

# Detekcja twarzy

Autor: Szymon Tokarz

Data:8.10.2024 r.

## Rezultaty

```
model = createSkinModel('model_skory.bmp');
mesh(model)

figure;imagesc(model);colormap(jet)
figure;imagesc(model2);colormap(jet)
```

```
addpath('BazaObrazow')

testowy = imread('testowy_0_0000.jpeg');
figure, subplot(2,3,1), imshow(testowy);

szary2 = probabilityIM(testowy,model2);
subplot(2,3,2), imshow(szary2,[])
colormap(gray);

level =0.001514
```

```
level = 0.0015

binarny = im2bw(szary2, level);
subplot(2,3,3), imshow(binarny);

se = strel('disk', 6);% dobierz parametry element strukturalnego
zamkniety = imclose(binarny, se);
subplot(2,3,4), imshow(zamkniety);

label1 = bwlabel(zamkniety);
res = regionprops(label1)
```

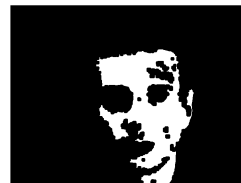
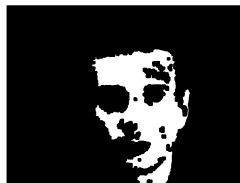
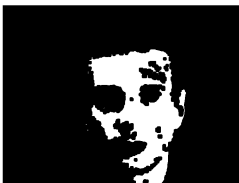
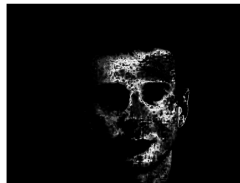
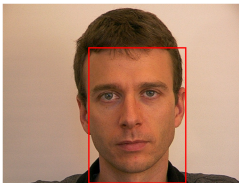
res = 8x1 struct

Field s	Area	Centroid	BoundingBox
1	5	[268.2000,382.8000]	[266.5000,381.5000,3,3]
2	6	[273,401.5000]	[271.5000,400.5000,3,2]
3	8	[274,216.5000]	[273.5000,212.5000,1,8]
4	60662	[442.0212,330.3165]	[276.5000,141.5000,312,435]
5	3	[326,330.6667]	[324.5000,329.5000,3,2]
6	1	[482,218]	[481.5000,217.5000,1,1]

Fields	Area	Centroid	BoundingBox
7	19	[497.6316,217.1053]	[494.5000,215.5000,6,4]
8	1	[502,223]	[501.5000,222.5000,1,1]

```
[res.Area];
wyczyszczony = bwareaopen(zamkniety,400); % dobierz parametry
subplot(2,3,5), imshow(wyczyszczony);

[x1, x2, twarz] = szukaj_twarz(wyczyszczony);
subplot(2,3,6), imshow(twarz);
%dodatkowa wizualizacja
subplot(2,3,1)
pos=[x1(2) x1(1) x2(2)-x1(2) x2(1)-x1(1)];
hold on;rectangle('Position',pos,'EdgeColor','red'); hold off
```



```
%Drugie zdjęcie testowe
testowy = imread('testowy_0_0004.jpeg');
figure, subplot(2,3,1), imshow(testowy);

szary2 = probabilityIM(testowy,model2);
subplot(2,3,2), imshow(szary2,[])
colormap(gray);
```

```
level =0.0012
```

```
level = 0.0012
```

```
binary = im2bw(szary2, level);  
subplot(2,3,3), imshow(binary);
```

```
se = strel('disk', 6);% dobierz parametry element strukturalnego  
zamkniety = imclose(binary, se);  
subplot(2,3,4), imshow(zamkniety);
```

```
label1 = bwlabel(zamkniety);  
res = regionprops(label1)
```

```
res = 65x1 struct
```

