Food Segmentation Semester Project

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December 9, 2020

FUNCTIONALITY

This program builds an active contour model via a GUI for the user to segment varying food items with. The original active contouring model was built off of the contouring program build in Lab 5. The program first converts a given .pnm image into a grayscale value via averaging the RGB pixel values. The gradient of the image is calculated along with the contouring each time a new contour is drawn by the user. The gradient kernel convolved against the image is a 3 by 3 sobel operator. For the active contour snake model, maintaining a proportional increase in weighting on the external and internal energies produced an overall better result; this helped the points favor movement inwards. It helped to weight the initial internal energy, which pulls a given point to the next, higher than the deviation of a given points' distance to the overall average. In certain cases, the active contouring model might skip over a "dip" (for example, the right side of the egg or piece of bread in Figures 2 and 3) and contour outwards. An improvement to this scenario would be using an external vector field, such as gradient vector flow. This would help points follow a strong path of descent towards a given edge along with the current edge detection.

When right-clicking, the program will set a bubble at the location of the mouse. Once the bubble contouring is started, the program will sample every 3rd pixel from the set circle around the pointer. The balloon model uses almost identical energy terms to the active contour, however, the internal energy terms are negated. The second internal energy term is also altered slightly to help maintain an outward shape. The average column and row is calculated for each iteration of contouring, and these values are used to define the average deviation of a given contour point to the average of all the contour points (instead of average distance between a contour point like in the snake model). This energy term helps push the contour points outwards. The appropriate weightings are also set up to negate the internal energies for a potential best fit for the balloon model. Some examples of the ballooning are shown in Figures 15 and 16. The balloon model does not work very strongly, however, without a very distinct sobel gradient. As observed, contour points may become "unbounded" from the rest, expanding too far over softer edges, and tend to scatter around more often than not. Two possible fixes include further fine tuning on the weightings or implementing another internal energy term that maintains minimization of difference each point has to an average curvature.

The program also performs a recontouring of a current contour if a contour point moved using shift + left mouse button. This fixates the point to where the user moved the point and recontours around that point in place. The operation works better in the active contouring model as opposed to the balloon model. This difference in effectiveness might be due to the lack of an

energy term that defines maintaining an average distance and curvature between the ballooning points. In both models, the movement and fixation of the point works well. However, the active contour model showed a better relative result than the balloon model. The snake model, after recontouring a point, will shift points on one side towards the point; however, the succeeding points continue forward. This results in leaving a gap after the contour point has been set again. An example of the recontouring of an image is shown in Figure 17.

