IJCTA, 9(36), 2016, pp. 305-313

Web Inference Model with Weighted Matrix Algorithm Based Facial Emotion using Artificial Feed Forward Neural Networks

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Abstract : Human emotions get changing at all the fraction of life; the emotions detection can be used in various domains like person identification and authentication purposes. We extend the problem of facial emotion detection to access media store and playing songs and videos according to the emotion of the user. The proposed method captures the user image through the webcam attached to the user machine; the captured image is submitted to the inference model. At the inference model, the input image is preprocessed to enhance the picture, and then the image is split into a number of integral images. For each integral image, an interesting point is generated using speed up robust features. The computed interest point is converted into a weight matrix which represents the strength of features at all the regions of the face. With the generated weighted matrix of features extracted from the facial image, the method generates an artificial neural network with eight layers. Each layer of neural network has a number of neurons with dedicated functions to compute the similarity and feature weight. Each layer of the system denotes the distinct emotion and according to the number feature vectors available in the training set for each emotion, there will be a number of neurons will be generated. Each neuron will be assigned with computed weighted matrix, and each neuron computes the similarity measure to produce an output to the next layers. The proposed model maintains feature for eight different emotions of the distinct user, based on that; first the user identification is performed, and then the emotion is identified. The proposed approach has produced efficient results compared to earlier methods.

Keywords : Emotion Detection, Weighted Matrix, Person Identification, SURF, Image Classification, Artificial Neural Networks.

1. INTRODUCTION

Some image features based on color and texture attributes have been reported in the literature. Although quantifying their discrimination ability to classification problem has not been so easy. Among the many possible features for classification purpose, extracted from an image. We focus on robust features like color distribution, density features, region features. The reason why we use three different features is the color distribution represent the distribution of color values throughout the image and part feature represent the features spread in a particular region where the density feature represent the feature density in each region.

A color is represented by a three-dimensional vector corresponding to a position in a color space. This leaves us to select the color space and the quantization steps in this color space. As a color space, first, we chose the RGB (Red-Green-Blue). The reason for this choice of RGB is that it is widely used in the literature. For the sake of comparison and completeness, we have considered other color spaces also while keeping other conditions identical. An explanation for this fact is that, after quantization into bins, no

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information about the color space is used by the classifier. A color histogram is a picture of the distribution of insignia in an image. For digital images, a color histogram signifies the number of pixels that have insignia in each of a fixed list of color varieties that span the image's hue space, the set of all conceivable colors. The color histogram container be built for any caring of color space, though the term is additional often used for three-dimensional chairs like RGB or HSV. For unicolor images, the time concentration histogram is used.

Many organizations started using face detection modules even for the person identification on daily attendance of persons. The facial image has been used for face identification, the facial image is captured through the camera, and the image features are extracted to identify the person from set of person's features. The person identification system may use any number of features for a single user, and the kind of feature also differs with the methodology. The person identification approaches are more growing, and many researchers are ongoing now a day.

The human can show any emotion in his/her face like happy, surprised, angry, sadness etc. The emotions can be used for person identification and can be applied to many factors. The speed-up robust feature is the most efficient way of representing the image elements which can be computed in a faster manner. The surf maintains 64 features for a region which are used to calculate the weighted matrix to identify the person.

Table 1

Shows set of facial emotions handles in this paper

Emotion Reaction	*Feature Representatives*
Happiness	Angles of lips are pinched back and up mouth parted/not with teeth exposed/not cheeks are raised lower eyelid shows wrinkles below it lines around the outer corners of the eyes
Sadness	Inner corners of eyebrows are drawn up upper lid inner edge is raised corners of the lips are drawn downwards
Anger	Lowered Brows/Drawn Together/Line between Browse/lower lid tense/ may be raised/upper lid tense/dropped due to brows' action/lips are pressed together with corners straight down or open
Surprise	Brows raised/ skin below brow stretched,/ /not wrinkled /horizontal wrinkles across forehead/ eyelids opened / jaw drops open or stretching of the mouth
Disgust	The upper lip is elevated the lower lip is raised and lacking up to the upper lip or it is lowered nose is wrinkled cheeks are raised brows lowered
Fear	Summits raised and haggard together forehead wrinkles drew to the center the upper eyelid is raised, and lower eyelid is drawn up mouth is exposed lips are somewhat tense or strained and drawn back
Confusion	
Excitement	
Desire	
Contempt	

The Table1 shows the set of emotions being considered in this article and the author has found eight different emotions to perform emotion detection.