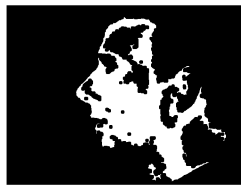
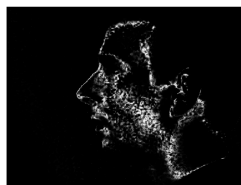
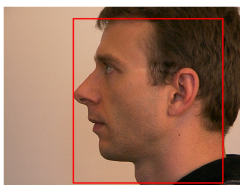
Field s	Area	Centroid	BoundingBox
1	3	[5.6667,115.6667]	[4.5000,114.5000,2,2]
2	1	[15,47]	[14.5000,46.5000,1,1]
3	3	[49.6667,137.6667]	[48.5000,136.5000,2,2]
4	2	[50.5000,242]	[49.5000,241.5000,2,1]
5	10	[62.2000,300.5000]	[60.5000,298.5000,3,4]
6	2	[79,332.5000]	[78.5000,331.5000,1,2]
7	1	[95,302]	[94.5000,301.5000,1,1]
8	11	[107.0909,255.2727]	[103.5000,254.5000,8,2]
9	2	[111,327.5000]	[110.5000,326.5000,1,2]
10	1	[159,495]	[158.5000,494.5000,1,1]
11	6	[159.5000,524]	[158.5000,522.5000,2,3]
12	1	[162,455]	[161.5000,454.5000,1,1]
13	6	[168,431.5000]	[166.5000,430.5000,3,2]
14	3	[169,498]	[167.5000,497.5000,3,1]
15	1	[184,544]	[183.5000,543.5000,1,1]
16	9	[192.1111,492.2222]	[190.5000,488.5000,4,8]
17	2	[191,525.5000]	[190.5000,524.5000,1,2]
18	4	[195.5000,519.5000]	[194.5000,518.5000,2,2]
19	3	[207,447]	[206.5000,445.5000,1,3]
20	3	[207,563]	[206.5000,561.5000,1,3]
21	2	[210.5000,383]	[209.5000,382.5000,2,1]
22	78906	[434.5933,317.9969]	[223.5000,38.5000,481,528]
23	3	[245.3333,533.6667]	[244.5000,532.5000,2,2]

Field s	Area	Centroid	BoundingBox
24	7	[259.7143,339.5714]	[258.5000,337.5000,3,4]
25	2	[264.5000,386]	[263.5000,385.5000,2,1]
26	1	[271,443]	[270.5000,442.5000,1,1]
27	3	[273.6667,503.6667]	[272.5000,502.5000,2,2]
28	2	[287,551.5000]	[286.5000,550.5000,1,2]
29	1	[293,463]	[292.5000,462.5000,1,1]
30	11	[296,524]	[294.5000,519.5000,3,9]
31	2	[302.5000,517.5000]	[301.5000,516.5000,2,2]
32	1	[322,496]	[321.5000,495.5000,1,1]
33	9	[351,459]	[349.5000,457.5000,3,3]
34	21	[357.7619,107.5238]	[356.5000,102.5000,4,9]
35	1	[363,112]	[362.5000,111.5000,1,1]
36	85	[374.3059,89.3882]	[366.5000,80.5000,12,18]
37	39	[380.0513,130.1795]	[376.5000,124.5000,7,10]
38	2	[383,551.5000]	[382.5000,550.5000,1,2]
39	11	[400.1818,512.1818]	[398.5000,510.5000,4,4]
40	68	[409.1618,104.9265]	[400.5000,97.5000,15,15]
41	1	[407,543]	[406.5000,542.5000,1,1]
42	2	[425,81.5000]	[424.5000,80.5000,1,2]
43	1	[428,542]	[427.5000,541.5000,1,1]
44	34	[437.2647,254.5588]	[432.5000,252.5000,10,4]
45	198	[456.4192,463.0657]	[444.5000,455.5000,27,15]
46	629	[472.7711,534.4595]	[454.5000,508.5000,43,54]
47	1	[477,470]	[476.5000,469.5000,1,1]
48	1	[489,224]	[488.5000,223.5000,1,1]
49	7	[504.2857,568.7143]	[502.5000,566.5000,4,4]
50	71	[572.4507,305.3099]	[563.5000,299.5000,15,16]
51	15	[659.8000,498.9333]	[656.5000,497.5000,8,4]
52	1	[666,497]	[665.5000,496.5000,1,1]
53	5	[670,495.4000]	[667.5000,494.5000,5,2]
54	1	[682,491]	[681.5000,490.5000,1,1]
55	58	[698.2414,485.5517]	[687.5000,480.5000,22,9]
56	4	[706.5000,449.5000]	[705.5000,448.5000,2,2]

