Face Detection with methods based on color by using Artificial Neural Network

Reza Abbasgolizadeh[1], HabibIzadkhah[2],Ramin Meshkabadi[1]
[1]Department of Electrical Engineering, Ahar Branch, Islamic Azad University, Ahar, Iran.
[2]Department of Computer Sciences,Faculty of MathematicalSciences , University of Tabriz, Tabriz, Iran.
Email: abbasgholizadeh.reza@gmail.com (Corresponding author)

Abstract

The face Detection methodsis used in order to provide security. The mentioned methods problems are that it cannot be categorized because of the great differences and varieties in the face of individuals. In this paper, face Detection methods has been presented for overcoming upon these problems based on skin color datum. The researcher gathered a face database of 30 individuals consisting of over 450 facial images to test fully automated face detection without verification, fully automated face detection with verification, manual face detection and automated face recognition, fully automated face detection and recognition and pose invariant face recognition. Successful results were obtained for automated face detection and for automated face recognition under robust conditions. In presented method, Scratch using Gaussian filter and morphology processing of the face areawould be selected and more complex neural network has been trained with over 200 images and totally, Three different sets of various images have been studied in terms of appearance number and lighting and quality. The experimental results showed the reliability of this method. In fact, by offering face recognition algorithm with color by artificial neural network is able to identify different types of faces. The accurateness of the proposed method would be more than 95 percent.

Keywords: artificial neural network, face detection, skin color, Gaussian filter

1. Introduction

In recent years, face recognition has attracted much attention and its research has rapidly expanded by not only engineers but also neuroscientists, since it has many potential applications in computer vision communication and automatic access control system. Especially, face detection is an important part of face recognition as the first step of automatic face recognition. However, face detection is not straightforward because it has lots of variations of image appearance, such as pose variation (front, non-front), occlusion, image orientation, illuminating condition and facial expression. Many novel methods have been proposed to resolve each variation listed above. For example, the template-matching methods are used for face localization and detection by computing the correlation of an input image to a standard face pattern. Fortunately, the images used in this project have some degree of uniformity thus the detection algorithm can be simpler: first, the all the faces are vertical and have frontal view; second, they are under almost the same illuminate condition. This project presents a face detection technique mainly based on the color segmentation, image segmentation and template matching methods.

Neural network systems and computational methods are the complex systems machine learning, knowledge representation, and finally applying the

knowledge obtained to predict the output response. The main ideas of these networks inspired by the way biological nervous system function for processing data, and data in order to learn and create knowledge. Nowadays, Neural networks has been used in numerous applications such as pattern recognition problems, which includes issues such as the recognition, speech recognition, image processing and such as these issues and the issues such as classifying text or image classification. In control or the modeling of the system, having unknown or complex structure also the artificial neural networks is applied.

Detection of skin color in color images is a very popular and useful technique for face detection. Many techniques [12], [13] have reported for locating skin color regions in the input image. While the input color image is typically in the RGB format, these techniques usually use color components in the color space, such as the HSV or YIQ formats. That is because RGB components are subject to the lighting conditions thus the face detection may fail if the lighting condition changes. Among many color spaces, this project used YCbCr components since it is one of existing Matlab functions thus would save the computation time.

Also detection of face has many applications in images in monitoring to human-computer interaction and the face plays more important role in individual identifying in society level. The faces detection ability of human is considerable. Face detection is a key issue in applications such as security systems and identified. Here a question is to what extent has the ability to measure the characteristics of the project and which face features for face recognition is detectable by humans[1],[2],[3].

Face Detection provides sabbatical research that scientists and engineers will challenge for the next few years. For example, creating a powerful face detection system can be used in projects linked to national security, human-computer interaction and many other items. The human visual system allocates to perceive the faces of some specialized neural resources. Responding time to face (face recognition) in the temporal cortex Infra is about 120 milliseconds and exhibits the type of Feedback process forward[4],[5]

1-1 Problem Statement and theory

In recent years a lot of attention has been provided in research areas related to biometric facial recognition, pattern recognition and computer vision. Also in some commercial applications and security procedures has been used for face recognition. These include control individuals security, access control, identification of criminals (eg for passport control), reconstruct the face of interfacing between humans and computers. Face detection methods can be divided in three categories:

1. The methods that consider the characteristics of the face.
2. The methods are based on the model are considered texture and characteristics of the face part.
3. The combination methods use both of them.

