International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Research Article

Frontal Enhanced Face Detection using Skin Pixels and ANN

Ankit Goswami†* and Ashutosh Datar‡

†Dept. of Electronic and Communication Engineering, SATI (Engg. College), Vidisha (M.P.), India
‡Dept. of Biomedical Engineering, SATI (Engg. College), Vidisha (M.P.), India

Accepted 28 Dec 2015, Available online 01 Jan 2016, **Vol.6, No.1 (Feb 2016)**

Abstract

With the growth of internet visual data like images, have attracted many researchers for searching the face in images from the collection. This paper focuses on the face detection of images by utilizing the visual features. Here Skin probability map is created for skin pixels. Skin pixels searching are done on the basis of passing image from the trained neural network and geometrical feature utilization. Experiment is done on standard and artificial dataset. Results show that proposed work is better for single as well as multi-face detection in given image.

Keywords: *Digital Image Processing, Information Extraction, face Detection, feature extraction.*

1. Introduction

Over the past few years, face detection has been thoroughly studied in computer vision research for mainly two reasons- First; face detection has a number of interesting applications: It can be part of a face recognition system, a surveillance system, or a video-based computer/machine interface. Second, faces form a class of visually similar objects which simplifies the generally difficult task of object detection.

Most of the past research works on face detection focused on detecting frontal faces thus leaving out the problem of pose invariance. Although there is still some space for improvement on frontal face detection, the key issue of current and future research seems to be pose invariance.

There are two interesting ideas behind part- or component-based detection of objects. First, some objects classes can be described well by a few Characteristic object parts (Haralick *et al*, 1992) and their geometrical relation. Second, the patterns of some object parts might vary less under pose changes than the pattern belonging to the whole object. The two main problems of a component-based approach are how to choose the set of discriminatory object parts and how to model their geometrical configuration. The above mentioned approaches either manually define a set of components and model their geometrical configuration or uniformly partition the image into components and assume statistical independence between the components. In our system we started with a manually defined set of facial components and a simple geometrical model acquired from the training set. In a further step we developed a technique for automatically extracting discriminatory object parts using a database of 3-D head models.

2. Related Work

A robust face detection technique which is based on skin color and geometric feature. The Accuracy of proposed method is 95% (Verma *et al*, 2014).The survey of face detection (Hjelm, 2001). They also presented some approaches like neural network. A model which is based on statistical data in different color space. That model also adapts itself with runtime condition (Alizadeh *et.al*, 2011). The LBP histograms extracted from each sub-region are then concatenated into a single, spatially enhanced feature histogram. The extracted feature histogram describes the local texture and global shape of face images (Kukenys, 2008). Support vector machine (SVM) for detection of human face is trained in a difference space that explicitly captures the dissimilarity between two facial images hence retiring a binary value, the class of the object. An Algorithm that deals with shortcoming very efficiently developed Adaboost classifier for face detection(Lu, 2003). It included implementation of a system that used such features would provide a feature set that was far too large, Hence the feature set must be only restricted to a small number of critical features which is achieved by boosting algorithm(Talele *et al*, 2012). Human face recognition from the large datasets which contain one image per person (Wiskott *et al*, 1997).An approach for detection and identification of human faces where face space treated as Eigen face (Turk, 1991).The Performance of histogram and mixture models in skin detection and find histogram models to be excellent in accuracy and computational cost (Jones,

*Corresponding author **Ankit Goswami; Dr. Ashutosh Datar** is working as HOD

1999). Detection framework which having higher detection rate (Viola, 2004).Neural Network approach for face recognition. They presented hybrid neural network solution. That model capable of rapid classification requires only fast approximate normalization and preprocessing, and consistently exhibits better classification performance than the Eigen faces (Lawrence et.al, 1997).Face detection with local binary pattern (LBP). The original LBP operator labels the pixels of an image by thresholding the 3-by-3 neighborhood of each pixel with the center pixel value and considering the result as a binary number. Each face image can be considered as compositions of micro-patterns which can be effectively detected by the LBP operate Adaboost (Ahonen, 2006).A new distinctive feature, called joint Haar-like feature, for detecting faces in images. This is based on co-occurrence of multiple Haar-like features, that provide a number of benefits like sort of ad-hoc domain knowledge, speed etc (Mita, 2005).

3. Background

As Image is collection of pixels and each pixel is treated as single value which is a kind cell in a matrices. In order to identify an object in that image some features need to be maintained as different object have different feature to identify.

Color feature: The stored pixel values represent the color intensity at that point in an image. Because of the various image formats, pixel values are different for the same image. This can be understand as in RGB model, three matrix of same image are prepare for Red, Green, Blue matrix range of any pixel value is between 0-1. While in the case of the gray format it is of single matrix range of any pixel value is between 0-255.

4. Proposed Work

In Proposed work, Image containing the facial details are read and the pixels are created in matrix form.

