Computer Vision
Task 2
Team 06

Team Members:

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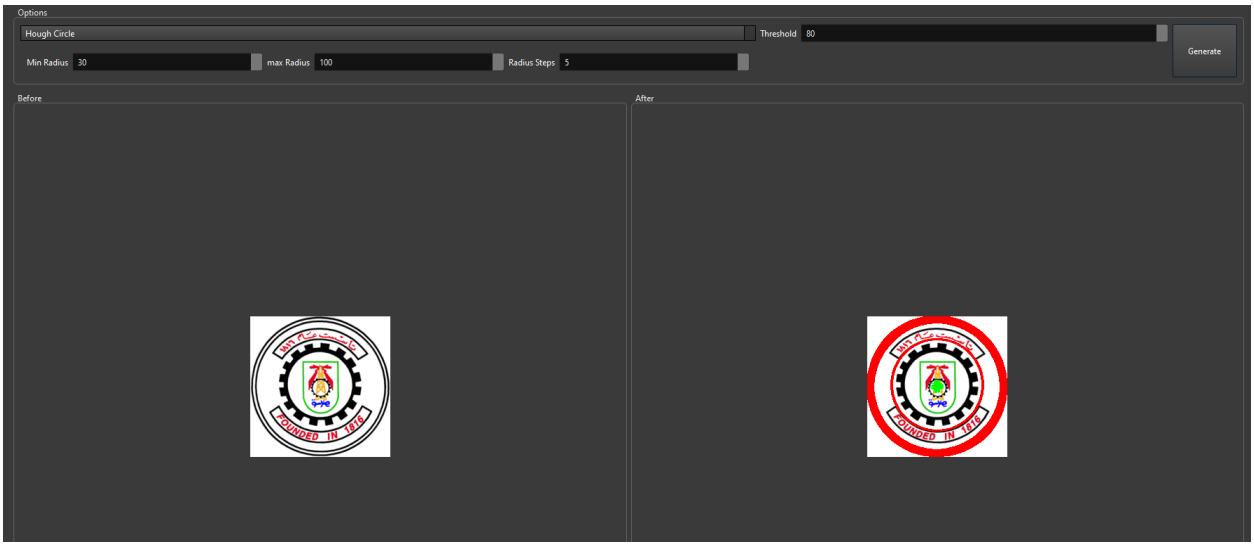
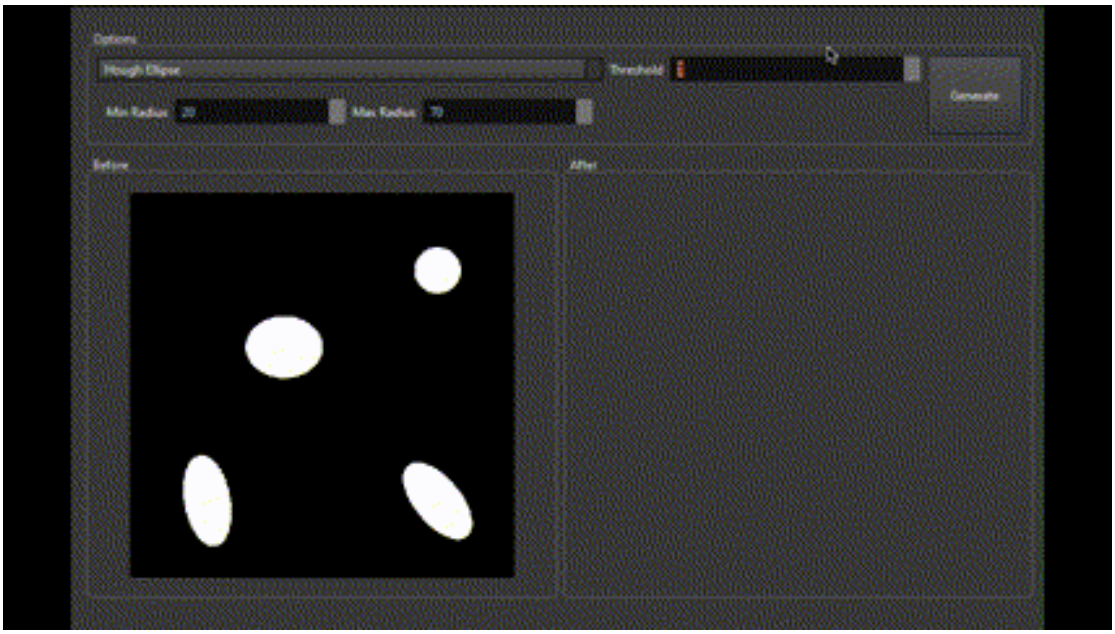
Part 1- HoughTransform:

1. HoughLine:
   Using HoughTransform, we can detect lines in images, using the parametric equation of the line, any line has two Parameters in polar coordinate, the angle, and distance from the origin to the line, then we complete accumulator and get lines that have value beyond a certain threshold.

