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CS 484, Fall 2017

Homework Assignment 1: Binary Image Analysis

Due: October 31, 2017

Question 1

Erosion Code

```
% definition source:
https://homepages.inf.ed.ac.uk/rbf/HIPR2/erode.htm
function e = erode(im, se);

[rows, cols] = size(im);
[p, q] = size(se);
offset_p = floor((p - 1) / 2);
offset_q = floor((q - 1) / 2);

result = zeros(rows-offset_p, cols-offset_q);
result = padarray(result, [offset_p offset_q],1 ,'post');

for i=1:rows-offset_p
    for j=1:cols-offset_q
        out = 0;
        for se_i=1:p
            if(i + se_i < offset_p || i + se_i - offset_p >= rows)
%out of vertical boundaries
                continue;
            end
            for se_j=1:q
                if( j + se_j < offset_q || j + se_j - offset_q >=
cols) %out of horizontal boundaries
                    continue;
                end
                if( im(i + se_i - offset_p + 1, j + se_j - offset_q +
1 ) && se(se_i, se_j))
                    out = 1;
                end
            end
        end
        result(i, j) = out;
    end
end

e = result;
end
```

This erosion implementation dilates the background (which is 1 in binary, white)

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Dilation Code

```
%definition source:
https://homepages.inf.ed.ac.uk/rbf/HIPR2/dilate.htm
function d = dilate(im, se);

[rows, cols] = size(im);
[p, q] = size(se);

offset_p = floor((p - 1) / 2);
offset_q = floor((q - 1) / 2);

result = ones(rows-offset_p, cols-offset_q);
result = padarray(result, [offset_p offset_q],1 ,'post');

for i=1:rows-offset_p
    for j=1:cols-offset_q
        out = 1;
        for se_i=1:p
            if(i + se_i < offset_p || i + se_i - offset_p >= rows)
                continue;
            end
            for se_j=1:q
                if( j + se_j < offset_q || j + se_j - offset_q >=
cols)
                    continue;
                end
                if( im(i + se_i - offset_p + 1, j + se_j - offset_q +
1) == 0 && se(se_i, se_j))
                    out = 0;
                end
            end
        end
        result(i, j) = out;
    end
end

d = result;
end
```

This dilation implementation erodes the background (which is 1 in binary, white).

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Question 2

I obtained the results as follows:

First, I took the blue color band of the RGB image and then applied thresholding for values greater than 65. Then, I chose a “disk” structuring element of size 4 and then eroded the image. After, I chose a “disk” structuring element of size 6 and then dilated the eroded image with this. I then slided the thresholded image by one row and one column down and right to match the indices of the morphed image. Then, I “AND”ed the thresholded image and the morphed image to get rid of the frames and any other artifacts that are not wanted. I then inverted the image and then applied connected components labeling in RGB. Every different component is assigned to a different color as a product.

est_095yhf_close.jpg

In this plate, it was impossible for me to get rid of the screw at the beginning of the plate even though it got smaller than before. I got rid of the frame successfully.

f_an-684-fh_close.jpg

For this plate, it was possible for me to get rid of most of the frame. However I could not get rid of the dashes.

gr_tkt-3442_close.jpg

For this plate, I successfully got rid of the stamp (or logo), however most of the frame in the top remained, since the optimal erosion structuring element size was not enough for the frame of this plate.

i_cz315ne_close.jpg

I got rid of the EU sign and the “05” sign, however I could not get rid of the logo at the middle right of the plate and the corners of the frames, since the optimal erosion structuring element size was not enough for this plate.

i_ed485kc_close.jpg

I successfully got rid of all the signs in this plate, however some regions of the frame remained. This is due to the lack of enough erosion.

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irl_132-ww-450_close.jpg

I successfully got rid of the writing at the top and the frames, but not the dashes, because eroding them also eroded the text.

md_chaw352_close.jpg

I got rid of the sign, however not completely the screw and the frames due to the lack of enough erosion.

n_dn96650_close.jpg

I successfully got rid of 90% of the frame and all of the signs. Since the corners of the frames were thicker, more erosion was needed.

pl_po3c008_close.jpg

I successfully got rid of 90% of the frame. Since the corners of the frames were thicker, more erosion was needed.

rus_am446739_close.jpg

This was the hardest because of the large and thick font of the sign “39” and the thick frame borders. The erosion was not enough for this plate and a larger structuring element of size 7 or 8 was needed as a disk.

s_jmr297_close.jpg

I successfully got rid of every unwanted element in this plate.

tr_34eu2170_close.jpg

I successfully got rid of 90% of the frame. Since the top corners of the frames were thicker, more erosion was needed.

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Question 3

In this part of the homework, I first converted the RGB image and the base image to greyscale and then subtracted the image from the base image. The result gave me the difference between two frames (which objects appeared, changed, moved and etc.). Then, I thresholded this result to get rid of any artifacts primarily. Then, I inverted the image to perform erosion and dilation, because my erosion and dilation were for black on white background images, so erosion does dilation's job if I did not invert it. This avoided any confusion in the conventional namings. After all, I performed an erosion operation with a structuring element of type disk and of size three. Then, I performed a dilation operation with a structuring element of type disk and of size 2 to the eroded image. Then, I performed a logical AND to the dilated image and thresholded image to fill in needed gaps and get rid of unwanted artifacts. Then, I inverted the image back and applied the connected components labeling in RGB via the `label2rgb` method.

2000

0150.jpg

In this part, it was hard for me to extract the top of the red car because of the light reflection. Since there was almost no difference between the background and the image, the top of the car is a lost part. Also, I could not get rid of the shadow of the car, because if I eroded it more, it would also erode the desired details.

0800.jpg

Again, in this part the tops of the cars are lost because of the fact that there is no difference between the background and the image in terms of average of the red green and blue values. Especially for the white cars this problem was present. The human was successfully identified in this frame.

1300.jpg

The shadow and the problem of losing the top of the car is present in this frame less. However, even though the humans are successfully identified, the legs of the human in the front are lossy because of the erosion being more than desired for thin objects to get rid of unwanted artifacts.

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2001

0535.jpg

The car is identified almost fully without any shadow in this frame, however almost half of the human image is lost due to excessive erosion.

0950.jpg

Here, because of the fact that humans and cars are smaller than other frames, even though they are identified, some of the body parts are lost to excessive erosion that is used to get rid of shadows.

1750.jpg

Here, since the humans are so far away, they are small and are identified but not restored fully in terms of size after thresholding. Since their cloth colors are similar to the asphalt, the difference image shows only a small part of their body. The same is valid for the cars, which have similar colors. This image did not have significant difference in terms of area to the base image; therefore most of the changed areas did not even pass the threshold.