Also, the paper considers the power of the artificial neural network in performing intelligent computing which can be applied to solve any complex issues. So that the author has used artificial feedforward neural network to train the features and to classify the facial emotions according to the features of the facial image obtained. The artificial neural network is a collection of neurons which are arranged in the form of layers where each layer has a number of the neuron. The beauty of neuron is the capability to perform

any complex computing using the input values given and could produce a single output to the next layer neurons. The output of neuron from one layer becomes an input to the next layer neurons. Based on the result of all the layers the neuron present in the last layer can classify the feature towards a number of emotions. This paper will discuss how the input function can be used to classify the facial emotion towards a number of emotions using neural networks.

2. RELATED WORKS

There are a number of approaches has been discussed for the classification and recognition of facial emotion using the facial features. We discuss some of the research articles and methods discussed earlier in this section.

Emotion Recognition System by a Neural Network Based Facial Expression Analysis

[1], proposes a system for human emotion recognition by analyzing key facial regions using principal component analysis and neural networks. The proposed system has been trained and tested on the FEEDTUM database where it achieved a relatively high average score of correct recognition and therefore showed promise for future development.

A fuzzy approach for facial emotion detection [2], offerings a new fuzzy-based method for emotion credit from eyes and mouth topographies in different ages. The technique detects eyes and mouth from a blend of different color spaces. Four structures consist of eye-opening, mouth inaugural, eye opening/ width ratio and opening width are designated for fuzzy analysis. Employing Mamdani-type suggestion relations, facial attributes, and their planning to emotion space are prearranged. Applying the technique on Ebner's facial appearance database designates 78.8% correctness.

Emotion and Gesture Recognition with Soft Computing Tool for Drivers Assistance System in Human Centered Transportation [3], Facial Emotion Recognition Using PHOG and a Hierarchical Expression Model [4], propose a fast method to detecting humanoid facial emotions, using a ranked numerous stage scheme and only the PHOG feature descriptors grounding on frontal imageries of human faces. In this model, the facemask expression is the arrangement of a set of strong facial districts which can be appraised with the trained expressive templates. Within this agenda, the proposed algorithm can accomplish acceptable detection accuracy for Cohn-Kanade dataset, with less time also space complexities compared with the approaches in other investigation literature, making it appropriate to low-cost hardware such as mobile device.

An efficient Facial Topographies Extraction Method for Face Recognition system Using Local Binary Patterns [6], presents a survey on the recent use of Local Binary Patterns (LBPs) for face recognition. It is becoming a favorite technique for face representation. In the existed system we are using LBP. It is a non-parametric kernel which summarizes the special local structure of an image, and it is invariant to monotonic gray scale transformations. Here, we describe the LBP technique and different approaches proposed in the literature to represent and to recognize faces but it is having some limitations like it not suitable for shadow images and low contrasted images. To overcome those problems in this project we are proposing 2D principles of component analysis (2D-pca) to extract the facial features of a picture. Here we are using our own databases to remove the facial features.

In Recognition of Facial Expression Using Eigenvector-Based Distributed Features and Euclidean Distance Based Decision Making Technique [7], firstly the imageries were acquired, and cropping of five important portions from the copy was performed to cutting and store the Eigenvectors unique to the languages. The Eigenvectors for the examination images remained also calculated, and finally, the facemask input image was recognized then similarity was obtained by calculating the minimum Euclidean distance between the test image and the different expressions.

Action Unit-Based Linked Data for Facial Emotion Recognition 8], rates organization to build linked data from the relations between facial deed units and their conditions as emotional parameters for the

facial feeling recognition. In this paper, the authors are mainly focusing on structure action unit-based linked data because it will be likely not only to use the data for the facial emotion credit but also to improve the usefulness of the data by amalgamation them with other linked data. Although in overall, the representation as related data seems to make the accuracy of the facial emotion gratitude lower than others, in almost the proposed method that uses action unit-based relevant data has almost the similar accuracy for the facial emotion recognition as those of other methods like using Artificial Neural Network and by means of Support Vector Machine.