IMAGE CONTOURS

Figure 1: Image bacon-eggs-toast.pnm - Bacon

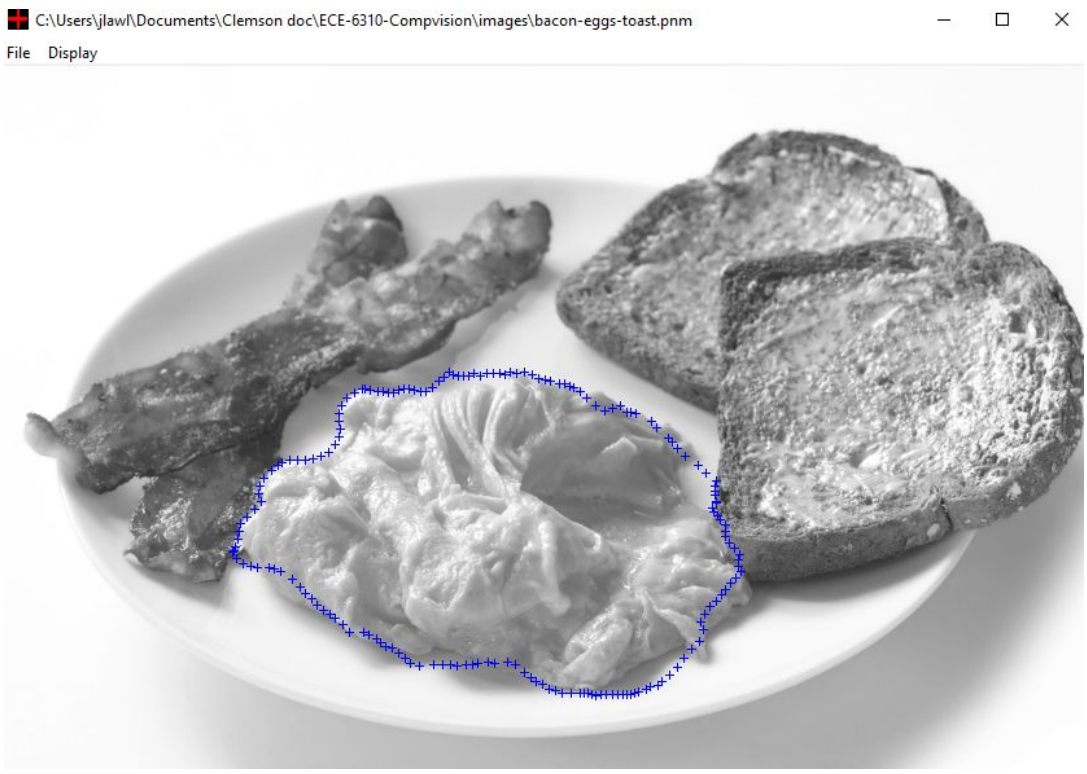

Figure 2: Image bacon-eggs-toast.pnm - Eggs

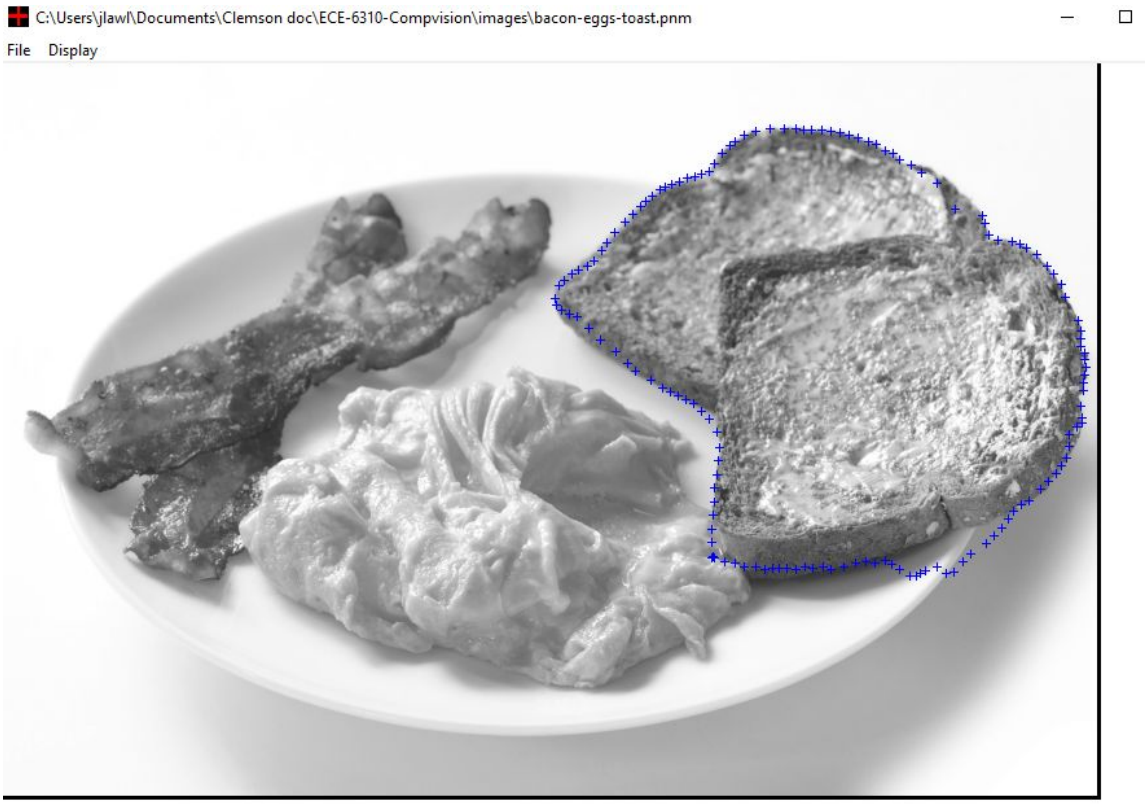

