Report of MP2

1. Morphological Operators

Based on the idea of dealing with binary images, getting rid of noise, image enhancement, and object segmentation. we introduced morphological operators. the key points of the operators are the input image(usually a binary image, even grayscale image), structure element, and set operator in mathematics. depend on the different set operations, we have dilation, erosion, opening, closing, and even boundary extraction, 5 different morphological operators.

Structure Element (SE): a small binary or grayscale image, the size(shape) and the origin are important. Usually has odd size (3X3, 5X5). And in binary image, the SE often defined with foreground, represented by 1s, and the background represented by 0s. Other common shapes have, circle, line and cross.

Dilation: Expand an image

Erosion: Shrink an image

Opening: remove small objects, break isthmuses. Essentially an erosion followed by a dilation.

Closing: Fill(elimate) small gaps in image. Essential a dilation followed by an erosion.

Boundary Extraction: find the outline and boundary of an image. Obtain by subtracing an erosion image from the original image.

2. Algorithm Implementation

Structure Element(SE): I use numpy to create arrays filled with 255 the size of array are determined by dimensions. I create 4 different SEs, [3,3],[5,5],[7,7] rectangle and a cross(3,3)

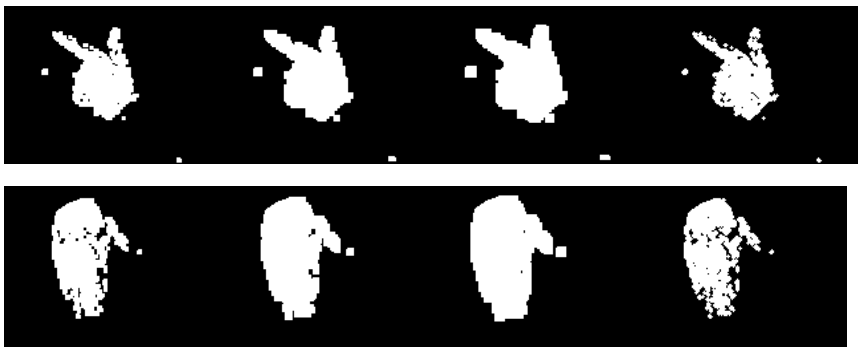
Dilation & Erosion: If any part of the structural element overlaps a white pixel in the image, dilation occurs by setting the pixel to white (expanding the image). On the other hand, erosion only works by setting a pixel to white if all parts of the structural element overlap with a white pixel in the image. Dilation adds pixels to the boundaries of objects in an image. Erosion removes pixels from the boundaries of objects in an image. And both use padding parameter to handle the border pixels.

Opening & Closing & Boundary: Just call the dilation and erosion functions to implement.

3. Result analysis

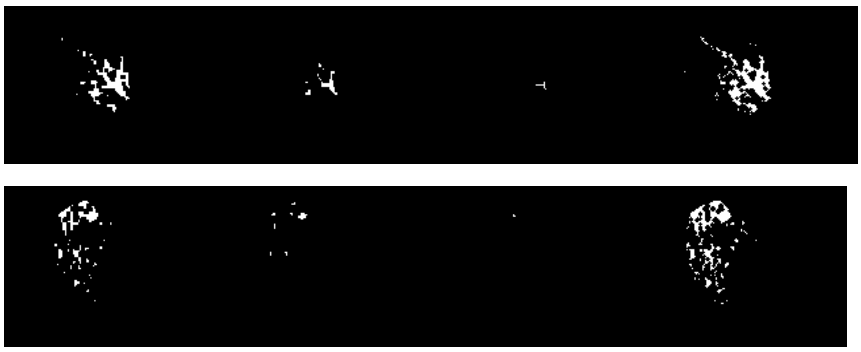
First line is gun image, second line is palm image. From left to right, the SEs selection are different, they are [3,3],[5,5],[7,7] rectangle and a cross (3,3) structure.

Dilation:



from the result, we can see, with the increased size of SEs, more gaps are filled.

Erosion:



The results are deeply influenced by the shape and size of SEs, within the rectangles, with the SEs size increase, the image going to disappear. But the cross structure makes the image clearer than then rectangle structure. However, this erosion operation does not make the whole image more clear.

Opening:

From the results, we can see the size of SEs is very important, and the rectangle structure is not so useful, it removes fingers due to the objects having many holes. But from the cross structure, we can see Opening operation makes the image small bridges get deleted.

Closing:

The Closing operation is more successful than Opening. Both two SE structures work, we can see the many gaps and holes are filled with white pixels, which the make the image smoother.

Boundary

From the above dilation and erosion operations, we can see they are too many bridges and holes in the result images. So the single combination of two operations can not get a clear boundary. but firstly use dilation to extend the object, then implement boundary operation can make more image segmentations (holes pixel and small parts) disappear from the boundary image.