

()

.()

Face Detection In Color Images

Najim Abd-Allah
Ass. Lec.

Dr. Manar Younis
Ass. Prof

Abstract

The aim of this study is face detection in colored images (single or multiple faces) where an algorithm based on skin color information, in addition to face features like eyes and mouth, are used. The study deals with the effect of colored images type in test where (jpg, jpeg) images are used. Different images of persons were obtained from the internet and different images background and their effect on face detection within the image are studied. Two groups of colored images, photographic images taken by a photographic camera and digital images taken by a digital camera are also studied. A comparison between the results of the two groups concerning face detection is made. This comparison is based on the face orientation angle for each image in the two groups using the frontal and side (right, left) template.

(pugalia) (prieto) (Kim)

(image-based) (feature-based)

(morphological)

[12]

2002 (EE 368 group 23)

2002 (Deshwal) (Shankar) .[9]

(SVM) (BP)

(Gupte) (Xie) . [18] (BP) (SVM)

2002 (Tang)

2003 .[22]

(Mar) (Ahmed) (Mohsin)

. [14] 164 160

(Abde-Mottaled) (Jain) (Lien)

(Leahy) . [11]

2003

[13]

(Sandeep) (Rajagopalan)

()

[17]

()

(Torrest) (Delp) (Albiol)

[3]

(Nakatsu) (Ohya) (kawato) (Tang)

(Division Curve)

[19]

:

:

:

. [1]

Images Matching (مواصفة الصور)

. [10]

Cross)

(Correlation

. [1]

(Feature based methods)

. [1] (Intensitybased methods)

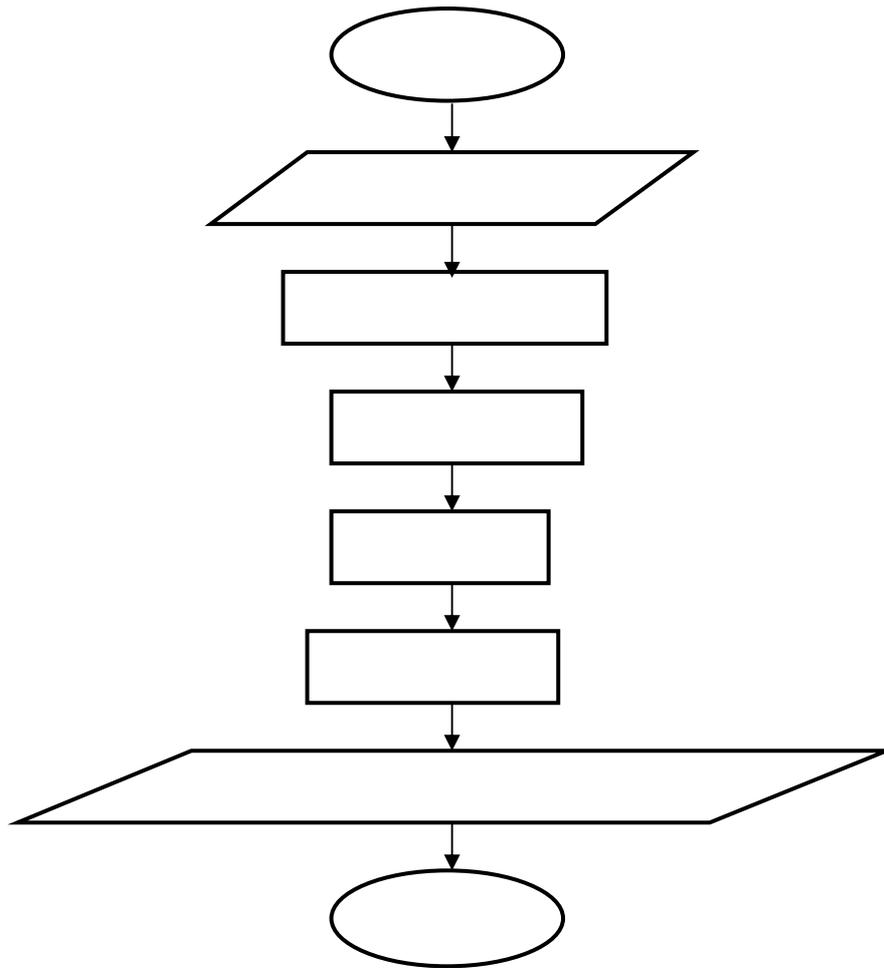
: Features based method

. [1]