In this study, it has been done to explore faces in color images using skin color by artificial neural network. Primary data

includes color images of 50 individuals and is in JPEG format would be provided from Georgia Tech databank.

There are 15 color images for every individual that a total of image is the 750. Many of the images were taken in two different sessions. Therefore there are changes in lighting conditions, facial expression and appearance. In addition, the face is built on a different scale and orientations. Then histograms all prepared images will be optimized and created from pictures with the optimum histogram using SVM to train a neural network and then the network would be trained and scaled. It should be noted that from all existence images, it would be used 90 percent for training and 10 percent for evaluating Neural Network application.

2- Previous Studies

Automated face recognition is an interesting computer vision problem with many commercial and law enforcement applications. Mug-shot matching, user verification and user access control, crowd surveillance, enhanced human computer interaction all become possible if an effective face recognition system can be implemented. While research into this area dates back to the 1960's, it is only very recently that acceptable results have been obtained. However, face recognition is still an area of active research since a completely successful approach or model has not been proposed to solve the face recognition problem.

The inadequacy of automated face recognition systems is especially apparent when compared to our own innate face recognition ability. We perform face recognition, an extremely complex visual task, almost instantaneously and our own recognition ability is far more robust than any computers can hope to be. We can recognize a familiar individual under very adverse lighting conditions, from varying angles or viewpoints. Scaling differences (a face being near or far away), different backgrounds do not affect our ability to recognize faces and we can even recognize individuals with just a fraction of their face visible or even after several years have past. Furthermore, we are able to recognize the faces of several thousand individuals whom we have met during our lifetime. Previous work was to detect and identify face was conducted from 1960 research to now, goes back to the discussion of biological and engineering subjects [7],[8].

More issues face recognition, for identification of three-dimensional objects is formulated from two-dimensional images. In 1960, the first automatic system which were produced to recognize faces, needed to controller person to determine place parts of the face, including the eye, ear, nose, and mouth.

This problem is because the calculation of the distance and rate of change still face a situation were not reliable. This early work was necessary to compare the current image with reference images in the database. For example, the studies has been presented from the early to mid-1970s, pattern classification techniques, were used of the special characteristics of the face image on the complete picture or profile. In the 1970s, providers [9], used of 21 important traits, such as hair, thick lips, and others to automate the detection and face recognition., in this procedure is one of the most important parts of the work to Identify and find locations of the faces.

In recognition of the image face has been detected input with respect to the existence information in the database. The bank contains detected characteristics individuals face image. Recognition of face has more application to identify criminals, credit cards, security systems, and all other issues and has been considered because of many applications in recent years. The recognition of faces is done in two stages in the image.

1. The location and rate of face or faces has been determined in the image, having different objects and fields.
2. The necessary characteristics has been extracted and recognized from determined face in image, including components of the eyes and determining their location and condition.

Completed tasks are to extract the characteristics of the image on the two types of image (images of full face and profile) and because profile images has less information than the full-faced picture. The implemented research focused more on full-face image. In recent decades, several methods have been proposed for face recognition; however, because of the difficulties of achieving this goal has not been fully achieved. Basically differences and varieties in the individuals' faces are such that we can't categorize the faces in the certain setsand groups. In addition, it may be occurred the differences such as long or short hair and face or arranging it and also change of age can be caused of the changing face.

Meanwhile, the face change can be caused by shooting conditions. This condition can contain the luminous intensity and also how to locate or imaging of face that in any case, the fundamental problem is recognized face image.