Figure 3: Image bacon-eggs-toast.pnm - Bread

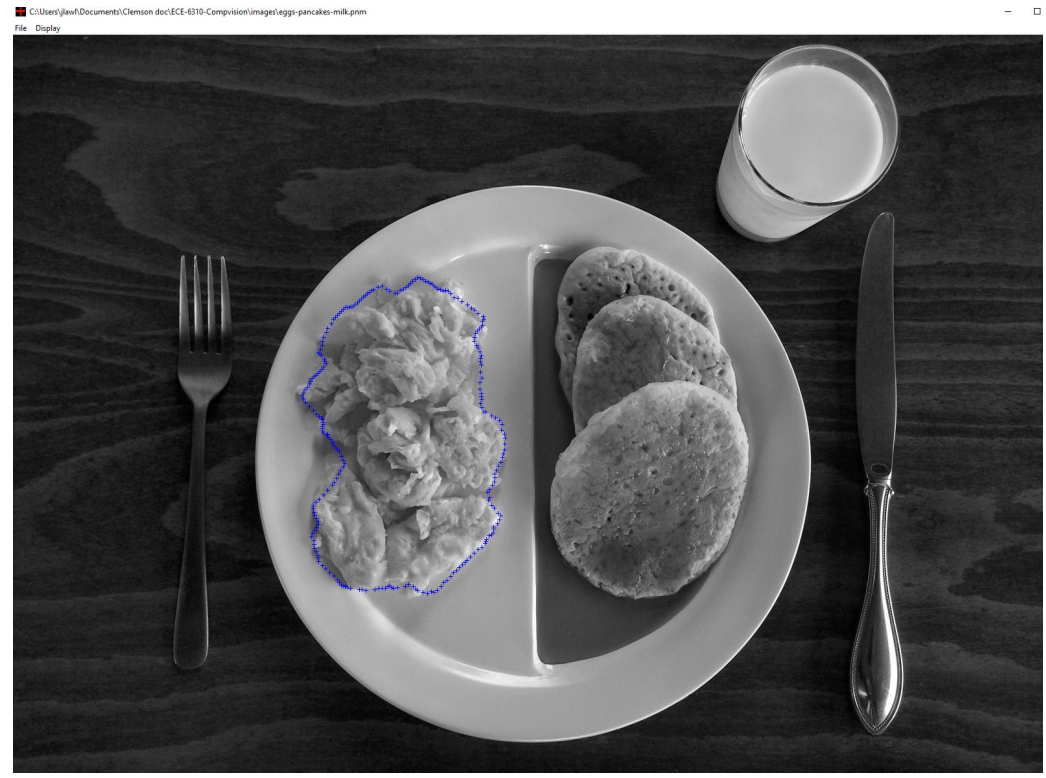

Figure 4: Image eggs-pancakes-milk.pnm - Eggs

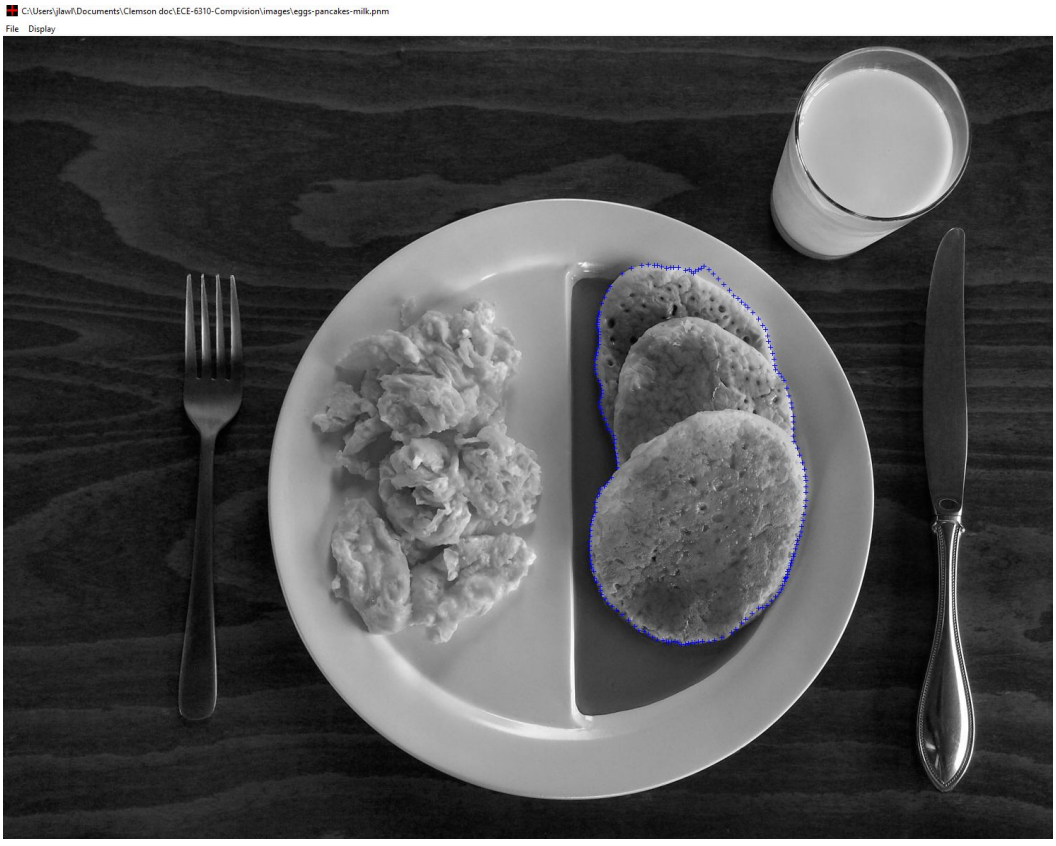