2. HoughCircle:
   Using the same technique in lines, the parametric equation of the circle, to test all possible circles in the screen and draw circles with values higher than a threshold, in a circle we need three parameters, two for the circle center, and the radius, so we create an accumulator with 3d dimension.
   And this is an example of HoughCircle:



3. HoughEllipse:
   Here we will use a different approach to detect ellipses, as the conventional approach will need a 5d array and so many computations, so we decided to follow “A New Efficient Ellipse Detection Method” Link, in this method we use only a 1d array as an accumulator, and we assume that every two points are a major axis for an ellipse, and test rest points to see if it is a real ellipse or not, and also to speed up the operation, we run the function using multi threads to parallelize the operation. And this example image takes less than 10s to run and get the output.



Part 2. Active Contour “Snake” greedy Algorithm.

Definition:

The active contour greedy algorithm, also known as the snake algorithm, is a computer vision technique used for image segmentation. Its main goal is to locate the boundaries of objects in an image by iteratively adjusting a contour that is initially placed near the object of interest. The algorithm works by minimizing an energy function that describes the contour's shape and its relationship to the image. This energy function is composed of two parts: internal energy, which measures the contour's smoothness and curvature, and external energy, which measures the contour's fit to the image.

Algorithm Common uses:

The algorithm starts with an initial contour that is placed near the object of interest. The contour is then iteratively deformed by minimizing the energy function. The deformation of the contour is guided by the gradient of the external energy, which attracts the contour to the boundaries of the object, and the curvature of the contour, which is minimized by the internal energy. This process continues until the contour converges to the object's boundary. The active contour greedy algorithm has many uses, including medical image analysis, object tracking, and shape recognition. It is particularly useful in cases where the object's boundary is difficult to detect using traditional edge-detection techniques or when the object's shape is irregular or complex.