In the mentioned reasons, extracting constant features of a face, with features extracted from the image of a person changes by changing the shooting conditions and sometimes in contrast of the features extracted from different faces (because of the similarity and diversity of faces), is very similar has been problematic in the image recognition [9]. As well as face detection with methods based on color by using artificial neural networks is more speed than local binary patterns technique.

3- Providing a New Method for Face Recognition

For face recognition based on skin color by artificial neural network is required the following:

1 pattern recognition
2. Color filter of Gaussian model
3. Processing morphology
4. The neural network design

3-1 The stages of pattern recognition

Identification of human faces contains two groups.

1. Detecting the face from non-face
2. Face Recognition

Studies have shown that the detection process is holistic to detailed process, it means when we see the object, initially understand its prominent position as the general framework of shape, color, edge, etc. Then we focus on details like texture and object insidious properties. Because of this we must use some of the learned information (acquiring) in the brain to detect the object. According to this process, in this article, the algorithm what has been expressed that visible

characteristics combine with the hidden features.

The ability to understand that the above image is not just a collection of pixels but is of a camouflaged frog on a log and to be able to identify exactly where the frog ends and log begins on the image is truly incredible. The fact that half of a primate's cerebral cortex is dedicated to visual processing underlies the difficulty of this task.

In the first stage, we separate the face location from other areas such as the head and neck to extract information of skin area location as skin color is one of the most distinct human facial expressions, Despite, distribution of human skin color in some parts of the skin color is different in the a small range.

In the second stage for limiting more candidate face regions to smaller regions and increasing of training speed, we resize that regions and change the color image to gray. In the third stage, wavelet Segmentation machine is used for classification and verification of candidates face. In the fourth stage, we examine education model by neuronal models to use learned knowledge to identify other figures.

3-1-1 Identification of skin color

The research showed that difference in the skin of skin color between different races are mostly in Brightness the not in the color radiation. For pixels are used to determine the skin there are different color spaces such as HSV, RGB, CIE LUV, YCrCb [10]. There are many ways to provide skin color model but all these models are not effective when there are very different light source spectrum.

In other words, the background and foreground color is variable according to lighting changes, accordingly, the only difference between skin color and background color, is similar to color of the face [6].Accordingly, we present a new attitude to use a skin color model in gray model for classifying pixels instead of using a fixed skin color model.

3-1-2 Color space

The results of research show that Distribution Skin Color in gray screen will be fixed that are why here we use the gray color space. After the color image becomes a space gray from RGB color space, a histogram is made from a two-dimensional color space gray.

3-2 Color Filter of Gaussian model

A series of skin areas related to human has been used for determining and extracted from skin area (pig 1). By applying a low-pass filter on skin samples, the noise increased and then each skin image transfer to YC_bC_r space and The two components C_r are C_b color are extracted [9].

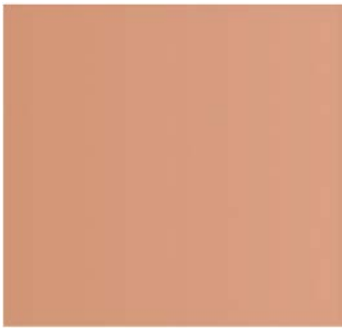


Fig.1.collected Combination skin samples (research findings)

In this stage, a color filter is provided for the separation of the skin. For separation and filtration of the skin, skin images have been considered as cluster database are all elements of that skin.

In fig 2 has been presented a) main image b) binary image of skin with cluster sample.

Fig 2. a) Main image b) binary image of skin with cluster sample fig 4-1 with $\alpha = 0.3$ (research findings)

3-3 Morphology processing

The next section block diagram isthe detection of the morphology operator's face appeared to fix some points what Gaussian filter has operated on preliminary image after primary filtering device and also making benefit in order to coherent objects. Figure 3 shows to understand the images theme.