In Emotion Recognition Using Hidden Markov Models from Facial Temperature Sequence [9], Firstly, the temperature difference histogram features and five statistical features are extracted from the facial temperature difference matrix of each difference frame in the data sequences. Then the discrete Hidden Markov Models are used as the classifier for each feature. In which, a feature selection strategy based on the recognition results in the training set is introduced. Finally, the results of the experiments on the samples of the USTC-NVIE database demonstrate the effectiveness of our method.

Facial Countenance Recognition Based on Supposed Facial Images and Local Feature Matching [10], recognition is to regulate the emotional state of the face nevertheless of its identity. Deriving an real facial representation from original face imageries is a vital step for successful facial appearance recognition. This paper offerings a biological vision-based facial account, called Perceived Facial Images “PFI” applied to facial look recognition. For the classification step, Scale Invariant Feature Alter “SIFT” is used to extract a native feature in images. Then, a matching calculation is processed between a challenging image and all train images for recognizing facemask expression.

All the above-discussed methods have produced a false classification and provides less emotion detection accuracy which has to be reduced to improve the detection ratio.

3. PROPOSED METHOD

The proposed weighted matrix facial emotion detection algorithm has three stages namely Preprocessing, Feature Extraction, weighted matrix computation, andNeuralemotion detection.

3.1. Image Capturing

The proposed model has designed a web interface through which the user face image is captured. The webcam attached to the user machine is accessed to capture the user face image and will be submitted to the inference model on the other side. The captured image is used for further stages of the proposed method.

3.2. Preprocessing

The captured image is prepared for feature extraction by enhancing the image quality. We apply histogram equalization technique to improve the picture quality. The RGB values of each pixel are adjusted to the normalized value to generate equalized image. Also, the skin features are extracted from the equalized image using surface matching techniques. A previously created probabilistic model of skin-color is used to calculate the probability of each pixel to represent some skin. Thresholding then indications to the coarse regions of curiosity. Some further analysis could for instance involve the size or boundary of the located regions to exclude areas such as the face.The preprocessing makes the image as completely ready for feature extraction.

3.3. Feature Extraction

The template matching technique is used to extract the feature from preprocessed image. We remove the following features like eye, nose, mouth and other skin region features. The proposed method maintains

set of templates for each case of an emotion considered in this paper according to Table 1. With the template matching technique, region growing methods are used to extract the features. The extracted features are used to generate the descriptor values for each of the interest points computed on the feature set. For each feature extracted, we calculate the interest points which specifies the characteristics of the region and calculated according to the neighbor values of the pixel and Hessian matrix. The features extracted are converted in the form of interest points.

Algorithm:

Input : Preprocessed image Img, Template set Ts.

Output: Set of interest points IPs.

Start

Initialize sub-image set I, initialize interest points Ips.

For each feature eye, nose, mouth

for each template T_i from Ts

if($T_i \in$ Img)

$I = \sum I + \int_{i=1}^{N} Ti\,(Img)$ // generate sub image

end

end

end.

For each Feature space I_i from I

Initialize box filter with M × N size

for each box, B construct integral image I_Σ

$I_\Sigma(x) = \sum_{i=0}^{i \le x} \sum_{j=0}^{j \le y} I(i, j)$

End.

For each integral image I_Σ

Generate Hessian Matrix $H = \begin{bmatrix} i=0,\ j=0 & j=n \\ i=m & i=m,\ n \end{bmatrix}$

Compute sum of intensities inside the matrix $W = \sum_{i=m}^{j=n} H(i, j)$

end.

Select most intensity region.

Select as an interesting point Ip.

Add the region into Interest point set IPs.

end

Stop.

3.4. Weighted Matrix Algorithm

This stage performs the computation of weighted matrix, which represents the features of various components of the human face. With the computed interest, point set the pattern is generated as follows. For each element of the face, there exist many numbers of interest points, and each has 64 features, so that, we maintain a multi-dimensional vector which stores the interest points of all the components in distinct dimensions. For each feature of the facial part with the interest points extracted, we compute a cumulative weight factor of all the interest points and store into the matrix. Finally, the weighted matrix consists of a set of weights for each component.