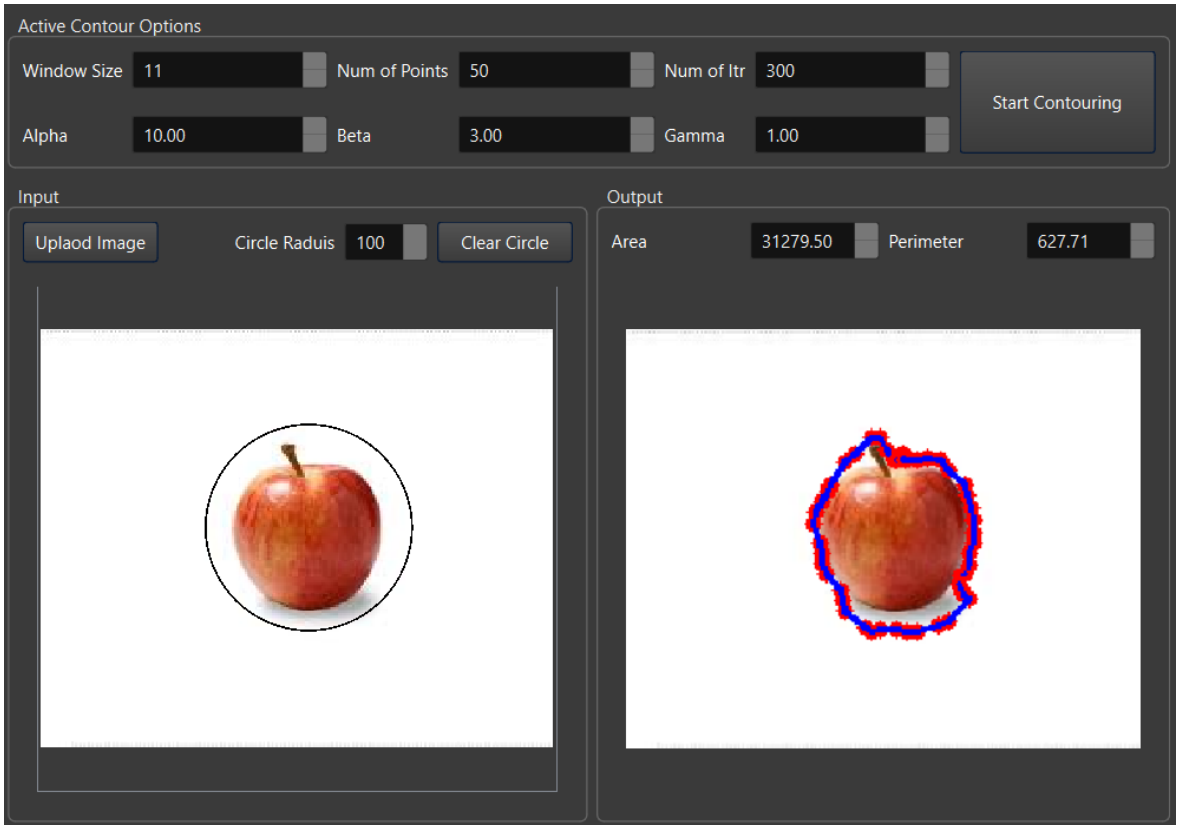
How to use our Algorithm

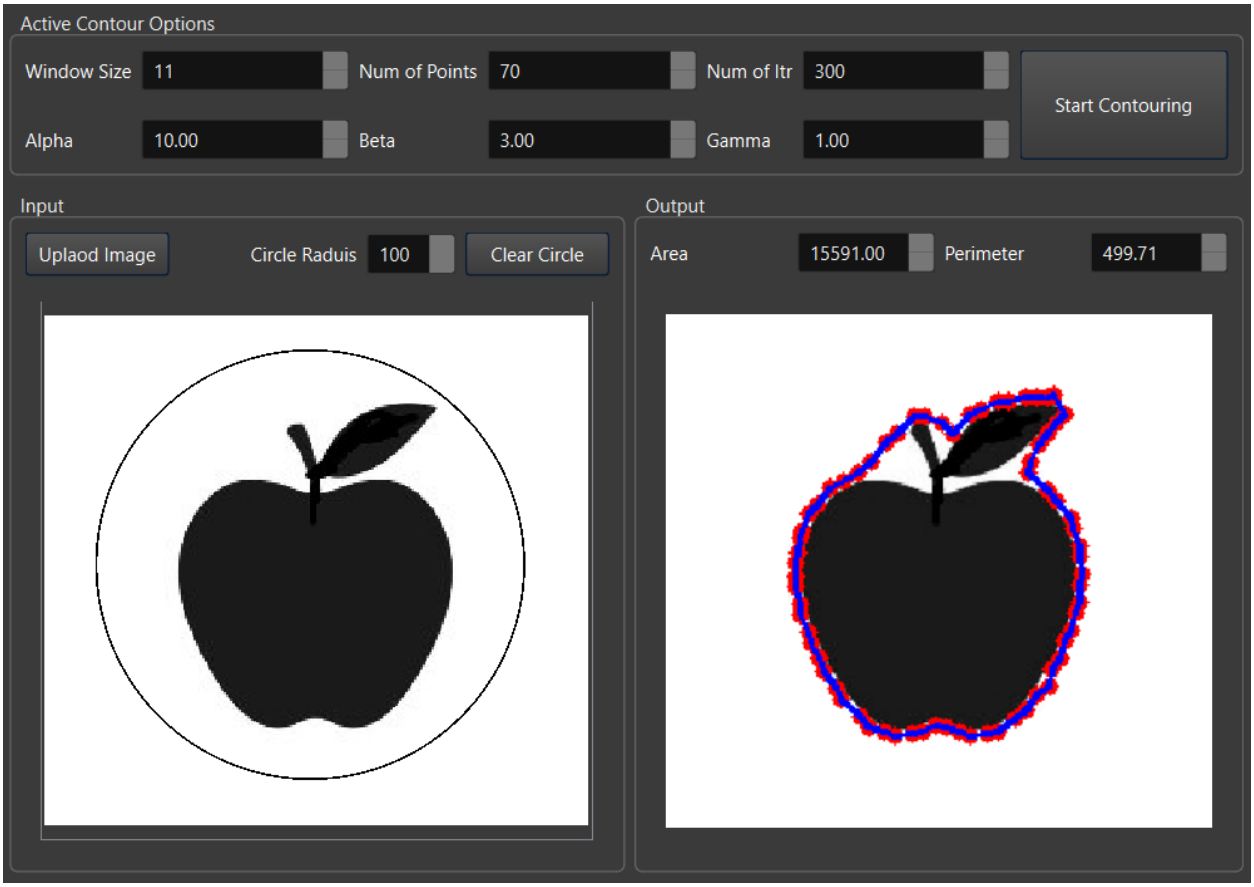
To use the active contour greedy algorithm, several parameters need to be set based on the specific image and object being segmented. One of the most important parameters is the number of iterations the algorithm should run. This determines the number of times the contour is deformed, and a higher number of iterations can lead to better accuracy but may also increase computation time. Another important parameter is the number of points used to interpolate the contour, which affects the smoothness of the contour and its ability to accurately capture the object's boundary.