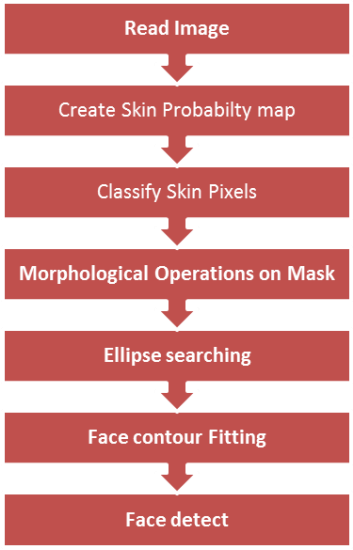


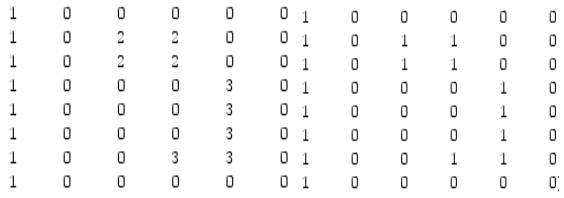
Fig.1 Block diagram of proposed model

Further the Skin probability map (SPM). Here, the mapping of image is done on the basis of some selected pixel values corresponding to skin color. For creating a map, training of an artificial neural network is done. In this training, fixed size of pixel number is passed as the identifier of skin color pixels so that network gets trained of the skin color pixel value. A multilayer perceptron with feed forward error back propagation algorithm is used for training.

A trained neural network is then tested with some more inputs and known output to ascertain its accuracy. The trained neural network is further utilized for the filtration of test image in two parts. First is skin part and other is non-skin part. As neural network is trained by that pixel combination which identifies skin color part, so output will be positive value (1) for skin color pixel and negative value (0) for the non-skin color pixel.

Fig.2 Image after classification

Morphological Operations on Mask: Binary Image obtained from neural network undergoes Morphological Operations. The image is divided into blocks where each block is identifying on the basis of the connectivity between pixel values. This can be understood as:



(A) (B)

Fig.3 Morphological mapping of the mapping into three groups

Thus image having connected skin color pixel is considered as the single block. Each block is then analyzed for the face identification.

The selected blocks are evaluated for the elliptical shape, resembling face outlier. Here few of centre pixels of blocks are considered as ellipse centre then

tried to locate that ellipse in block. If ellipse is found then it is considered as the face region in the image. So in similar fashion whole image blocks are passed and analysed.

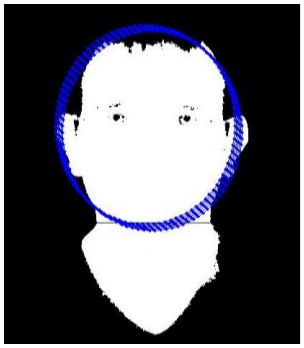


Fig.4 Ellipse region in the connected block of image

This can be understand as, let X be a ellipse of face F_i and Y be the ellipse of same face F_i from then distance can be calculate as:

$$D = \sqrt{\sum((X - Y)^2)} \quad (1)$$

Proposed Algorithm

Input: I, SM // I: Image, SM: Skin Matrix
Output: FI // FI: Face Detect Image

1. I←Read Image(I)
2. TN←Train Neural network(SM) // TN: Trained Neural Network
3. BI←Test Neural Network(TN) // BI: Binary Image
4. BB[n] ←Morphology(BI)
5. Loop 1:n
6. If Ellipse(BB[n])
7. FI[m]←Plot Circle(BB[n])//m :number of ellipse
8. End If
9. End Loop
10. Loop 1:m
11. Loop 1:m'
12. FIT←Euclidean distance(FI[m], FI[m'])
13. End Loop
14. End Loop

5. Result and Analysis

In this section, first experimental settings are introduced, and then present the experimental results that validate the effectiveness of the approach. This work is also compared with other existing methods. All algorithms and utility measures were implemented using the Math works MATLAB. The tests were performed on 2.27 GHz Intel Core i3 machine, equipped with 4 GB of RAM, and running under Windows 7 Professional.

5.1 Evaluation Parameter

To test outcomes of the work, following evaluation parameter such as Precision, Recall and F-score are used.

$$\text{Precision} = \frac{TP}{(TP + FP)} \quad (2)$$

$$\text{Recall} = \frac{TP}{(TP + TN)} \quad (3)$$

$$F - \text{score} = \frac{2 * \text{Precision} * \text{Recall}}{(\text{Precision} + \text{Recall})} \quad (4)$$

Where TP: True Positive
TN: True Negative
FP: False Positive

5.2 Data Sets

Face detection is done on the standard test images such as Lena, pirate, etc. as well as on the artificial images. The experiment is carried out on images containing single face as well as multiple faces. So for experiment total 100 images are taken for single face and 20 images are taken for multi-face detection.