Algorithm:

Input: Interest Point Set IPs.

Output : Weighted Matrix Wm.

For each feature space Fi

for each interest, point ip from Ips

Weighted Feature Wf = $\int_{i=1}^{64}\left(\sum \mathrm{F}i(\mathrm{I}p) \times \frac{\sum \mathrm{F}i(\mathrm{I}p)}{\mathrm{N}}\right)$

Wm(I, j) = Wf.

end.

end.

Stop.

3.5. ANN BasedEmotion Detection

In this stage, the method identifies the set of emotions considered and for each emotion, the process generates a layer in the feed forward neural network. Using the interest points computed in the feature extraction stage, the process generates a number of neurons. With the labeled feature set the process makes the neurons at different levels or layers to make the artificial feedforward neural network. Then for the input feature set of interest points the method makes a neuron and initializes with the interesting point computed. At each layer, the neuron computes the weighted matrix with the input feature given at the initial stage. Using both weighted matrices of the neuron, the method calculates the cumulative weight for each class of emotion. Based on calculated cumulative relative weight one of the emotion is selected as a result.

Input : Interest Point Set Ips, Training set Ts, Total Weight Matrix Twm.

Output : Final Emotion Em

Start

Compute Emotion Set Es = $\int_{i=1}^{\mathrm{size(Ts)}} \sum \mathrm{Ts}(i).\,\mathrm{Emotion} \not\exists \mathrm{Es}$

Generate Artificial Neural network NN.

For each Emotion Ei from Es

Generate Layer Li

Generate Neurons Ne.

$\mathrm{Ne} = \int_{i=1}^{\mathrm{size(Es)}} \int_{j=1}^{\mathrm{size(Ts).\,Emotion\,=\,E}i} \mathrm{Create\ Neuron\ (Ts}(j)$

NN = $\sum(\mathrm{Li} \in \mathrm{NN}) \cup \mathrm{Li}$

End

For each Layer Li from NN

for each Neuron Ni from Ne

For each feature space Fi

for each interest point ip from Ips

Weighted Feature Wf = Wf = $\int_{i=1}^{64}\left(\sum \mathrm{F}i(\mathrm{I}p) \times \frac{\mathrm{F}i(\mathrm{I}p)}{\mathrm{N}}\right)$

Wm(I, j) = Wf.

end.

end.

compute weighted feature Wf.

Twm = ΣWm + Wf.

compute cumulative relative weight Crw = $\text{Crw} = \int_1^{64} \frac{l(i) - l(j)2}{\text{N}}$

N- the number of interest points from the feature set of the component.

End

Forward cumulative relative weight to next layer.

End

Select most weighted entry.

Swm = Max(crw).

Select the category as emotion.

Em = Class(Max(crw)).

stop.

4. RESULTS AND DISCUSSION

Table 2

Shows the size of data set used for evaluation

Emotion	*Train*	*Test*	*Total*
Anger	42	28	70
Fear	36	16	52
Joy	48	16	74
Relief	38	12	50
Sadness	29	17	46
Confusion	26	14	40
Excitement	31	16	46