Figure 5: Image eggs-pancakes-milk.pnm - Pancakes

Figure 6: Image eggs-pancakes-milk.pnm - Milk

Figure 7: Image fish-lemon-rice-greens.pnm - Fish

Figure 8: Image fish-lemon-rice-greens.pnm - Lemon

Figure 9: Image fish-lemon-rice-greens.pnm - Rice

Figure 10: Image fish-lemon-rice-greens.pnm - Greens

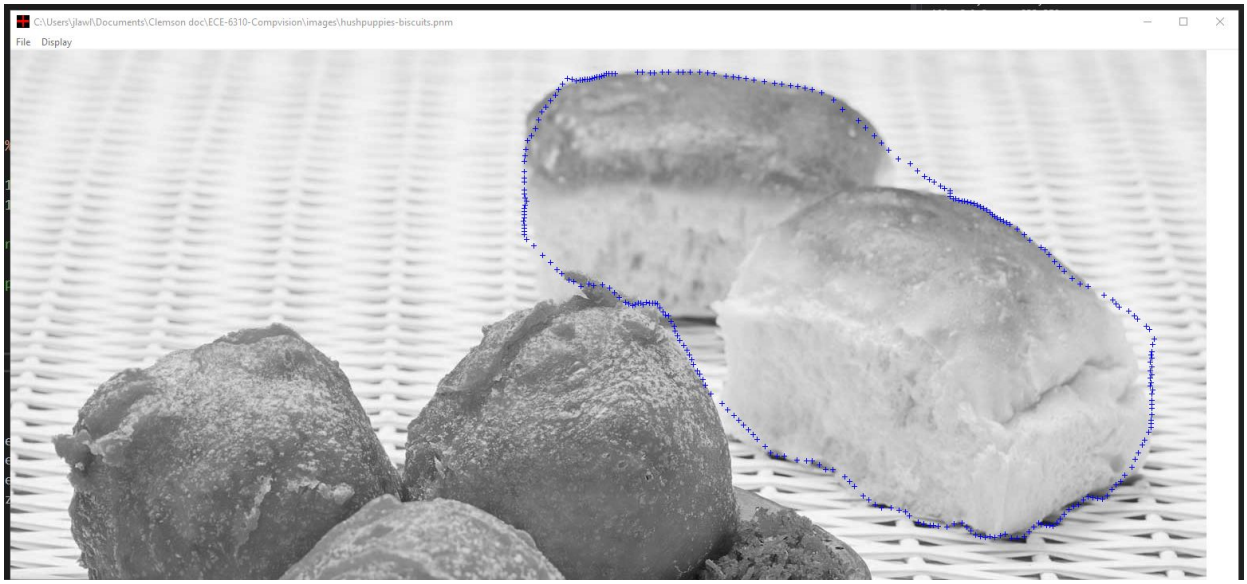

Figure 11: Image hushpuppies-biscuits.pnm - Biscuits

