Assignment 7: Image Segmentation Project

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Handed out: November 2, 2022
Due: 11:59pm, November 18, 2022
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Important Notes:

- Feel free discuss the homework with the instructor or the TAs.

- Handwritten solutions will not be accepted.

- Turn in a PDF report and .m/.py files through Canvas as a compressed (.zip) file; turn in a hardcopy of PDF printout in class)

Note: I used smaller data sets for each fish (50 images of each type of fish) to keep my computation a bit less expensive and to keep what I turn in less than a gigabyte or two. However, I still feel that the images I chose are a good representation for what my algorithm can do as a whole.

Edge Detection Segmentation

(1) Details of the entire system including a block diagram or a flow chart
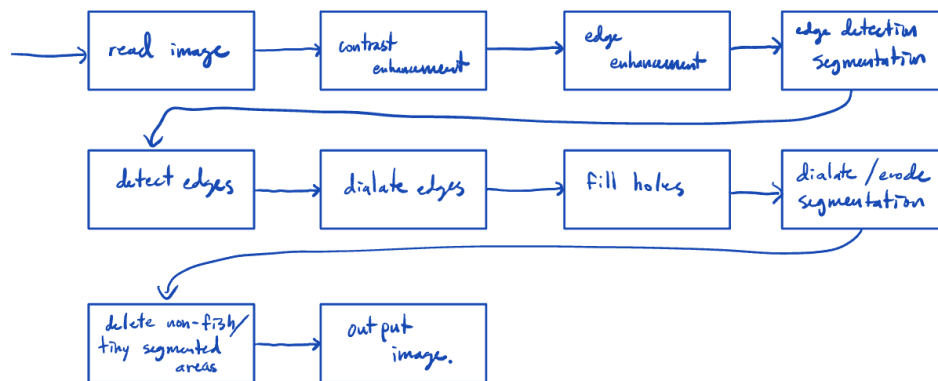
(a) Any preprocessing and/or post processing modules/functions you are using.

I used a lot of preprocessing and post processing functions from Matlab including, but not limited to: adapthisteq, fspecial, imfilter, edge, imdialate, imerode, imfill, and bwareaopen.

(b) Any assumptions you are making about the dataset.

An assumption that I made about the data set: The fish would be relatively centered in the images.

(c) Any assumptions you are making about the segmentation algorithm.

I wasn't making any particular assumptions about the segmentation algorithm, no.

(2) Details of segmentation algorithm you tried.

   (a) Methods or description.

      For the edge detection segmentation algorithm, I primarily relied on the edges of the images to determine the segmentation area of the fish.

   (b) Hyper parameters you tuned.

      I tuned the sharpness of the edge by having a relatively large number in the center of the kernel surrounded by -1. I also tuned the amount of erosion and dilation that the segmentation would go through to get the best desired area.

   (c) Results using different hyper parameters.

      Different hyper parameters would result in extra segmentation connected to or around the area of the desired area which would result in lesser accuracy.

   (d) Why is the current hyper parameter the best?

      Because it gives me the best desired accuracy overall given what I am doing.

   (e) Do these hyper parameters have failing cases in the dataset? By failing cases we mean where the algorithm does not work well.
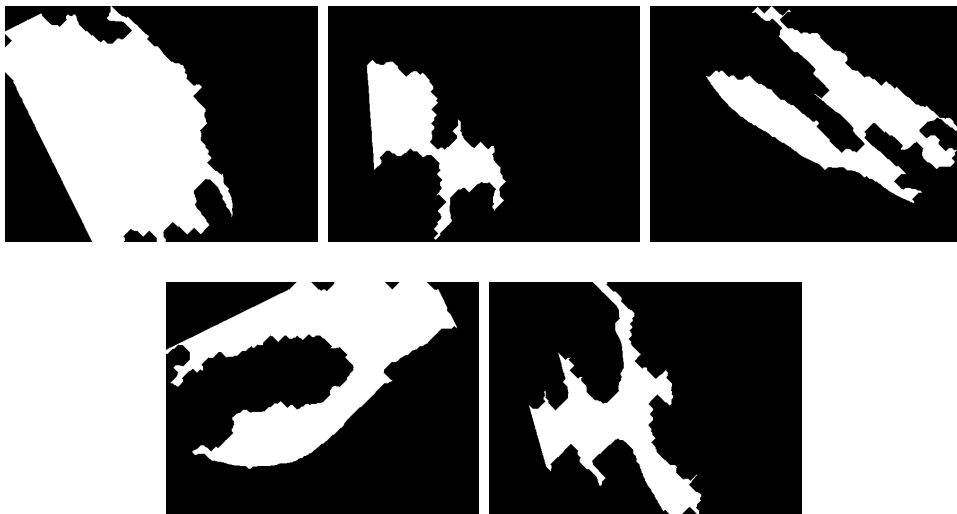
      Cases where the algorithm does not work well are particularly glare highlight noises from a light source or if there is a ledge or super dark area that creates a false edge.