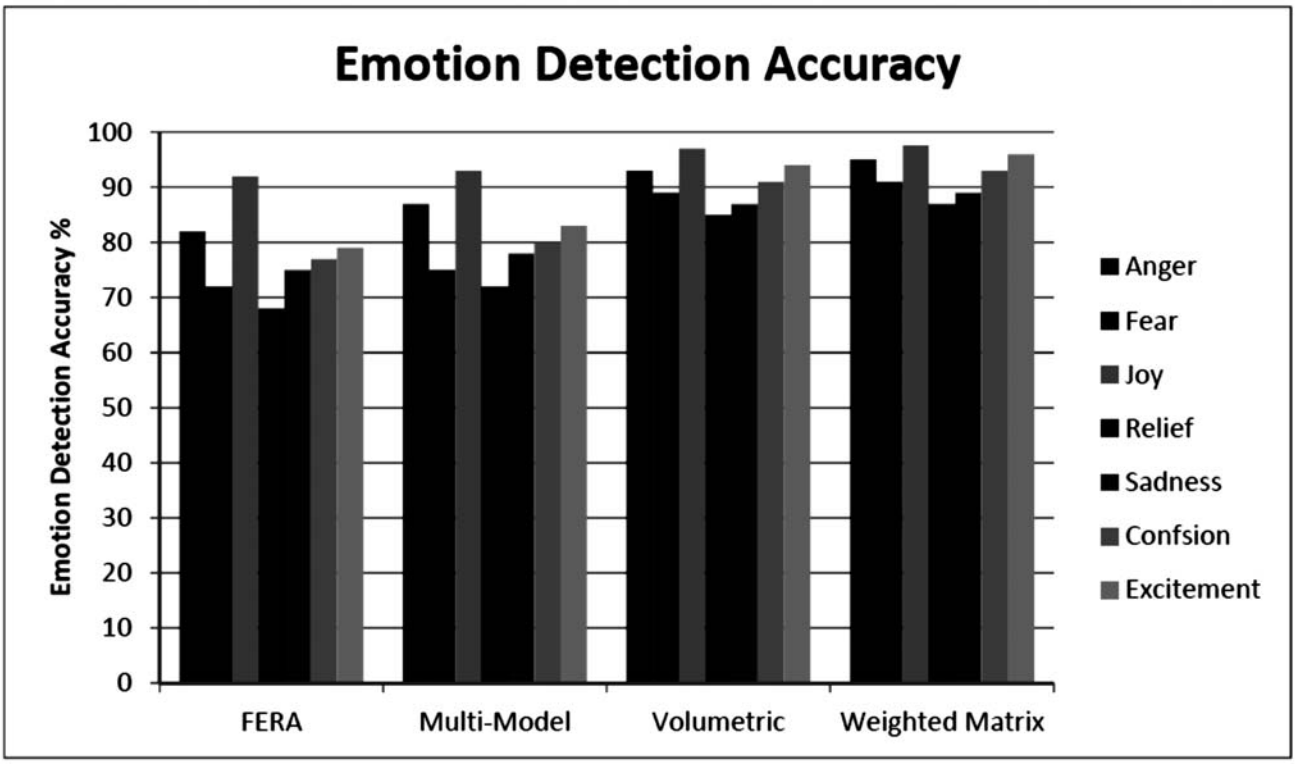

Figure 1: Shows the accuracy of emotion detection of different methods

The proposed weighted matrix based web inference model for facial emotion detection using artificial neural network has produced good results. The proposed method has produced good efficiency in feature extraction which plays a vital role in the proposed method. It has produced efficiency up to 97.2 % for a variety of facial feature. The accuracy of emotion recognition is reached up to 91% on the AM-FED and

FERET face database. Speed improvement achieved over the previous method is more than 20 times. The proposed method has replaced the offline emotion detection methods by providing an online model. Fera is the baseline method we have used to evaluate our proposed method.

We have used different size of data for training and testing phase, and the proposed method has evaluated at all the cases for the accuracy of detection.

The graph1 shows the accuracy of emotion detection achieved by proposed method for various data sets and various emotions of a human. It shows clearly that the proposed method has produced efficient result in all the cases of emotion detection.

