**

I. Object Counting

In this part, it is asked to count number of flying jets. To separate flying jets from other objects like sky, cloud, trees, mountain or smoke, we used several morphological operation to objects. For given 6 input images, generally used thresholding and generated binarized images. Then, different morphological operations like closing, opening, delation, erosion performed. Lastly, detected jets are counted. You can see performed operations in detail.

A. Image A1

Firstly, we converted given RGB colored image to gray scaled image. We created a binarized image with using 90 threshold value. Then, we applied dilation followed by erosion using 5x5 sized structural element with all ones (square structural element). Also, we tried to apply closing instead of dilation followed by erosion. We got exactly same result since closing operation is defined as first doing dilation then doing erosion. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A1 is 4

Fig. 1. A1 output

B. Image A2

Firstly, we converted given RGB colored image to gray scaled image. Since image has darker colors in lower part (i.e. trees) and lighter colors in upper part (i.e. sky), we used different threshold values for upper and lower parts. Without doing that, the jet located in place with tree background part couldn't detected correctly while jet located in place with sky could and vice versa. After creating binarized image, closing operation is applied. However, the line between tree and sky were still visible. To delete the line, we applied erosion using 3x3 sized structural element with all ones. To connect separated parts of jets we applied dilation using 16x16 sized structural element with all ones. Then we used imfill operation to fill holes in jets. However, some of the pixels of trees couldn't thresholded. To delete them, we applied bwareaopen. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A2 is 2

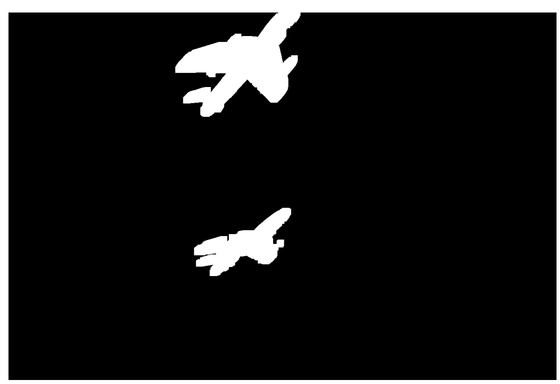

Fig. 2. A2 output

C. Image A3

Firstly, we converted given RGB colored image to gray scaled image. We created a binarized image with using 65 threshold value. Then, we applied closing using 3x3 sized structural element with all ones to connect separate parts and fill black parts of the jets. However, there were still noise around jets. To get rid of them we used bwareaopen to delete areas that have fewer pixels than 10. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A3 is 6

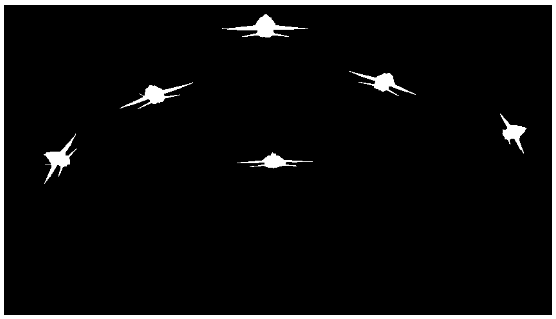

Fig. 3. A3 output

D. Image A4

Firstly, we converted given RGB colored image to gray scaled image. We created a binarized image with using 60 threshold value. Since two jets intersect in right, we applied erosion using 1x11 sized horizontal structural element like a line structure to separate them. Then, we applied closing using 7x7 sized structural element with all ones to connect separate parts and fill black parts of the jets. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A4 is 4

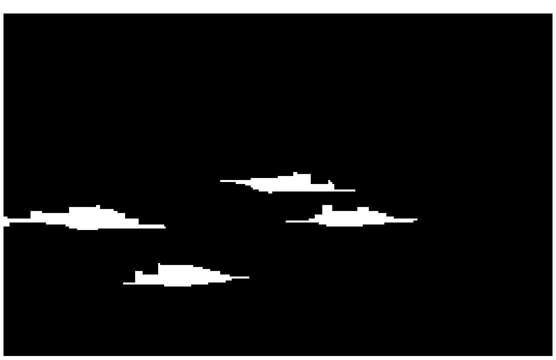

Fig. 4. A4 output

E. Image A5

Firstly, we take only B channel of RGB colored image. We created a binarized image with using 155 and 200 threshold values. However, there were still noise on the right side. To get rid of noise on the right side we used bwareaopen to delete areas that have fewer pixels than 10. Then, we applied closing using 11x11 sized structural element with all ones to connect separate parts and fill black parts of the jets. Then we used imfill operation to fill holes in jets. Letters at the lower right corner were still visible. To delete them we used bwareaopen to delete areas that have fewer pixels than 4200. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A5 is 2

Fig. 5. A5 output

F. Image A6

Firstly, we take only B channel of RGB colored image. We created a binarized image with using 55 threshold value. However, the mountain part located in left bottom were still visible. Since it is a too large area to use erosion we could get rid of it only using a mask operation in the creating binarized image process. There were noise on the right side after these operations. To get rid of noise, we used bwareaopen to delete areas that have fewer pixels than 30. hen, we applied closing using 5x5 sized structural element with all ones to connect separate parts and fill black parts of the jets.Then we used imfill operation to fill holes in jets. Finally we counted the jets using bwlabel which labels the connected components and return number of different connected components. You can see related output below.