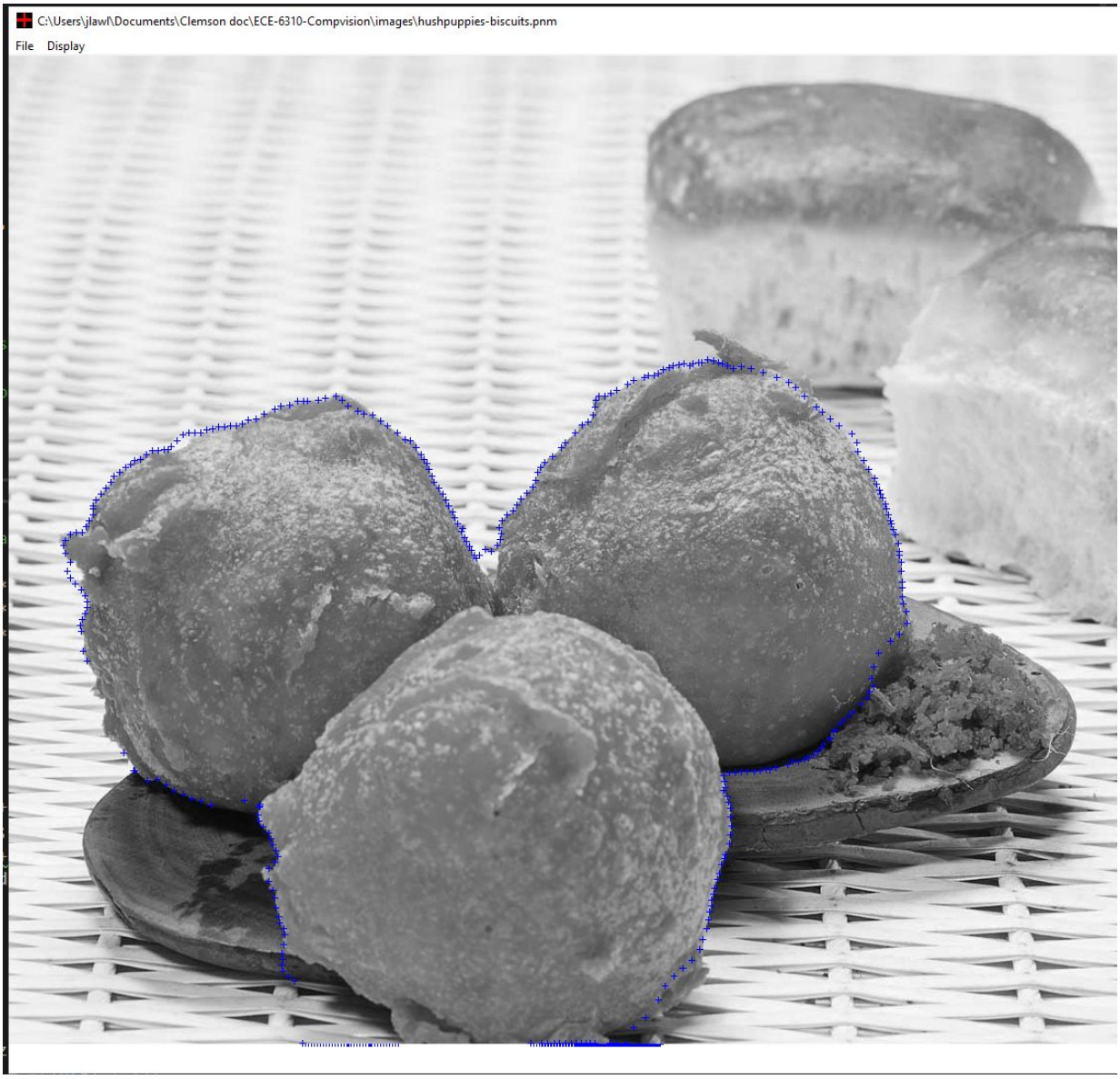

Figure 12: Image hushpuppies-biscuits.pnm - Hushpuppies

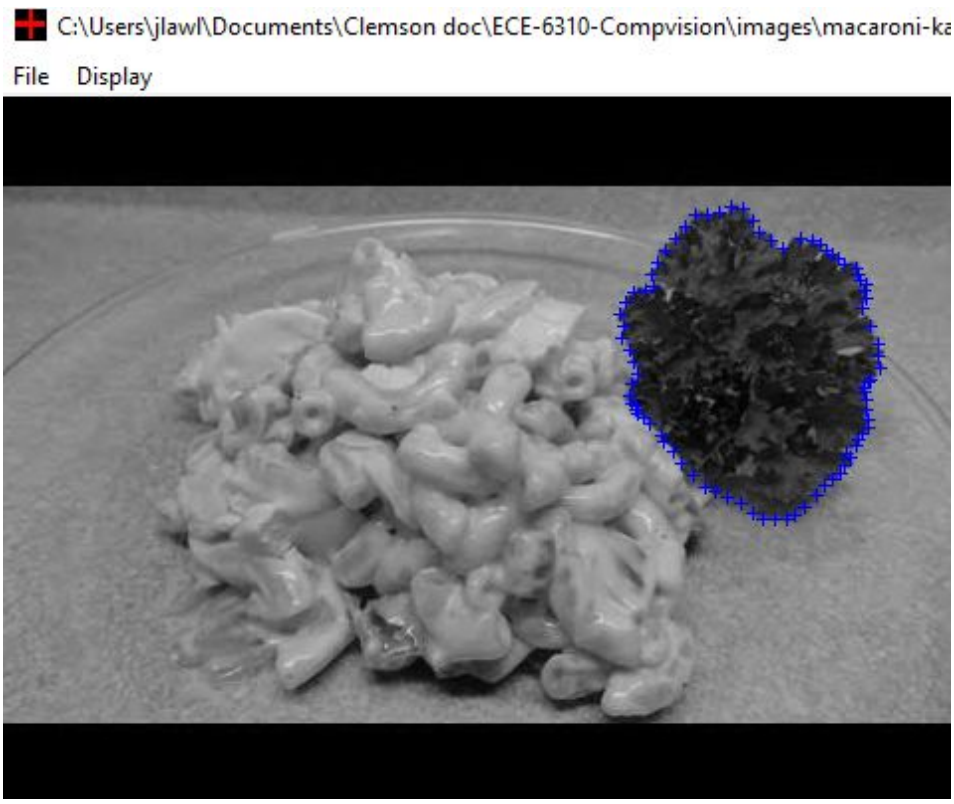

Figure 13: Image macaroni-kale.pnm - Kale