Fields	Area	Centroid	BoundingBox
57	5	[711.8000,466.8000]	[710.5000,464.5000,2,4]
58	1	[723,399]	[722.5000,398.5000,1,1]
59	2	[737.5000,415]	[736.5000,414.5000,2,1]
60	3	[742.6667,367.6667]	[741.5000,366.5000,2,2]
61	8	[746.1250,362]	[744.5000,359.5000,3,5]
62	2	[748.5000,355.5000]	[747.5000,354.5000,2,2]
63	7	[754.4286,339.7143]	[753.5000,337.5000,2,4]
64	17	[760.9412,16.8824]	[757.5000,14.5000,8,6]
65	6	[767.1667,38.6667]	[766.5000,36.5000,2,5]

```
[res.Area];
wyczyszczony = bwareaopen(zamkniety,400); % dobierz parametry
subplot(2,3,5), imshow(wyczyszczony);

[x1, x2, twarz] = szukaj_twarz(wyczyszczony);
subplot(2,3,6), imshow(twarz);
%dodatkowa wizualizacja
subplot(2,3,1)
pos=[x1(2) x1(1) x2(2)-x1(2) x2(1)-x1(1)];
hold on;rectangle('Position',pos,'EdgeColor','red'); hold off
```



```
%trzecie zdjęcie testowe
testowy = imread('testowy_5_0000.jpeg');
figure, subplot(2,3,1), imshow(testowy);
```

```
szary2 = probabilityIM(testowy,model2);
subplot(2,3,2), imshow(szary2,[])
colormap(gray);
```

```
level =0.0012
```

```
level = 0.0012
```

```
binarny = im2bw(szary2, level);
subplot(2,3,3), imshow(binarny);
```

```
se = strel('disk', 6);% dobierz parametry element strukturalnego
zamkniety = imclose(binarny, se);
subplot(2,3,4), imshow(zamkniety);
```

```
label1 = bwlabel(zamkniety);
res = regionprops(label1)
```

```
res = 129x1 struct
```

Field s	Area	Centroid	BoundingBox
1	8	[693.7500,1.2908e+03]	[691.5000,1.2895e+03,4,3]
2	6	[706,1.2975e+03]	[704.5000,1.2965e+03,3,2]
3	5	[711.4000,1.2932e+03]	[710.5000,1.2915e+03,2,3]
4	651	[747.8740,1.3381e+03]	[712.5000,1.3075e+03,95,72]
5	1	[729,489]	[728.5000,488.5000,1,1]
6	10	[740,417.5000]	[737.5000,416.5000,5,2]
7	5	[741.6000,450.6000]	[740.5000,448.5000,2,4]
8	3	[742.3333,396.6667]	[741.5000,395.5000,2,2]
9	368263	[1.0612e+03,762.8886]	[746.5000,352.5000,638,852]
10	14	[757.7143,1.1736e+03]	[755.5000,1.1715e+03,4,4]
11	4	[767.5000,374.5000]	[766.5000,373.5000,2,2]
12	42	[770.7619,1.1991e+03]	[767.5000,1.1945e+03,7,10]
13	144	[774.3681,1.0932e+03]	[768.5000,1.0825e+03,12,23]
14	1026	[829.7719,1.2591e+03]	[774.5000,1.2075e+03,114,91]
15	1	[776,1124]	[775.5000,1.1235e+03,1,1]