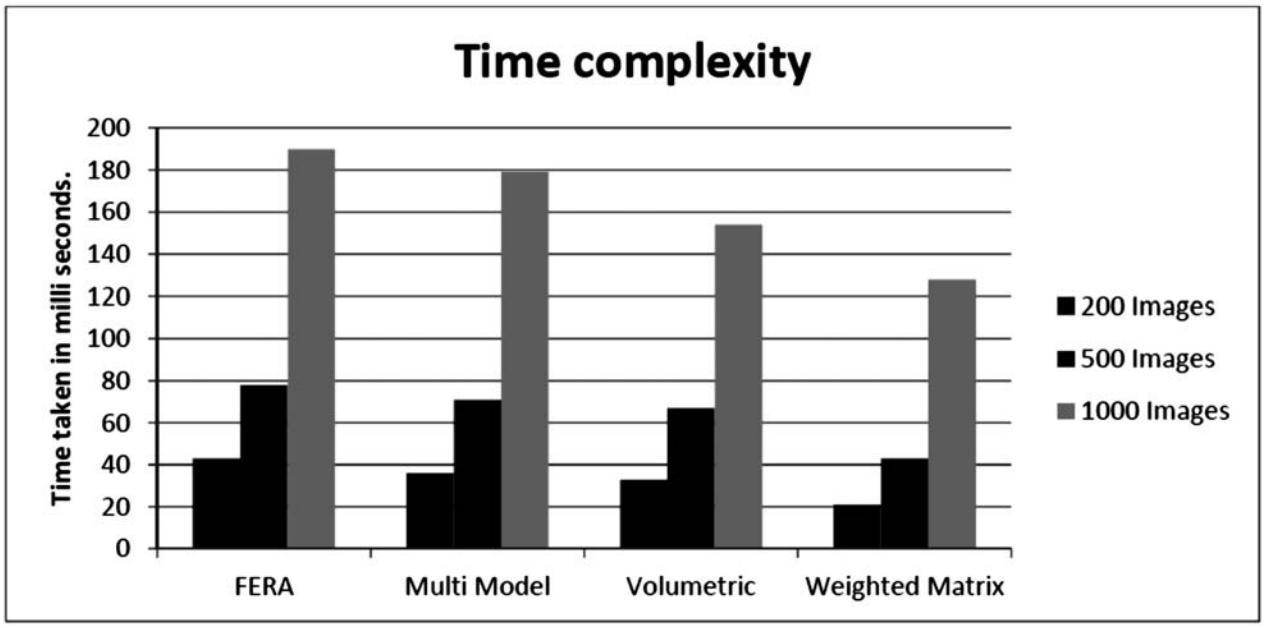

Figure 2: Comparison the time complexity of different methods

The graph2 shows the time complexity achieved by the different methods and it shows the proposed method has produced less time complexity than other methods.

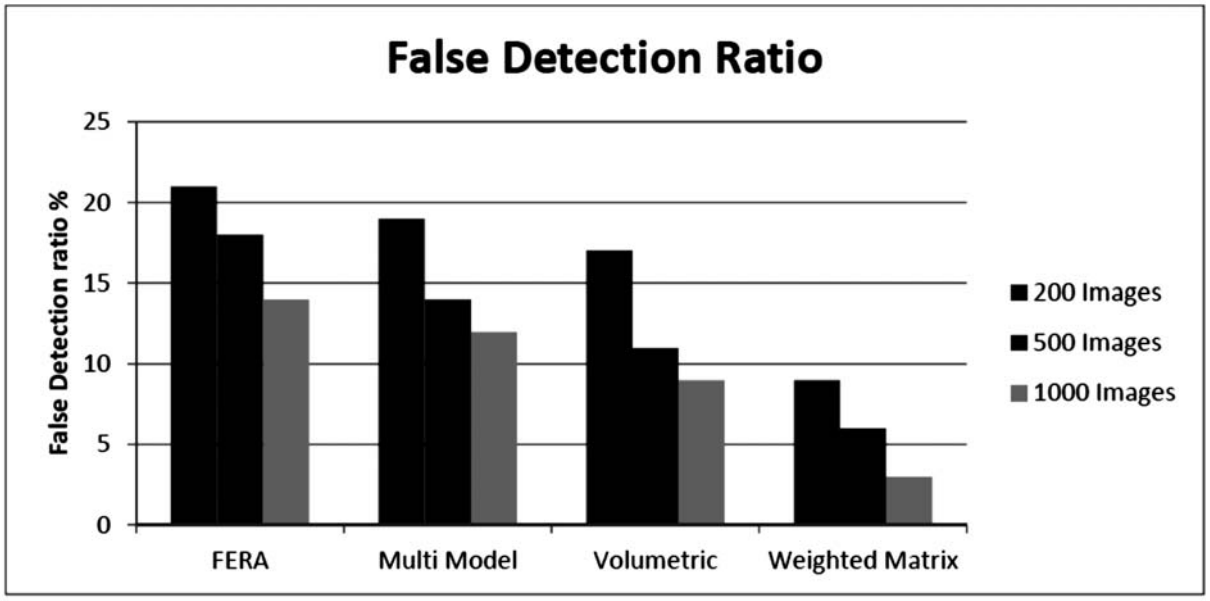

Figure 3: Comparison of false detection ratio

The Graph 3, shows the comparison result of false classification ratio produced by different methods on varying number of samples. The results show that the proposed method has produced more efficient results with less false classification ratio.