Fig 3. a) main image [12], b) output image after applying the Gaussian filter c) Video outputafter applying theClosing operator

3-4 neural network design

Two numbers of banks faces of images and non-image models has been considered with dimensions of 64 * 64 that the minimum number of images is 200 in each of them. We extract the face and non-face characteristics by Gaussian filter and morphology processing and save in a file.
We use multilevel neuron model for training, having 250 inputs and its output face image has been determined [11].
For separation of the non-face image from the input image, it is enough to deliver that to the system is pre-trained, then separating from up to down with dimensional of 20 * 20 and dealing with correcting brightness and image histogram equalization. We investigate the image 20*20 pixels whether it is a face or non-face.

In case of being face, it takes Small Square around it (fig 4) again in second stage, we minimize that input image and repeat pervious stage. We will implement the work based on experience and the input image resizing in several stages. The results of ANN training stage is presented in Figure 6.In training stage the best validation results is equal to 0.0021 (Figure 6 a). In statistics, dependence is any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence, though in common usage it most often refers to the extent to which two variables have a linear relationship with each other.In this study, the correlation coefficient is equal to 0.925 obtained in training stage, which worked very well quantity.

Fig 4. A sample of face imagesfor training the neural network [12]

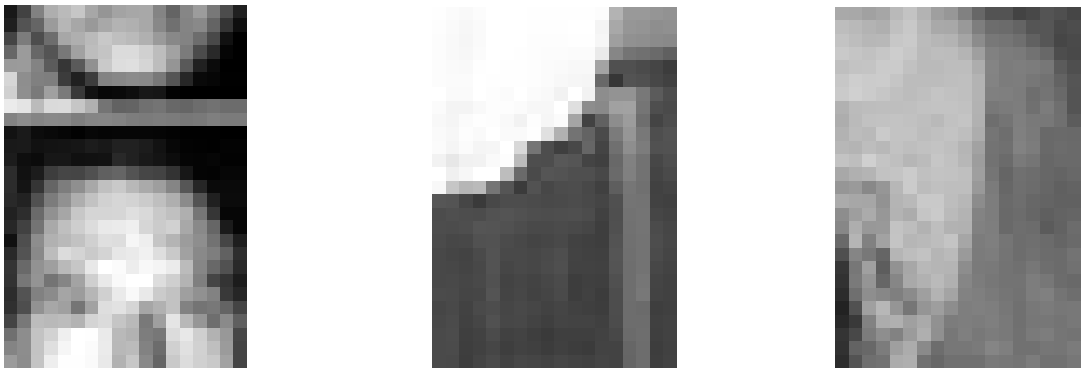
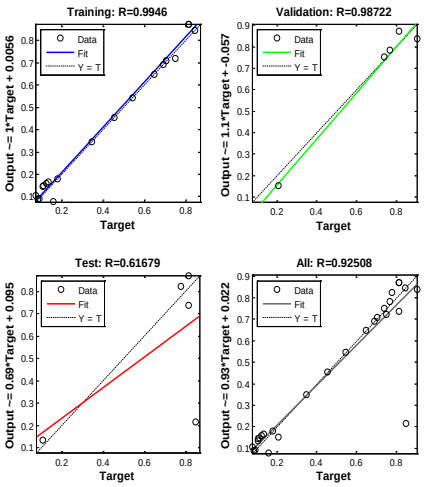
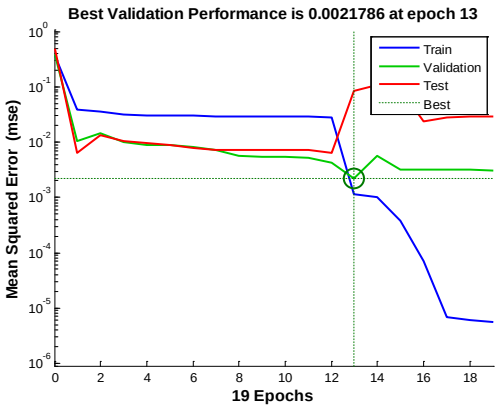


Fig 5. Examples of non-face images for training t
he neural network [12]



(A)



(B)

Fig 6. (A) Performance graph structure.(B) Performance graph structure based on correlation coefficient

4. The results of Experiments

To verify the proposed method, we had done experiments on color image.We divided test set into three groups.Test Set 1 has 100 high quality images and each image has one face of the standard color test image collections.