Field s	Area	Centroid	BoundingBox
16	4	[783.5000,346.5000]	[782.5000,345.5000,2,2]
17	2	[786.5000,1238]	[785.5000,1.2375e+03,2,1]
18	13	[792.5385,341.6154]	[790.5000,339.5000,4,4]
19	168	[835.1012,1.3898e+03]	[816.5000,1.3795e+03,35,18]
20	38	[820.8421,1.0722e+03]	[817.5000,1.0625e+03,8,19]
21	7	[826.1429,305.2857]	[824.5000,303.5000,3,3]
22	1	[826,1083]	[825.5000,1.0825e+03,1,1]
23	50	[834.3800,295.8600]	[828.5000,292.5000,11,7]
24	3	[833,1195]	[832.5000,1.1935e+03,1,3]
25	171	[861.8889,272.9708]	[844.5000,264.5000,34,14]
26	5	[847.8000,1.1696e+03]	[846.5000,1.1685e+03,3,2]
27	6	[856.3333,1.1755e+03]	[855.5000,1.1735e+03,2,4]
28	2	[861.5000,292]	[860.5000,291.5000,2,1]
29	75	[869.8667,1.4023e+03]	[862.5000,1.3965e+03,16,10]
30	2	[871,1.1825e+03]	[870.5000,1.1815e+03,1,2]
31	11	[883.1818,1.4075e+03]	[879.5000,1.4065e+03,7,2]
32	5	[886.8000,1.2104e+03]	[885.5000,1.2095e+03,3,2]
33	2	[887.5000,284]	[886.5000,283.5000,2,1]
34	6	[889.6667,259.1667]	[888.5000,257.5000,3,3]
35	41	[898.5122,1.3008e+03]	[891.5000,1.2985e+03,13,4]
36	712	[963.0660,1.4210e+03]	[892.5000,1.4065e+03,136,29]
37	23	[895.7826,1.2031e+03]	[893.5000,1.1955e+03,5,14]
38	1699	[1.0385e+03,1.3220e+03 ]	[910.5000,1.3035e+03,288,33]
39	2	[914,1.2175e+03]	[913.5000,1.2165e+03,1,2]
40	21	[927.3333,271]	[921.5000,268.5000,11,7]
41	1	[926,1221]	[925.5000,1.2205e+03,1,1]
42	4	[927.5000,219.5000]	[926.5000,218.5000,2,2]
43	1	[927,250]	[926.5000,249.5000,1,1]
44	7	[929.2857,1.3934e+03]	[927.5000,1.3925e+03,4,2]
45	126	[949.5397,1.2309e+03]	[937.5000,1.2255e+03,20,12]
46	3	[939,1394]	[937.5000,1.3935e+03,3,1]
47	3	[942,226]	[940.5000,225.5000,3,1]