5. CONCLUSION

We proposed a weighted matrix based web inference model for facial emotion detection method which uses artificial feedforward neural network to detect the emotion based on the various features of the image. We have used skin matching technique to remove unwanted skin features from the image then we have used template matching technique which has few set of templates for each of the feature. The template matching is used to identify the location of the facial feature and the feature is extracted to compute the interest points. The interesting point represents the region properties in 64 levels. Based on computed interest point, the method generates the artificial neural network with nine layers. There will be a distinct layer for number emotions and there will be a number of neurons generated according to the number of samples available. Each neuron computes weighted matrix and cumulative relative weight and forwards the output to the next layer. This will be performed for each layer neurons and finally the neurons at the last layer select the emotion with most cumulative relative weight to detect the emotion. The proposed method has reduced the time complexity and increased the accuracy of emotion detection than other previous methods.

6. REFERENCES

1. DamirFilko, GoranMartinovi´, Emotion Recognition System by a Neural Network Based Facial Expression Analysis, ATKAFF, vol.54, issue.2, 263–272 2013.
2. Farahani, A fuzzy approach for facial emotion recognition, Iranian conference on Fuzzy systems,2013.
3. Agarwa; w, Emotion and Gesture Recognition with Soft Computing Tool for Drivers Assistance System in Human Centered Transportation , IEEE International conference on system man cybernatics ,pp:4612-4626.
4. Zhao Zong, Facial Emotion Recognition Using PHOG and a Hierarchical Expression Model, Intelligent networking and collabo, ative systems ,, pp>741-746, 2013.
5. Mischel valster, The Continuous Audio/Visual Emotion and Depression Recognition Challenge, ACM Multimedia, 2013.
6. C. Nagaraju, An efficient Facial Features extraction Technique for Face Recognition system Using Local Binary Patterns ., International Journal of Innovative Technology and Exploring Engineering (IJITEE) , Volume-2, Issue-6, May 2013
7. Jeemoni Kalita, Recognition of Facial Expression Using Eigenvector Based Distributed Features and Euclidean Distance Based Decision Making Technique, International Journal of Advanced Computer Science and Applications, Vol. 4, No. 2, 2013
8. Kosuke Kaneko, Yoshihiro Okada, Action Unit-Based Linked Data for Facial Emotion Recognition, Active Media TechnologyLecture Notes in Computer Science Volume 8210, 2013, pp 211-220.
9. Zhilei Liu, Shangfei Wang , Emotion Recognition Using Hidden Markov Models from Facial Temperature Sequence, Affective Computing and Intelligent Interaction Lecture Notes in Computer Science Volume 6975, 2011, pp 240-247
10. Hayet Boughrara, Liming Chen, Chokri Ben Amar, Mohamed Chtourou, Facial Expression Recognition Based on Perceived Facial Images and Local Feature Matching, Image Analysis and Processing – ICIAP Lecture Notes in Computer Science Volume 8157, 2013, pp 591-600.
11. Challenges and Surveys in Key Management and Authentication Scheme for Wireless Sensor Networks“ in Abstract of Emerging Trends in Scientific Research 2014– 2015.
12. “Teleimersion” Research Journal of Pharmaceutical, Biological and Chemical Sciences on March – April 2016 issue.
13. Giampaolo L. Libralon, Roseli Ap. Francelin Romero, Neural Information Processing Lecture Notes in Computer Science Volume 8227, 2013, pp 409-416. Investigating Facial Features for Identification of Emotions Giampaolo L. Libralon, Roseli Ap. Francelin Romero.
14. AndréMourão, Facial Expression Recognition by Sparse Reconstruction with Robust Features, Image Analysis and RecognitionLecture Notes in Computer Science Volume 7950, 2013, pp 107-115.
15. Challenges and Authentication in Wireless Sensor Networks by using promising Key Management Protocols” at International Conference in Kristu Jayanthi College, Bangalore on Feb 19th & 20th 2015 and Published in International Journal of Computer Applications