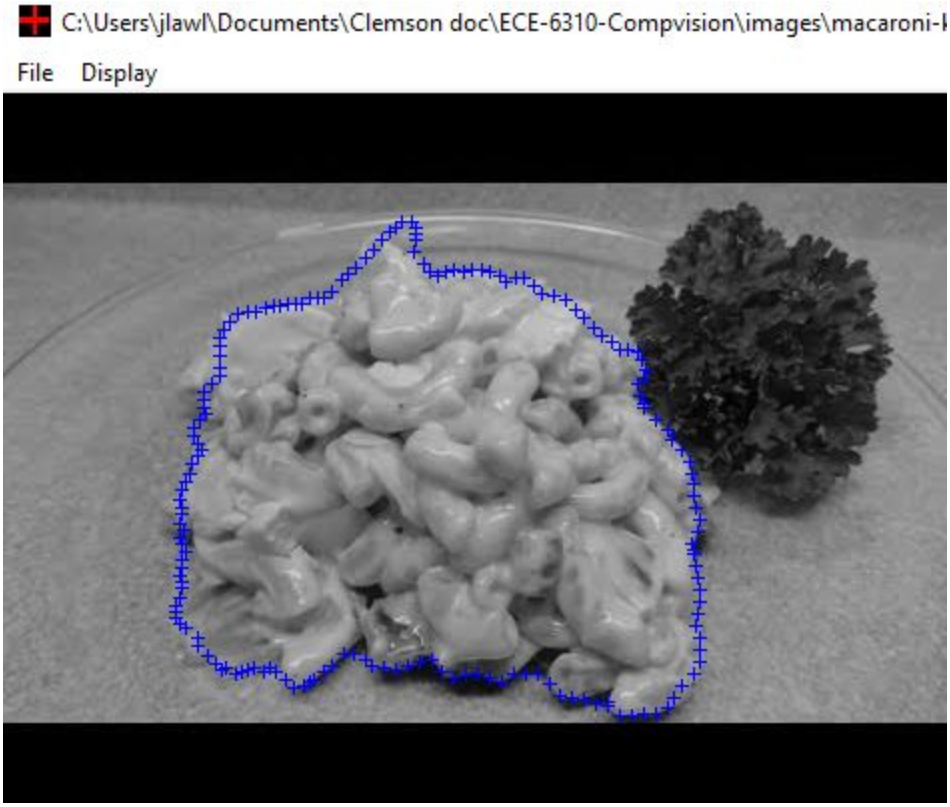

Figure 14: Image macaroni-kale.pnm - Macaroni

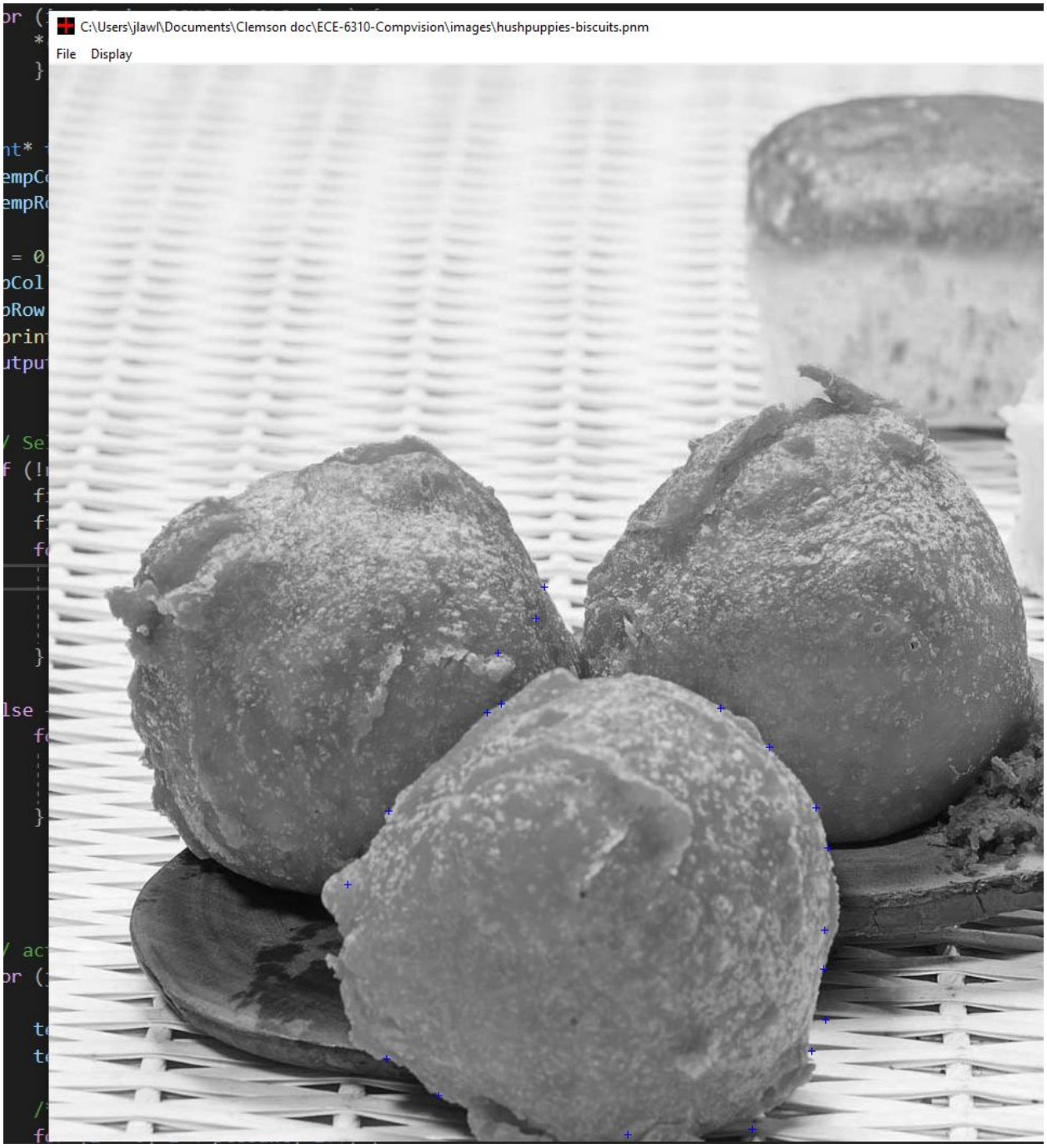

Figure 15: Image hushpuppies-biscuits.pnm - Hush Puppy Balloon