Field s	Area	Centroid	BoundingBox
48	14	[948.1429,232.9286]	[945.5000,231.5000,5,3]
49	19	[965.7895,1.4018e+03]	[961.5000,1.4005e+03,9,3]
50	1	[964,204]	[963.5000,203.5000,1,1]
51	19	[971.2632,1.2366e+03]	[968.5000,1.2335e+03,5,6]
52	9	[975,297.3333]	[972.5000,296.5000,6,2]
53	13	[984.4615,1.2442e+03]	[982.5000,1.2415e+03,4,5]
54	22	[986.5000,1.4039e+03]	[982.5000,1.4015e+03,8,5]
55	10	[998.2000,207.3000]	[995.5000,205.5000,5,3]
56	46	[1.0020e+03,1.2465e+03 ]	[997.5000,1.2405e+03,8,15]
57	1	[1010,775]	[1.0095e+03,774.5000,1,1]
58	56	[1.0200e+03,1.2542e+03 ]	[1.0165e+03,1.2485e+03,8,11]
59	11	[1.0347e+03,1.2579e+03 ]	[1.0315e+03,1.2565e+03,5,4]
60	33	[1.0412e+03,244.9091]	[1.0345e+03,242.5000,12,4]
61	3	[1.0367e+03,1.4293e+03 ]	[1.0355e+03,1.4285e+03,2,2]
62	13	[1.0484e+03,1.4307e+03 ]	[1.0455e+03,1.4285e+03,5,4]
63	3	[1.0553e+03,243.3333]	[1.0545e+03,242.5000,2,2]
64	13	[1.0592e+03,771.5385]	[1.0555e+03,770.5000,7,2]
65	1	[1058,965]	[1.0575e+03,964.5000,1,1]
66	1	[1059,241]	[1.0585e+03,240.5000,1,1]
67	4	[1.0622e+03,1408]	[1.0605e+03,1.4065e+03,3,3]
68	1	[1064,1432]	[1.0635e+03,1.4315e+03,1,1]
69	8	[1.0725e+03,1270]	[1.0705e+03,1.2685e+03,4,3]
70	73	[1.0842e+03,1.4310e+03 ]	[1.0715e+03,1.4285e+03,26,8]
71	7	[1.0753e+03,1.2561e+03 ]	[1.0745e+03,1.2535e+03,2,5]
72	58	[1.0921e+03,1.2556e+03 ]	[1.0875e+03,1.2495e+03,9,12]
73	43	[1.1022e+03,1.4018e+03 ]	[1.0975e+03,1.3965e+03,9,9]
74	12	[1.1006e+03,1.4376e+03 ]	[1.0985e+03,1.4355e+03,5,4]



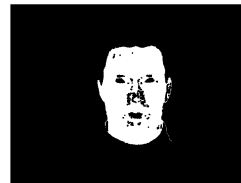
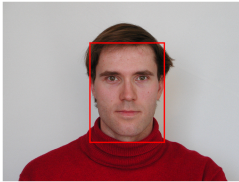
Field s	Area	Centroid	BoundingBox
75	72	[1.1087e+03,1.2551e+03 ]	[1.1045e+03,1.2485e+03,9,14]
76	7	[1.1087e+03,1.4356e+03 ]	[1.1065e+03,1.4345e+03,4,2]
77	10	[1.1151e+03,1.4304e+03]	[1.1125e+03,1.4295e+03,6,2]
78	1	[1115,767]	[1.1145e+03,766.5000,1,1]
79	41	[1.1299e+03,803.5854]	[1.1235e+03,800.5000,13,6]
80	121	[1.1439e+03,1.2470e+03 ]	[1.1235e+03,1.2425e+03,36,9]
81	14	[1131,784.2143]	[1.1275e+03,782.5000,6,3]
82	81	[1.1442e+03,1.4276e+03 ]	[1.1285e+03,1.4225e+03,30,9]
83	1	[1163,1240]	[1.1625e+03,1.2395e+03,1,1]
84	15	[1.1721e+03,1.4207e+03 ]	[1.1685e+03,1.4185e+03,8,4]
85	232	[1.1884e+03,1.2363e+03 ]	[1.1695e+03,1.2265e+03,43,20]
86	5	[1.1836e+03,654.4000]	[1.1825e+03,652.5000,2,4]
87	2	[1191,1.4175e+03]	[1.1905e+03,1.4165e+03,1,2]
88	23	[1.2060e+03,1.4132e+03 ]	[1.2005e+03,1.4115e+03,10,3]
89	1	[1203,1301]	[1.2025e+03,1.3005e+03,1,1]
90	4	[1.2138e+03,1.3012e+03 ]	[1.2125e+03,1.3005e+03,3,2]
91	63	[1.2320e+03,1.2918e+03 ]	[1.2215e+03,1.2865e+03,22,10]
92	11	[1.2237e+03,1.4071e+03 ]	[1.2215e+03,1.4055e+03,5,3]
93	14	[1.2341e+03,1.2182e+03 ]	[1.2315e+03,1.2165e+03,5,4]
94	7	[1.2373e+03,1.4034e+03 ]	[1.2355e+03,1.4025e+03,4,2]
95	1	[1250,1347]	[1.2495e+03,1.3465e+03,1,1]
96	8	[1.2551e+03,1.2822e+03 ]	[1.2535e+03,1.2805e+03,4,4]
97	19	[1267,1.2753e+03]	[1.2635e+03,1.2725e+03,7,5]
98	18	[1.2733e+03,1.3377e+03 ]	[1.2705e+03,1.3355e+03,5,5]
99	44	[1.2802e+03,1.1864e+03 ]	[1.2765e+03,1.1805e+03,6,13]