(3) Best and worst Results of your proposed segmentation algorithm for at least 5 images from the dataset in terms of accuracy scores.

Best segmentations:
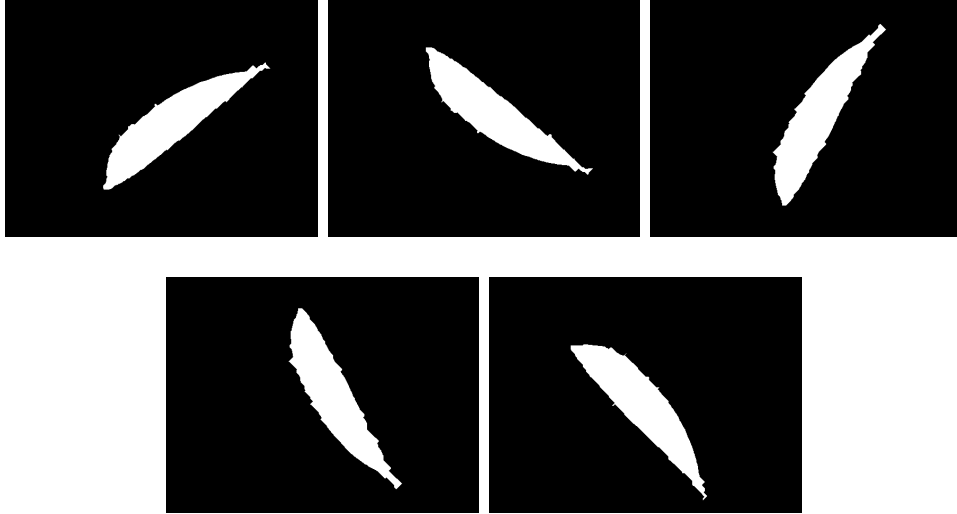
Worst segmentations:

(4) Report the overall accuracy scores for different algorithms.

Accuracy for Black Sea Sprat is: 9.397939e+00
Accuracy for Gilt-Head Bream is: 3.772806e+00
Accuracy for Hourse Mackerel is: 4.872611e+00
Accuracy for Red Mullet is: 7.997593e+00
Accuracy for Red Sea Bream is: 4.399770e+00
Accuracy for Sea Bass is: 5.542632e+00
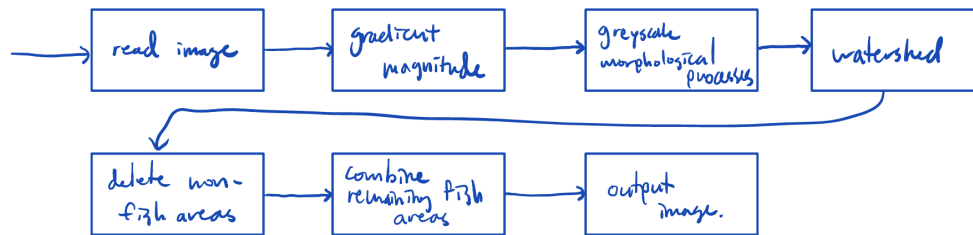Accuracy for Shrimp is: 9.162567e+00
Accuracy for Striped Red Mullet is: 1.094848e+01
Accuracy for Trout is: 3.518766e+00

Overall accuracy score: 6.623684889e+00

Segmentation with Watershed Segmentation

(1) Details of the entire system including a block diagram or a flow chart

(a) Any preprocessing and/or post processing modules/functions you are using.

I used a lot of preprocessing and post processing functions from Matlab including, but not limited to: rgb2gray, fspecial, imfilter, sqrt, imreconstruct, imdialate, imerode, imfill, imregionalmax, watershed, and bwareaopen.

(b) Any assumptions you are making about the dataset.

An assumption that I made about the data set: The fish would be relatively centered in the images and that areas up to a certain area would be the different segmentations of the fish.

(c) Any assumptions you are making about the segmentation algorithm.

I wasn't making any particular assumptions about the segmentation algorithm, no.

(2) Details of segmentation algorithm you tried.

    (a) Methods or description.

        For the watershed segmentation algorithm, I used the example given to us in the text book to determine the segmentation area.

    (b) Hyper parameters you tuned.

        I tuned the size of the disks of the opening and closing throughout the algorithm mostly. I also controlled the size of the different segmentation areas to keep and ones to zero out. Everything else was from the textbook example.