: Intensity based method

. [1]

: (1)



(1)

Skin Color Model

[15,8]

[2]

()

(**Luminance**)

[8]

(**Pure Color**)

[5,3] (**Normalization**)

$$r = \frac{R}{R + G + B} \dots\dots\dots (1)$$

$$g = \frac{G}{R + G + B} \dots\dots\dots (2)$$

$$b = \frac{B}{R + G + B} \dots\dots\dots (3)$$

$$r + g + b = 1 \dots\dots\dots (4)$$

(R,G,B)

(r,g,b)

. [21]

. [5] (2)

(Noise)

. [20] (5)

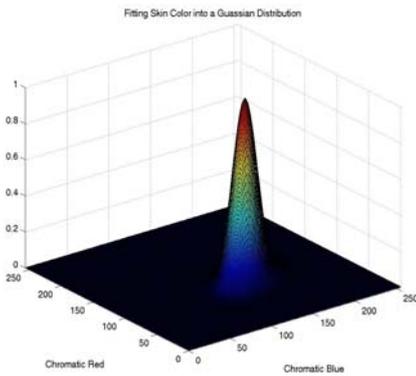
$$h = \frac{1}{9} \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \dots\dots\dots (5)$$

b r

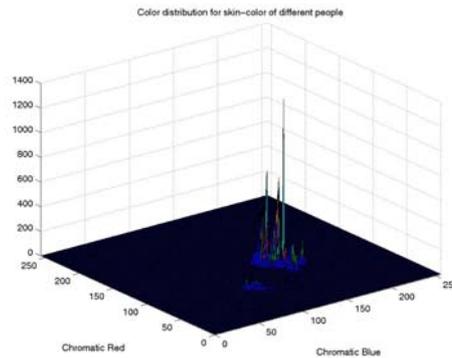
(Covariance)

(Mean)

-: [12 8] (7) (6)



Gaussian (3)



(2)

$$\text{Mean} : m = E \{x\} \dots\dots\dots (6)$$

$$x = (\mathbf{r} , \mathbf{b})^T$$

$$\text{Covariance: } C = E \left\{ (x - m)(x - m)^T \right\} \dots\dots\dots (7)$$

(Gaussian)

. (3)

[8] N (m , c)

-: [16 2] (likelihood)

$$P(r, b) = \exp[-0.5(x - m)^T C^{-1} (x - m)] \dots\dots\dots (8)$$

(4) . [8]



(4)



(Threshold)

. [16]

Skin segmentation

.(8)

)

(4)

(

. [13,4]

[9,6] (Threshold)

. [16]

(Optimal threshold)

[17]

[8]

Skin Regions

(1)

(0)

[7]

()

()



(7)



()

()

(8) . ()

()

(8)

(Euler)

[6](9)

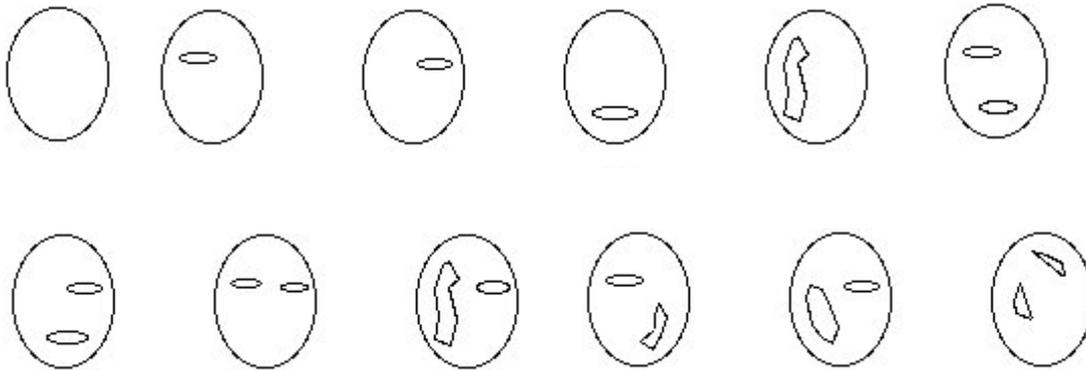
$$E = C - H \dots\dots\dots(9)$$

-:

: E

: C

: H



() (8)