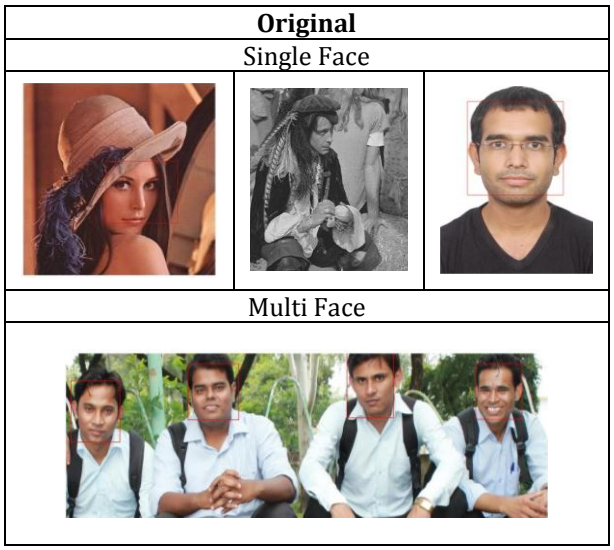


Fig.5 Ellipse region in the connected block of image

Results are compared with the previous work:

Table 1 Comparison results of previous work with proposed work for single face detection

Single Face		
	Previous [verma,2014]	Proposed Work
TP	46	48
TN	38	40
FP	04	02
FN	12	10

Table 2 Comparison results of previous work with proposed work for Multi face detection

Multi Face		
	Previous [verma,2014]	Proposed Work
TP	08	09
TN	07	08
FP	02	01
FN	03	02

Table 3 Comparison results of previous work with proposed work for single face detection

Values	Previous [verma,2014]	Proposed
Precision	0.92	0.96
Recall	0.55	0.54
F-Measure	0.688	0.6912

Table 4 Comparison results of previous work with proposed work for Multi face detection

Values	Previous [verma,2014]	Proposed
Precision	0.8	0.9
Recall	0.533	0.529
F-Measure	0.639	0.669

It has been observed by table 4 & 5 that face detection of proposed work is better as compared to previous one, as precision, f-measure value is higher. It is also observed that as the number of the faces increases, then the right face detection instances decreases. However, the may further be improved by increasing neural network training sessions with larger image datasets.

Conclusions

This research work proposes an improvised system to evaluate the face detection and recognition methods. Proposed work utilize artificial neural network for distinguish of image into skin and non-skin area. This mapping play important role. Then ellipse searching help in finding a single as well as multi-face reorganization. Results show that proposed work is better as compared to previous methods.

The next logical step is to cover a larger range of pose changes by training the component classifiers on rotated faces. Another promising topic for further research is developing geometrical model of the face by adding the image locations of the detected components to the input features of the geometrical configuration classifier.

References

Haralick, Robert M., Linda G. Shapiro (1992), Computer and Robot Vision, Addison-Wesley, 1, pp. 28-48.

Alok Verma, S Achyut Raj, Abhishek Midya, Jayasree Chakraborty (2014), Face Detection using Skin Color Modeling and Geometric Feature, 3rd International Conference on Informatics, Electronics & Vision(ICIEV), pp. 1-6.

Erik Hjelm as, B. K. Low (2001), Face detection: A survey, Computer Vision and Image Understanding, 83(3), pp. 236 – 274.

Fattah Alizadeh, Saeed Nalousi, Chiman Savari (2011),Face Detection in Color Images using Color Features of Skin, World Academy of Science Engineering and Technology,5(4), pp. 366-372.

I. Kukenys, B. McCane (2008), Support Vector Machines for Human Face Detection, Proceedings of the New Zealand Computer Science Research Student Conference, pp. 226-229.

J Lu, K. N. Plataniotis, A. N. Venetsanopoulos(2013), Face recognition using LDA-based algorithms, IEEE Neural Networks Transaction, 14(1), pp. 195–200.

K. T. Talele, S. Kadam, A. Tikare (2010), Efficient Face Detection using Adaboost, IJCA Proc on International Conference in Computational Intelligence(ICCIA'12), 10.

L. Wiskott, M. Fellous, N. Krger, C. Malsburg (1997), Face recognition by elastic bunch graph matching, IEEE Trans, on PAMI, 19, pp. 775–779.

M. A. Turk, A.P. Pentland (1991), Face recognition using Eigen faces, Proceedings of the IEEE (CVPR'91), pp. 586-591.

M. J. Jones, J. M. Rehg (1999), Statistical color models with Application to skin detection, Computer Vision and Pattern Recognition, 46(1), pp. 81-96.

P. Viola, M. Jones (2004), Robust real-time face detection," International Journal of Computer Vision, 57(2), pp. 137–154.

Steve Awrence, C. Lee Giles, Ah Chung Tsoi , Andrew D. Back, (1997), Face Recognition: A Convolutional Neural-Network Approach, IEEE transactions on neural network, 8(1), pp. 98-113. T. Ahonen, A. Hadid, M. Peitikainen (2006), Face recognition with local binary patterns, In Proc. of European Conference of Computer Vision, pp. 1-15.

T. Mita, T. Kaneko, O. Hori (2005), Joint Haar-like Features for Face Detectio, Proceedings of the Tenth IEEE International Conference on Computer Vision (ICCV'05), 2, pp. 1619-1626.