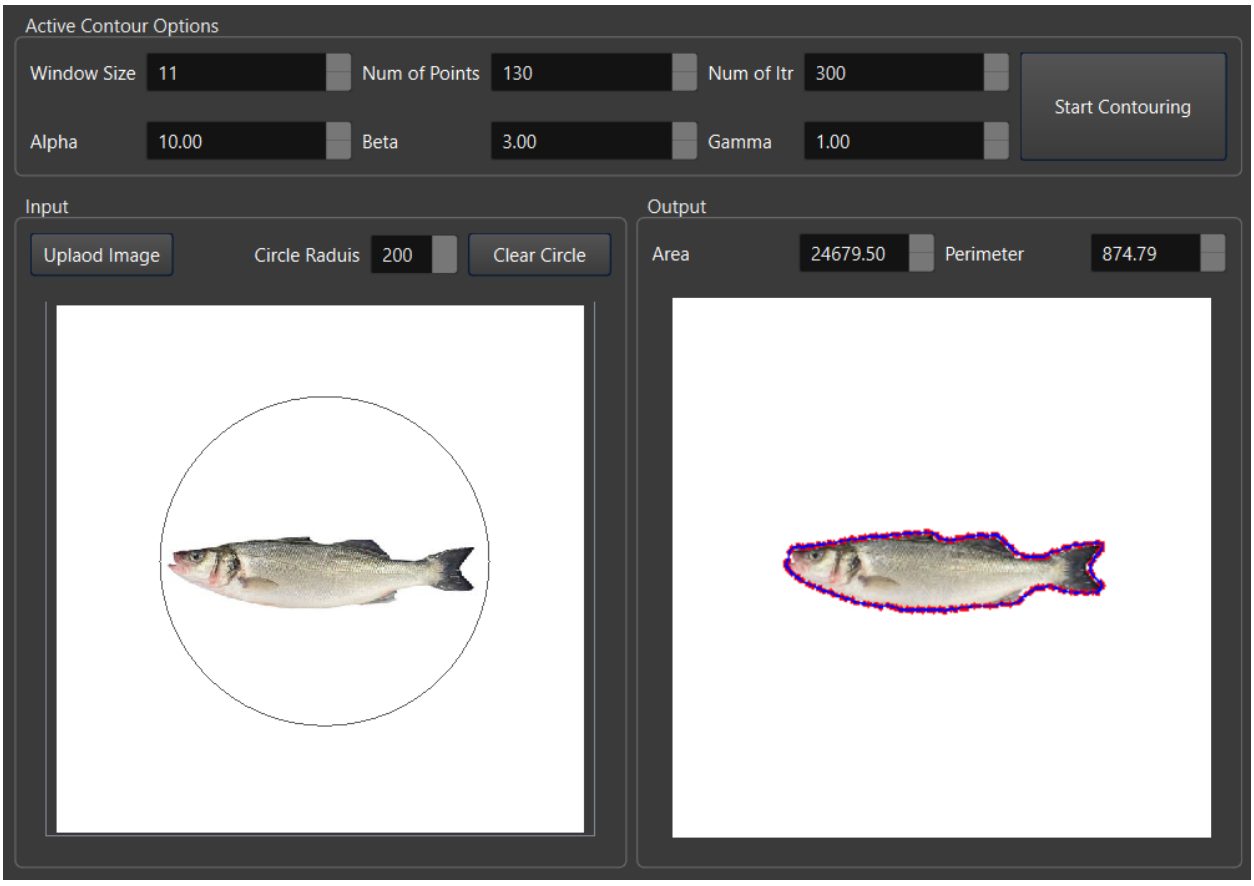
Additionally, the algorithm requires setting values for the internal energy parameters alpha and beta, and the external energy parameter gamma. Alpha controls the contour's elasticity and smoothness, while beta controls its rigidity and resistance to deformation. Gamma controls the contour's attraction to edges in the image, and higher gamma values increase the contour's sensitivity to image features. The window size parameter controls the size of the local region around the contour used to compute the external energy gradient, and larger window sizes can help the contour adapt to changes in the object's boundary over larger regions.

Overall, the active contour greedy algorithm provides a powerful tool for image segmentation in a variety of applications. Its ability to adapt to complex object shapes and features makes it particularly useful in fields like medical imaging and robotics, where precise object recognition and localization are critical. However, choosing appropriate parameter values and fine-tuning the algorithm to specific applications can be a challenging and iterative process.

Results:




Active Contour Options
Window Size
11
Num of Points
70
Num of Itr
300
Start Contouring
Alpha
10.00
Beta
3.00
Gamma
1.00
Input
Uplaod Image
Circle Raduis
100
Clear Circle
Output
Area
15591.00
Perimeter
499.71


Active Contour Options
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Num of Points
130
Num of Itr
300
Start Contouring
Alpha
10.00
Beta
3.00
Gamma
1.00
Input
Uplaod Image
Circle Raduis
200
Clear Circle
Output
Area
24679.50
Perimeter
874.79