: (C=1)

$$H = 1 - E \dots \dots \dots (10)$$

-:

$$- \infty \leq E \leq 1$$

: E

: [8](12) (11)

$$\bar{x} = \frac{1}{A} \sum_{i=1}^n \sum_{j=1}^m jB [i, j] \dots \dots \dots (11)$$

$$\bar{y} = \frac{1}{A} \sum_{i=1}^n \sum_{j=1}^m iB [i, j] \dots \dots \dots (12)$$

-:

()

: A

[n*m]

: B

. (Center)

Orientation

()

: [16]

$$a = \sum_{i=1}^n \sum_{j=1}^m (x'_{ij})^2 B[i, j] \dots \dots \dots (13)$$

$$b = 2 \sum_{i=1}^n \sum_{j=1}^m x'_{ij} y'_{ij} B[i, j] \dots \dots \dots (14)$$

$$c = \sum_{i=1}^n \sum_{j=1}^m (y'_{ij})^2 B[i, j] \dots \dots \dots (15)$$

$$x' = x - \bar{x} \dots \dots \dots (16)$$

$$y' = y - \bar{y} \dots \dots \dots (17)$$

-:

$$\theta = \frac{1}{2} \text{atan} \frac{b}{a - c} \dots \dots \dots (18)$$

(θ)

.(Orientation

()

. [16]

Ratio

: [8] (19)

$$\text{Ratio}(R) = \frac{\text{Height}(Hy)}{\text{Width}(Wx)} \dots \dots \dots (19)$$

. (1)

Template Face

()

. [16]

(9) .



(9)

Template Matching ()

. (10)



()

() (10)
()

:-

.1

. (11)



(11)

(12)

.2

(θ)

.3

(Crop)

. (11)

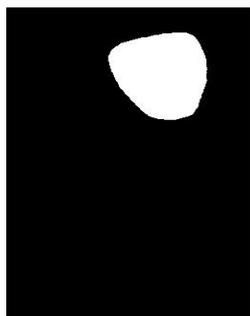
. (3)

.4

.5

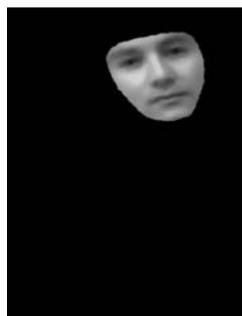
. (13)

. (12) (11)



(13)

(14)



(13)

(Cross Correlation)

.6

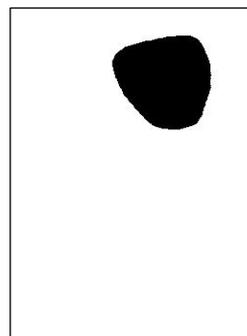
(13)

. (14)

(14)

.7

. (16)



(14)

(15)

(13)

.8

. (14)

.9

. [24] [12] (16)



Phahmad 7



Phahmad 6



Phahmad 5
(- 29)



Phahmad 4



Phahmad 3



Phahmad 2



Phahmad 1



Phahmad 7



Phahmad 6



Phahmad 5

(- 29)



Phahmad 4



Phahmad 3



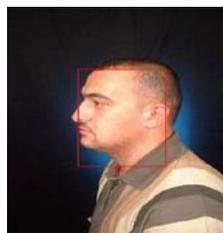
Phahmad 2



Phahmad 1



Phahmad 7



Phahmad 6



Phahmad 5

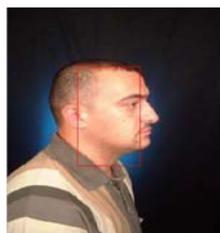
(- 29)



Phahmad 4



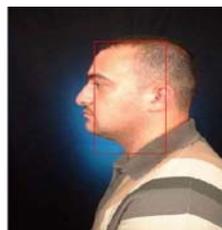
Phahmad 3



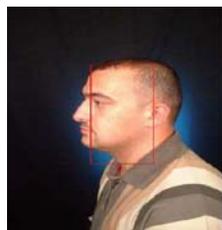
Phahmad 2



Phahmad 1



Phahmad 7



Phahmad 6



Phahmad 5

(- 29)

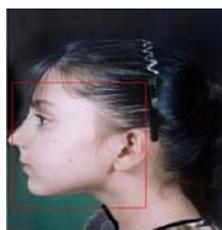


Phnora 7



Phnora 2

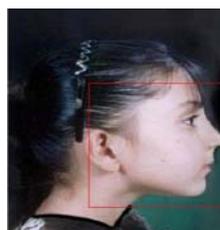
(-30)