The number of flying jets in image A6 is 7

Fig. 6. A6 output

II. Segmentation

In the segmentation part, it is asked to separate to dogs from their background. To do this we have used threshold method. In this method, after reading images we have converted RGB images to gray scale images. A general idea of our algorithm is finding a threshold value and assigning two different color values to pixels. If the color value of the pixel is under the threshold value we have assigned 0. Otherwise we have assigned 1. We have chosen the threshold value as average value of that image. Below encountered situations are specified and results of images are shown.

A. Image B1

In the first picture, the dog is black and the background is mostly green. But the color of the tree and the dog's are similar. We have separated the dog from the background. But the tongue of the dog is red so in the final image the tongue is not a part of the dog. Here is the result :

Fig. 7. B1 output

B. Image B2

In this image, dogs are separated well from the background. Because the colors are very different. But the problem is dogs have similar colors with the building. Here is the result :

Fig. 8. B2 output

C. Image B3

In the third image, the dog is not black or white. So when we converted to gray scale image there were no big color difference between the dog and the background. The dog is not separated from the sky. Here is the result image :

Fig. 9. B3 output

D. Image B4

In this image, since the dog has lighter color with respect to the trees, the separation is successful. But again the dog and the sky has similar color in gray scale and the ears of the dog is not successfully separated :

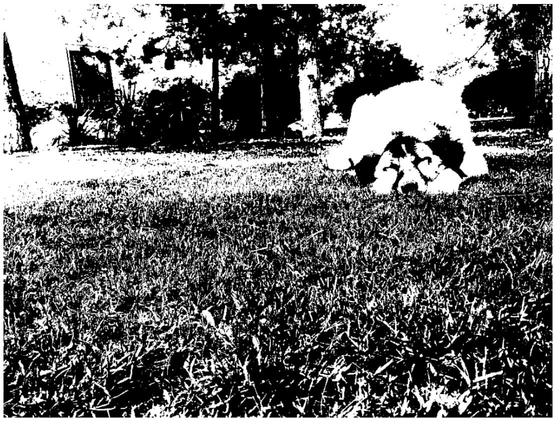

Fig. 10. B4 output

E. Image B5

In the final image, the color of the dog and the background are different. It may not be separated from the sky but there is no intersection with the sky. So the separation is successful and here is the result :

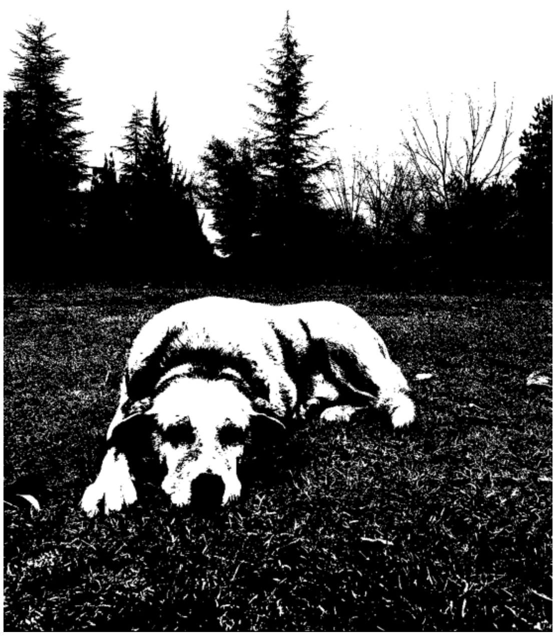

Fig. 11. B5 output

III. Old Exam Question

A.

To determine size of an image we can simply find the number of pixels and multiply with color channel number. In hue channel there are $7+(8*7)=63$ pixels, in saturation channel there are $(8*7)+7=63$ pixels and in intensity channel there are $20+10+1+2+10+20=63$ pixels. The pixel numbers are same in all color channels. We can say that image has 63 pixel. Also we now that there are 3 color channel to represent image. So the total size is $63*3=189$.

B.

- Since dramatic changes are happened in third histogram which is intensity histogram, do calculations on h_I.
  Divide h_I into two part, left peak and right peak respectively. So that, adaptive threshold can be implemented.
  For left peak, consider the pixels with intensity value less than 3. Set threshold value to be $t<2$. This result represents an object in image or background. Label it with red color.
  For right peak, consider the pixels with intensity value more than 4. Set threshold value to be $t>5$. This result represents an object in image or background. Label it with blue.
  Hence, segmentation for different object can be done.
- There are at least two homogeneous region in this image.