Test Set 2 contains two images with simple background, several face, and normal lighting conditions of different images. Test Set 3 includes images background complex and varied lighting conditions. Samples of images of Test Set 2 are shown in Figures 7 to 9.

Fig 7. Images 1 relating to experimental set number 2. [12]

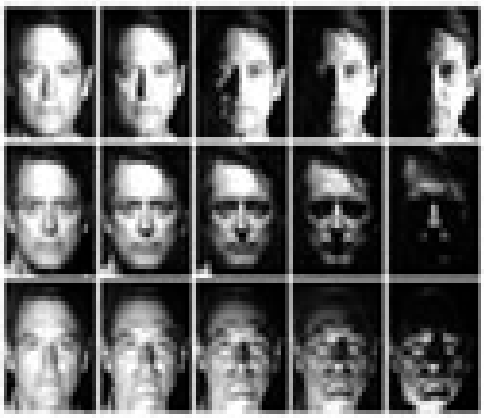


Fig 8. Images 2 relating to experimental set number 2. [12]

Fig. 9. Images 3 relating to experimental set number 3. [12]

Face detection are shown in images set of number 2 and 3 in Figures 9 to 17.

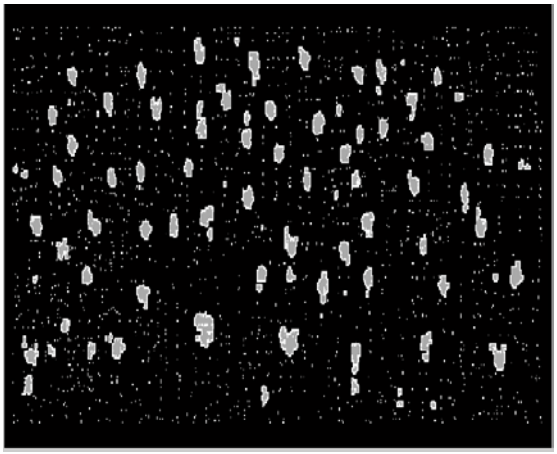


Fig .10. Scanning the entire image to detect faces 6 [findings research]

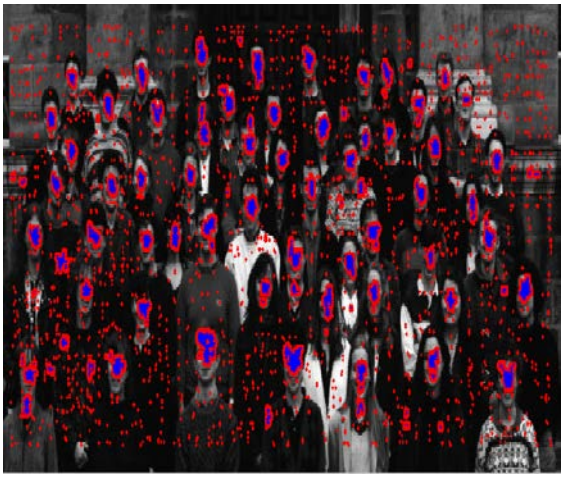


Fig. 11. Identifying faces in Figure 6 relating to Test number2 [findings studies]

Fig 12. Identifying faces in Figure 6 by dragging square around the face [findings studies]

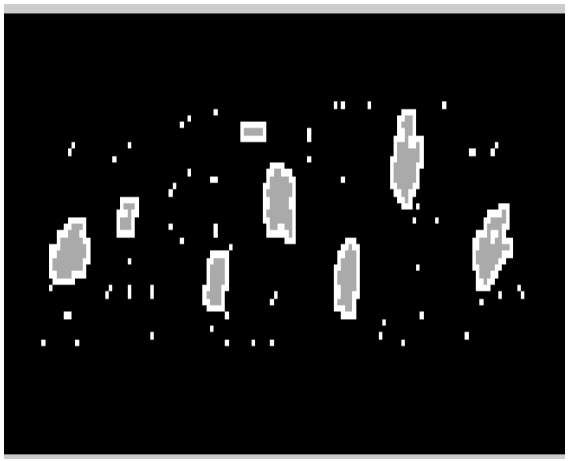


Fig13. Scanning the entire image to detect faces 8 [findings research]