Field s	Area	Centroid	BoundingBox
100	18	[1282,1.3285e+03]	[1.2775e+03,1.3265e+03,8,4]

⋮

```
[res.Area];
wyczyszczony = bwareaopen(zamkniety,400); % dobierz parametry
subplot(2,3,5), imshow(wyczyszczony);

[x1, x2, twarz] = szukaj_twarz(wyczyszczony);
subplot(2,3,6), imshow(twarz);
%dodatkowa wizualizacja
subplot(2,3,1)
pos=[x1(2) x1(1) x2(2)-x1(2) x2(1)-x1(1)];
hold on;rectangle('Position',pos,'EdgeColor','red'); hold off
```



```
addpath("BazaObrazow")

testowy = imread('testowy_0_0000.jpeg');
faceDetector = vision.CascadeObjectDetector();

bbox = step(faceDetector, testowy)
Out = insertObjectAnnotation(testowy,'rectangle',bbox,'Twarz');
figure, imshow(Out), title('Wykryta twarz');
```

```

files = dir('BazaObrazow');

brak_detekcji=0;
detekcja=0;

for i=4:numel(files);
    nazw_pliku=files(i).name;
    testowy = imread(nazw_pliku);
    faceDetector = vision.CascadeObjectDetector();

    bbox = step(faceDetector, testowy)
    Out = insertObjectAnnotation(testowy,'rectangle',bbox,'Twarz');
    figure, imshow(Out), title('Wykryta twarz');

end
%za dużo jest obrazów tutaj żeby je wyświetlić

```

Program szukaj\_twarzy.m raczej dobrze wyszukuje twarz tylko robi to z szyją. Daje radę nawet z zdjęciami z bocznego profilu, gdzie gotowy program matlaba nie daje rady.

Przy programie wykorzystującym kaskady Haara nie udało się wykryć twarzy na żadnym zdjęciu z profilu. W pozostałych przypadkach detekcja się udała i dopasowanie było lepsze niż przy użyciu szukaj\_twarz.m.

## Analiza i wnioski

Etapy wyznaczenia koloru skóry

1. konwersja z RGB na YCbCr
2. dobranie progów Cb i Cr
3. obliczenie średniej i macierzy kowariancji
4. wyznaczenie funkcji gęstości

Operacja zamknięcia służy do usunięcia ,lub jeżeli to jest niemożliwe, wygładzenia dziur w obrazie. Składa się z dylatacji i erozji morfologicznej.

Użyci kaskad Haara świetnie sprawdza się przy zdjęciach frontalnych, daje dalej dobre wyniki przy zdjęciach z pół-profilu, a przy obrazach wykonanych z boku nie daje sobie rady.

## Pytania

Metody detekcji twarzy:

1. PCA
2. ICA
3. LDA
4. EP
5. EBGM

## 6. metody kernela

Metoda detekcji twarzy z wykorzystaniem kaskad Haara opiera się na zastosowaniu serii klasyfikatorów, które wykrywają cechy charakterystyczne. Proces ten wykorzystuje uczenie maszynowe, w którym kaskada jest trenowana na dużej liczbie obrazów zawierających twarze (przykłady pozytywne) oraz bez twarzy (przykłady negatywne). Kluczowym elementem tej metody jest wcześniejsze wyodrębnienie istotnych cech z obrazu.