    (c) Results using different hyper parameters.

        Different hyper parameters would result in extra segmentation connected to or around the area of the desired area, sometimes the entire background, which would result in lesser accuracy.

    (d) Why is the current hyper parameter the best?

        Because it gives me the best desired accuracy overall given what I am doing.

    (e) Do these hyper parameters have failing cases in the dataset? By failing cases we mean where the algorithm does not work well.
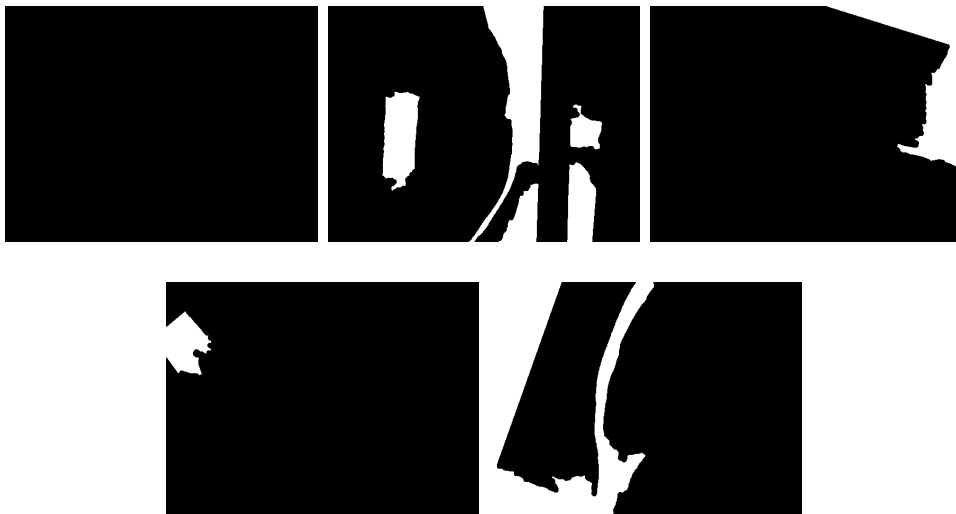
        Cases where the algorithm does not work well are particularly glare highlight noises from a light source or if there is a ledge or super dark area that creates false areas.

(3) Best and worst Results of your proposed segmentation algorithm for at least 5 images from the dataset in terms of accuracy scores.

Best segmentations:
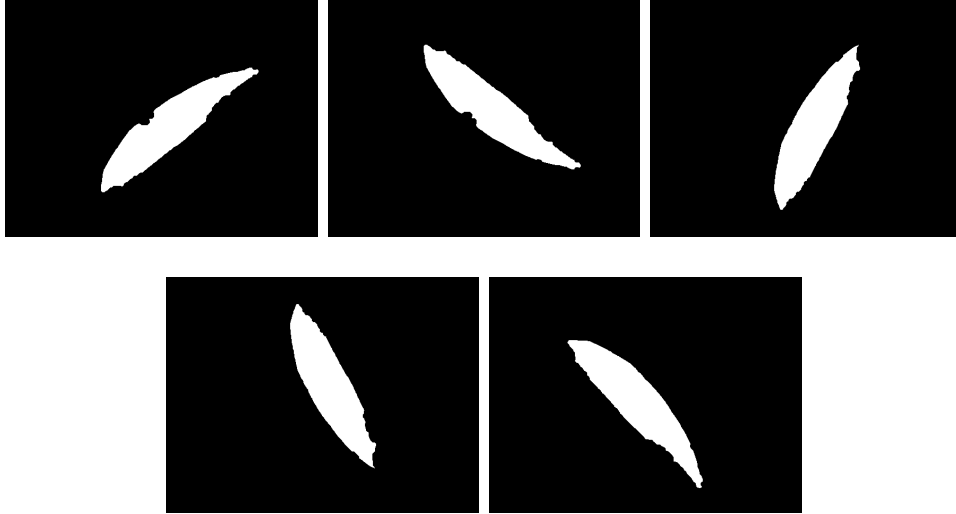
Worst segmentations:

(4) Report the overall accuracy scores for different algorithms.

Accuracy for Black Sea Sprat is: 9.470075e+00
Accuracy for Gilt-Head Bream is: 4.048258e+00
Accuracy for Hourse Mackerel is: 6.058121e+00
Accuracy for Red Mullet is: 8.413342e+00
Accuracy for Red Sea Bream is: 3.697705e+00
Accuracy for Sea Bass is: 5.720201e+00
Accuracy for Shrimp is: 8.887716e+00
Accuracy for Striped Red Mullet is: 1.198469e+01
Accuracy for Trout is: 2.503999e+00

Overall accuracy score: 6.753790e+00