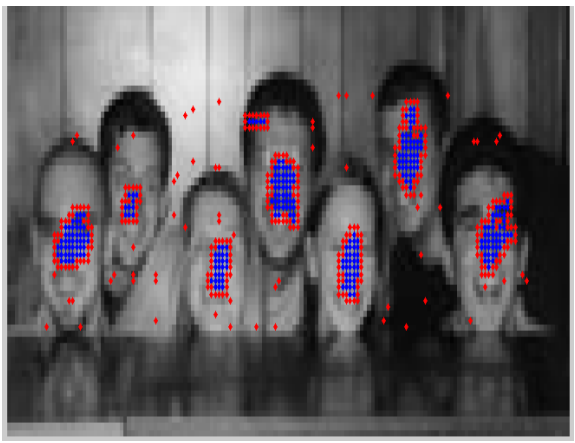


Fig14. Scanning the entire image to detect faces 8relating to Test number2[findings research]

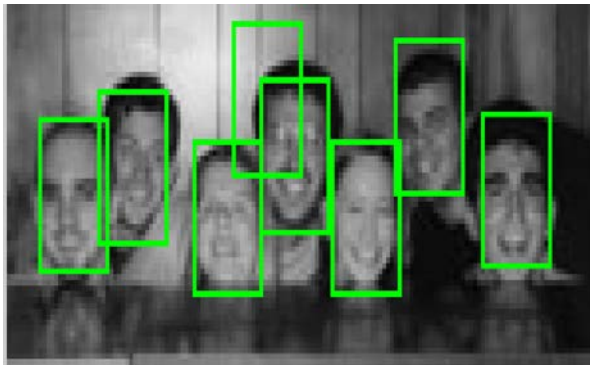


Fig 15.Identifying faces in Figure 8by dragging square around the face [findings studies]

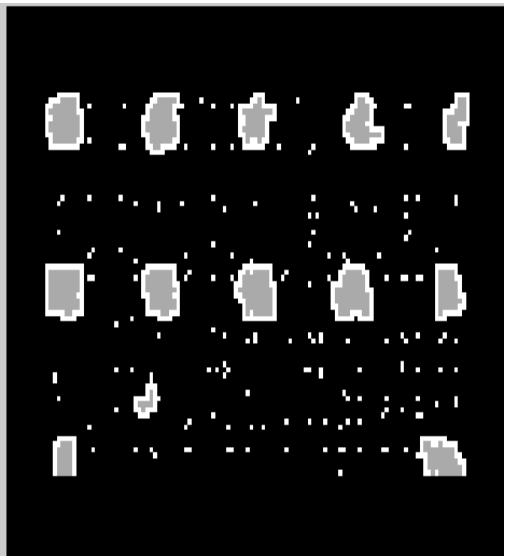


Fig16. Scanning the entire image to detect faces 7 [findings research]

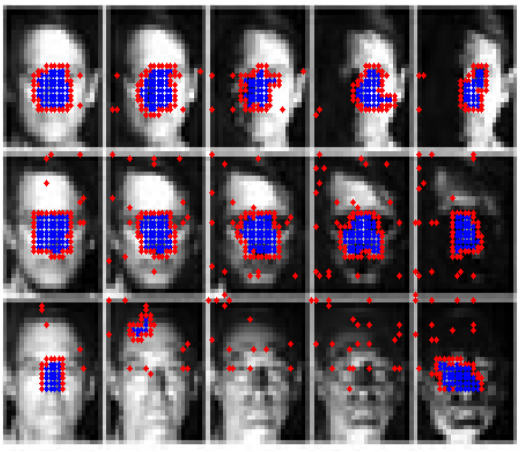


Fig 17. Identifying faces in Figure 6 byrelated to test set number 2 [findings studies]

Fig 18. Identifying faces in Figure 9by dragging square around the face [findings studies]

As shown in Figures 10 to 18, the proposed algorithm is able to identify faces in a variety of moods and different angles of light and in all collections of the study presented here, only figure 8 is associated with non-face detection and in other images, faces would be fully recognized and identified.