Phnora 7



Phnora 2



Phnora 1

(-30)



Phnora 7



Phnora 2

(- 30)



Phnora 7

Phnora 2

Phnora 1

(- 30)

Phahmad.jpg

(3)

الزاوية	أسم الصورة	قالب وجه جانبي					قالب وجه أمامي				
		ccorr	Rect Coord				ccorr	Rect Coord			
0	Phahmad1	0.75	61	70	160	235	0.82	41	53	207	255
30	Phahmad2	0.73	57	61	166	274	0.81	35	48	222	291
60	Phahmad3	0.65	103	59	92	186	0.76	84	66	125	185
90	Phahmad4	-	-	-	-	-	0.65	82	82	122	178
120	Phahmad5	0.52	91	66	86	174	0.62	77	73	118	171
150	Phahmad6	0.57	62	62	92	184	0.67	52	69	124	184
180	Phahmad7	0.62	29	90	160	227	0.68	15	80	202	237

Diahmad.jpg

(4)

الزاوية	أسم الصورة	قالب وجه جانبي					قالب وجه أمامي				
		ccorr	Rect Coord				ccorr	Rect Coord			
0	Diahmad1	0.78	82	63	98	195	0.85	64	67	133	197
30	Diahmad2	0.76	98	105	86	174	0.87	83	108	118	175
60	Diahmad3	0.64	95	99	103	185	0.71	70	109	141	184
90	Diahmad4	-	-	-	-	-	0.80	106	111	108	160
120	Diahmad5	0.65	102	99	103	185	0.71	91	102	139	193
150	Diahmad6	0.75	116	104	86	174	0.86	100	111	120	170
180	Diahmad7	0.78	120	63	98	187	0.85	104	71	135	194

Phnora.jpg

(5)

الزاوية	أسم الصورة	قالب وجه جانبي					قالب وجه أمامي				
		ccorr	Rect Coord				ccorr	Rect Coord			
0	Phnora1	0.68	112	128	184	212	0.73	93	104	220	238
30	Phnora2	0.69	54	138	205	249	0.68	30	112	250	278
60	Phnora3	0.72	74	137	140	164	0.75	40	130	183	183
0	Phnora4	-	-	-	-	-	0.79	46	119	173	251
120	Phnora5	0.71	53	118	144	204	0.77	34	118	198	216
150	Phnora6	0.67	18	107	199	273	0.60	18	92	250	287
180	Phnora7	0.66	8	128	183	215	0.62	17	109	220	233

Dinora.jpg

(6)

الزاوية	أسم الصورة	قالب وجه جانبي					قالب وجه أمامي				
		ccorr	Rect Coord				ccorr	Rect Coord			
0	Dinora1	0.78	79	122	140	189	0.83	62	107	176	207
30	Dinora2	0.73	91	137	148	158	0.74	78	117	172	180
60	Dinora3	0.80	105	131	105	174	0.82	90	122	141	185
90	Dinora4	-	-	-	-	-	0.88	100	124	118	169
120	Dinora5	0.79	94	111	98	190	0.87	71	116	138	187
150	Dinora6	0.78	87	119	113	195	0.83	61	118	154	196
180	Dinora7	0.76	83	121	139	190	0.82	61	111	175	200

.1

(0.6)

. (0.82) (0.44)

. (0.7) (0.1) (Optimal threshold) .2

.3

.4

(4) (3) ()

(6) (5)

.5

" (2003) .1

2. .Al-aqrabawi M., Du F. , (11/3/2000), "Human Skin Detection using Color Segmentation" , Term Project ECPE 5554 .

<https://courseware.vt.edu/users/abbott/5554/SkinReport.pdf>

3. Albiol A. , Torrest L. , Delp J. Edward , "An Unsupervised Color Image Segmentation Algorithm for Face Detection Applications",
Email : albiol@dcom.upv.es

4. Arentz W. Archer, (31/10/2003), "Segmentation of Skin", TDT4270 Bayesian skin bildeanalyse, NTNU,
Email : Willa@idi.ntnu.no .

5. Caetano T.S., Barone D.A.C., "A Probabilistic Model for the Human Skin Color" .

[Email : { caetano,barone }@inf.ufrgs.br.](mailto:caetano,barone@inf.ufrgs.br)

6. Cai J., Goshtasby A., Yu C., (1998) , “Detecting Human Faces in Color Images” Write state University, University of Illinois.