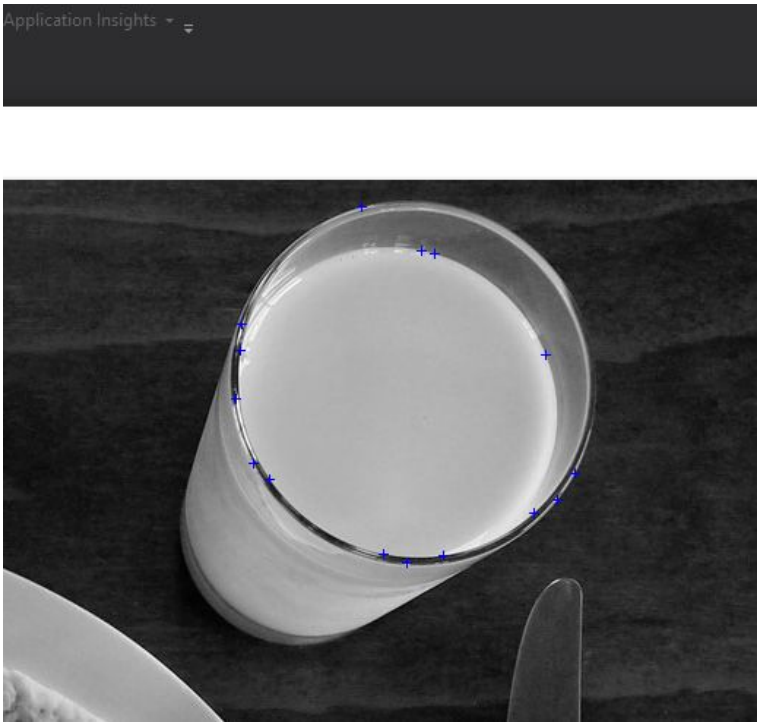

Figure 16: Image eggs-pancakes-milk.pnm - Milk Balloon

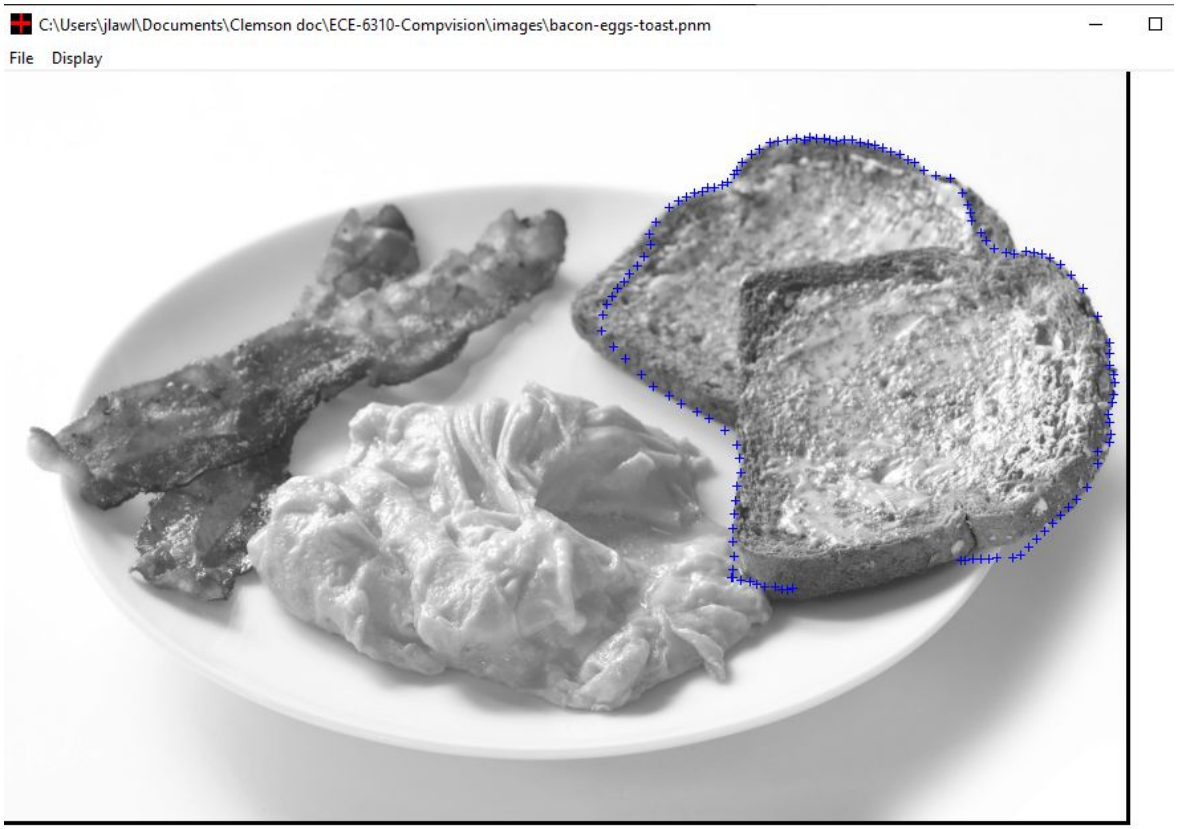

Figure 17: Figure 3's Bottom right Bread Recontour