The main factor of recognition in Figure 7 can be known in very bad quality resolution images because in the scanning algorithm was not able to distinguish any facial features as seen in fig 18, the lower images have not been identified by the algorithm

5- Conclusion

Artificial Neural Network is a data processing system taken ideas of human brain and put the data process on microprocessors treated as interconnected and parallel network together to solve a problem. In this research, we offered a way to identify human facesused skin color information to identify on it and by using Gaussian filter and morphologic processing; the face areas of candidate would be extracted.

In totally, the artificial neural network has been trained by more than 200 images and in the end, three different images of different images in terms of appearance, lighting and quality has been evaluated. The experimental results showed the reliability of this method. In fact, by offering face recognition algorithm with skin color is able to identify different types of faces by artificial neural network.

Reference

[1]. M. Jamshidi, M. TavakoliTabrizi, Recognizable faces in color images using color segmentation and facial feature "power control Engineering and Electronic Engineering University of Khorasan" 2013.

[2]. Mohammad Mehdi Mahsoli, R. Safabakhsh, Detect human faces using points, Eighth Conference on Machine Vision and Image Processing Iran - Department of Computer Engineering & Information Technology, Amirkabir University of Technology (2013).

[3]. M. Beiglari, F. Mirzaee and Hussein Ibrahim Pur, A new system for fast face detection accuracy with the use of rectangular features, First National Conference on New Ideas in Electrical Engineering, Islamic Azad University, Isfahan, 2013.

[4]. Zhang Jun-chang, Zhang Yi,,Human,, Face Detection Based on Genetic Algorithm ,,School of Electronics and Information Northwestern Polytechnical University Xian, china(2012).

[5]. HazM . El-Bakry ,, Face detection using fast neural networks and image decomposition Facultyof computer science information systems Mansoura Egypt(2002)

[6]. Yang,M.-H. Ahuja, N.Gaussian Mixture Model for Human Skin Colour and its Applications in Image and Video Databases. SPIE/EI&T Storage and Retrieval for Image and Video Databases (San Jose, January 1999), pp. 458-466.

[7]. Gomez, G. Morales, E.Automaticfeatureconstruction and a simple rule induction algorithmfor skin detection. Proc.

of the ICML Workshop onMachine Learning in Computer Vision,.2002. pp. 31–38

[8]. Zhanwu, Xu. Miaoliang, Zhu. Color-Based SkinDetection: Survey and Evaluation. 12th InternationalConference on Multi Media Modelling,. 2006.

[9]. Phung,S.L. Bouzerdoum,A. Skinsegmentation using color pixel classification:analysis and comparison. IEEE Trans. Pattern Anal.Mach. Intell.,2005. Vol. 27 no. 1.

[10]. Song,M. H.Lee,J. Cho,S.P. Joung Lee, K. Support Vector Machine BasedArrhythmia Classification Using ReducedFeatures, International Journal of Control,Automation, and Systems, vol. 3, no. 4, pp. 571-579, December 2005

[11]. Lin-Lin Huang, et al. Face detection from cluttered images using a polynomial neural network. Neurocomputing,2003, Vol.51, pp197 – 211.

[12]. http://www.anefian.com/research/face_reco.htm

[13]. Henry A. Rowley, ShumeetBaluja, and Takeo Kanade. “Neural network based face detection,” IEEE Transactions on Pattern Analysis and Machine Intelligence, 20(I), pp.23-38, 1998.