E-mail: arthur.goshtasby@wright.edu

7. Carmen N. , Pun T. , (May 2002) , “ Statistical Approach to a Color –based Face Detection Algorithm” , EE368 Digital Image Processing.

[WWW.ise.stanford.edu/2002projects/ee368/Project/slides/ee368_group_15.ppt.](http://WWW.ise.stanford.edu/2002projects/ee368/Project/slides/ee368_group_15.ppt)

8. Chang H., Robles U., (May 2000), “ Face Detection ”

[http://WWW-cs-students.stanford.edu.](http://WWW-cs-students.stanford.edu)

9. EE368 Final Project, Lee J., Chu A., (2002) , “Face Detection”,

[WWW.ise.stanford.edu/2002projects/ee368/project/reports/ee368_group_23.pdf.](http://WWW.ise.stanford.edu/2002projects/ee368/project/reports/ee368_group_23.pdf)

10. Girdziusas, R., Laaksonen, J., (2001) , “ Neural Network Approach To Non – Rigid Image Matching ”, Laboratory of Computer and Information Science, Helisinki University of Technology,

[Email : Ramunas Girdziusas@hut.fi.Jornal.](mailto:Ramunas.Girdziusas@hut.fi)

11. Hsu R., Abdel-Mottaleb M., Jain K. Anil, (2002) , “ Face Detection in Color Images ”,

[Email : {hsureinl,Jain}@cse.msu.edu.](mailto:hsureinl,Jain@cse.msu.edu)

[mohamed.abdel-mottaleb@philips.com.](mailto:mohamed.abdel-mottaleb@philips.com)

12. Kim S., Prieto R., Pugalia A., “ Face Detection in color Images” .

[WWW.ise.stanford.edu/2002projects/ee368/project/reports/ee36_group_10.pdf.](http://WWW.ise.stanford.edu/2002projects/ee368/project/reports/ee36_group_10.pdf)

13. Leahy S. ,(spring 2003),“Face Detection on Similar Color Photographs”, EE368:Digital Image Processing, Stanford University.

14. Padilla M., Fan Z., (2003) , “EE368 Digital Image Processing Project – Automatic Face Detection Using Color Based Segmentation and Template / Energy Thresholding” Group 16,Department of Electrical Engineering, Stanford University,

[Email : mtp@stanford.edu.](mailto:mtp@stanford.edu)

[Email : zihongf@stanford.edu.](mailto:zihongf@stanford.edu)

15. Phung S. Lam, Chai D. , Bouzerdoum A. , (2003) , “Adaptive Skin Segmentation In color Images ” , School of Engineering and Mathematics – Edith Cowan University , Perth , Australia .

16. Rademacher D., (December 2001), “ Face Detection” Colorado School of Mines, Introduction to Computer Vision and Image processing EGGN 498c.

17. Sandeep K., Rajagopalan A. N., “Human Face Detection in Cluttered Color Images Using Skin Color and Edge Information ” ,

[Email : Sandeepkanumuri@yahoo.co.in.](mailto:Sandeepkanumuri@yahoo.co.in)

18. Shanker A., Deshwal P., (April 2002) , “Face Detection in images: Neural networks & Support Vector Machines”.

[Email : Asim@Cse.iitk.ac.in.](mailto:Asim@Cse.iitk.ac.in)

19. Tang J., Kawato S., Ohya J., Nakatsu R., “ Locating Human Face in a Complex Background Including Non – face Skin Colors” ,

[Email : {Stang,skawato,ohya,nakatsu}@mic.atr.co.jp](mailto:{Stang,skawato,ohya,nakatsu}@mic.atr.co.jp).

20. Tseng Yu. C., “Human Face Tracker System” ,
WWW.ece.sunysb.edu/~cvI/ese558/sp2002.
21. Vezhnevets V. , Sazonov V. , Andreeva A., “A survey on Pixel – Based Skin Color Detection Techniques , ” , Graphics and Media Laboratory , Faculty of Computational Mathematics and Cybernetics , Moscow State University Moscow , Russia .
22. Xie G., Gupta A., Tang J., (May 2002), “ Integration of Segmentation and Template Matching in Face Detection”, Department of Electrical Engineering, Stanford University.