EE 146: Computer Vision

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Lab 7: Image Matching - Template and Chamfer Matching

Date: 02/21/2022

```
clc
clear all
close all
```

Problem 1 - templete matching

```
I = imread('cameraman.tif');
imshow(I)
```

```
t = I(60:85,130:170 ); % this is your template image
imshow(t)
```

```
% write your code here
% functions: imadjust(), imrotate(), xcorr2(), normxcorr2()

% step 1 - get cross correlation / normalized cross correlation
cross_correlation = xcorr2(t, I);
norm_correlation = normxcorr2(t, I);
% step 2 - find the peak value location in the correlation matrix
[x_peak, y_peak] = find(norm_correlation == max(norm_correlation(:)))
```

```
x_peak = 85
y_peak = 170
```

```
% step 3 -  use function size() to get the size of template image
template_size = size(t)
```

```
template_size = 1×2
    26    41
```

```
% step 4 - use insertShape() to display the matched box;
```

(a) Report results by showing the results of cross-correlation and normalized cross-correlation. Find the instances of template by thresholding the cross-correlation results

```
matched_box_a = insertShape(I, 'Rectangle', [y_peak - template_size(1,2), x_peak...
    - template_size(1,1), size(t,2), size(t,1)]);
imshow(matched_box_a)
```

```
% for each experiment, display the related search image, template image,
% and matched box
```

(b) Change the template's intensity but leave the images intensity as in (a) then compare the results obtained in (a)

```
new_temp = imadjust(t, [0.4; 0.5]);
norm_correlation2 = normxcorr2(new_temp, I);
[x_peak_b, y_peak_b] = find(norm_correlation2 == max(norm_correlation2(:)))
```

```
x_peak_b = 85
y_peak_b = 170
```

```
new_template_size = size(new_temp)
```

```
new_template_size = 1×2
    26    41
```

```
matched_box_b = insertShape(I, 'Rectangle', [y_peak_b - new_template_size(1,2), x_peak
    - new_template_size(1,1), size(new_temp,2), size(new_temp,1)]);
imshow(matched_box_b)
```

After chanigng the intensity value of the template image, we see no change in the template matching of a gray scale image

(c) Keep the templates intensity the same as in (a) but the image intensity has changed. Compare the results with those obtained in (a) and (b)

```
I_c = imadjust(I, [0.4; 0.5]);
matched_box_c = insertShape(I_c, 'Rectangle', [y_peak - template_size(1,2), x_peak...
    - template_size(1,1), size(t,2), size(t,1)]);
imshow(matched_box_c)
```

After chanigng the intensity value of the image, we see no change in the template matching of a gray scale image

(d) After the intensity of both the image and template have been changed, Compare the results with what was obtained in (a), (b), and (c)

```
matched_box_d = insertShape(I_c, 'Rectangle', [y_peak - new_template_size(1,2), x_peak
    - new_template_size(1,1), size(new_temp,2), size(new_temp,1)]);
imshow(matched_box_d)
```

After chanigng the intensity value of the template and the image, we see no change in the template matching of a gray scale image

(e) Evaluate the effect of rotation on the performance of detection by template matching after the template has been rotated by 90 degrees

```
rotated_t = imrotate(t, 90);
norm_correlation_rotated = normxcorr2(rotated_t, I);
[x_peak_e, y_peak_e] = find(norm_correlation_rotated == max(norm_correlation_rotated(:)
```

```
x_peak_e = 92
y_peak_e = 91
```

```
rotated_template_size = size(rotated_t)
```

```
rotated_template_size = 1×2
    41    26
```

```
matched_box_e = insertShape(I, 'Rectangle', [y_peak_e - rotated_template_size(1,2), x_p
    - rotated_template_size(1,1), size(rotated_t,2), size(rotated_t,1)]);
imshow(matched_box_e)
```

After rotating the template by 90 degrees we see that the template matching algortihm is not as succesful in locating the camera in the image

Problem 2 - binary image matching

```
BW  = zeros(100);
b = strel( 'diamond',3);
b = b.Neighborhood;
R = b;

x = [3, 3, 50, 78, 90 ];
y = [5, 60, 20, 80, 1 ];
for i = 1 : length( x )
    BW(y(i):y(i)+6,x(i):x(i)+6) = b;
end

b = strel( 'square',5);
b = b.Neighborhood;

x = [31, 35, 80, 7, 60, 15, 20, 70 ];
y = [5, 60, 60, 80, 30, 20, 50, 66 ];
for i = 1 : length( x )
    BW(y(i):y(i)+4,x(i):x(i)+4) = b;
end

% now, BW is your search image, R is your reference image

% write your code here

% use cross correlation from problem 1 to find matching, record time
before = cputime
```

```
before = 1.7442e+03
```

```
matching = xcorr2(R, BW);
after = cputime
```

```
after = 1.7443e+03
```

```
time = after - before
```

```
time = 0.0300
```

```
% use chamferMatch() to get the distance transform image Q
Q = chamferMatch(BW,R);
before = cputime;
[x_min, y_min] = find(Q == min(Q(:)))
```

```
x_min = 5×1
     5
    60
    20
    80
     1
y_min = 5×1
     3
```

```
     3
    50
    78
    90
```

```
after = cputime;
% then find the minimum distance in Q, record time
time = after - before
```

```
time = 0.0300
```

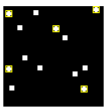
```
% display all the matching using insertShape()
refSize = size(R)
```

```
refSize = 1×2
     7     7
```

```
before1 = cputime;
matching_1 = insertShape(BW, 'Rectangle', [y_min(1,1), x_min(1,1)...
    refSize(1,2), refSize(1,1)]);
imshow(matching_1)
after1 = cputime;
time1 = after1 - before1
```

```
time1 = 0.1200
```

```
matching_2 = insertShape(matching_1, 'Rectangle', [y_min(2,1), x_min(2,1)...
    refSize(1,2), refSize(1,1)]);
imshow(matching_2)
matching_3 = insertShape(matching_2, 'Rectangle', [y_min(3,1), x_min(3,1)...
    refSize(1,2), refSize(1,1)]);
imshow(matching_3)
matching_4 = insertShape(matching_3, 'Rectangle', [y_min(4,1), x_min(4,1)...
    refSize(1,2), refSize(1,1)]);
imshow(matching_4)
matching_5 = insertShape(matching_4, 'Rectangle', [y_min(5,1), x_min(5,1)...
    refSize(1,2), refSize(1,1)]);
imshow(matching_5)
```



```
after = cputime;
time = after-before1
```

```
time = 0.4500
```

The cross correlation and the distance formula took the same amount of CPU time, however, the chamfer matching for each took longer. I learned that the chamfer matching is not as quick as the cross correlation.