Proceedings of 14th Global Engineering and Technology Conference
29-30 December 2017, BIAM Foundation, 63 Eskaton, Dhaka, Bangladesh
ISBN: 978-1-925488-60-9

Facial Expressions Recognition Using Bezier Curve and Performance Analysis Using Ann, Naïve-Bayes and SVM Classifiers

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Facial Expression is an acknowledged, non-nosy additionally skillful technique for communication that has been well thoroughly considered as a plausible cooperation of such interface. The mean of this examination is making a Facial Expression Recognition (FER) conspire by utilizing Bezier curve and afterward checking the precision by utilizing diverse classifiers. Initial, a picture is taken from a dataset and afterward skin color segmentation is executed utilizing RGB display. After that the biggest associated part is identified and if it has the likelihood of ending up being a face, the biggest associated area is taken by editing the facial skin district and interfacing the biggest skin locale to recognize the skin surface of the person. Next a binary image is converted from the picture and from that it isolates eyes and also lips from the face. Subsequently Bezier curve for eyes and lips are recognized and is contrasted with those pictures with the stored pictures in the database for every emotion distinguishing curve potential outcomes of a human face. Next it finds the nearest Bezier curve from the database and gives an outcome as it is put away in Bezier curve emotion as this present picture's emotion probability. In this way by utilizing this technique emotions communicated by the human face can be distinguished effortlessly. Hence, a Bezier curve based solution together with image processing is used in classifying the emotions. Finally ANN, Naïve Bayes and SVM classifiers are used to determine the accuracy of the system.

Keyword: Facial Expression, Emotion Detection, Bezier Curve, ANN, SVM, Naïve Bayes.

1. Introduction

A computer will be comfortable with the perspective of an individual when the range of human-computer interaction (HCI) will come in actuality. Feeling or response comes about on the substance of the individual which can be identified by the inclination of the individual. Outward appearances can be perceived, by the instrument of human's feelings and state of mind. Outward appearance examination (B. Fasel and J. Luettin,2003) that has been very prevalent on account of the significant consideration it has been attracting the improvement of human machine interface(Dong Li.,Shuai Shi Liu, Yan Tao Tian, 2009) given that it offers an acknowledged equipped technique for correspondence between human. Individual recognizable proof with get to control, video telephone and remotely coordinating and others are a portion of the couple of cases identified with outward appearances. A few plans have been anticipated to recognize a human face in pictures that can be

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ISBN: 978-1-925488-60-9

sorted into following gatherings: information based plans, include based plans, and layout based plans additionally appearance-based plans. In the event that they are connected separately, these plans can't manage every one of the issues of face acknowledgment (A. K. Jain and S. Z. Li., 2005) for instance posture, articulation, introduction. Parallel or progressive techniques can be utilized for a superior operation. Outward appearance acknowledgment techniques basically concentrate on the accompanying essential expressions (H. Kobayashi, A. Tange, and F. Hara., 1995) : bliss, trouble, fear, outrage, nauseate and pain. A man's interior perspective, expectations or social interchanges is the reasons that trigger outward appearance change. Outward appearance (F. B. Claude C. Chibelushi., 2003) is a fundamental part in our contacts between individuals since they can uncover the consideration, identity, aim and mental condition of a man. They are intelligent signs that can control our correspondence with the earth and other individuals in our general public. Hence, outward appearances give the most imperative information for feelings impression in facial correspondence.

The framework offers a chance to recognize human outward appearances. To do this, eyes and lip are removed from the face and approximated utilizing Bezier bends speaking to the relationship in the midst of the activity of highlights and changing of appearances. For confront location (J. Bassili) shading division has been connected that impact vulnerability in hues. Exploratory outcomes uncover that this technique can firmly order skin district and non-skin locale. What's more, to pick whether the skin locale is a face or not, biggest network strategy has been utilized. This method can recognize the outward appearance classification.

This paper is sorted out as takes after: next segment portrays the writing survey about outward appearance acknowledgment. Segment III gives the total strategy for outward appearance acknowledgment procedure. Data about various classifiers are given in segment IV. In segment V the way toward applying classifiers and the outcome correlation are portrayed and segment VI is about the conclusion.

2. Literature Review

The starts of outward appearance investigation started from the nineteenth century when Darwin essentially foreseen the possibility of basic outward attributes in living animals.Since the mid-1970s, Ekman and Friesen (1975) have made various inquires about of human outward qualities, giving confirmation to support this comprehensiveness theory. Various late papers subsist on programmed influence break down and acknowledgment of outward appearances (G. H. and P. M,2009).The paper examines on the full of feeling face and body show recommends a technique to naturally identify their transient fragments or stages. The test comes about acquired give emotional face and body shows are immediate yet not entirely synchronous. Ira et al (I. Cohen, A. Garg, and T. S. Huang, 2000) recommended an engineering of Hidden Markov Models for the naturally fragment and perceive human outward appearance from video arrangements. The work depends on programmed outward appearance acknowledgment from live video contribution with fleeting prompts. Yashnari (Y. Koda, Y. Yoshitomi, M. Nakano, and M. Tabuse, 2009) researched a strategy for outward appearance acknowledgment for a human speaker by utilizing warm picture preparing and a discourse acknowledgment framework. Discourse acknowledgment framework has been improved to spare warm pictures at the three planning places of just before talking, and exactly when talking the phonemes of the first and last vowels. With this framework, purposeful

ISBN: 978-1-925488-60-9

outward appearances of "irate", "cheerful", "unbiased", "miserable", and "shocked" were recognized with great acknowledgment exactness. As of late Caifeng Shan (Caifeng Shan,2012) utilized the power contrasts between pixels in the grayscale confront pictures as highlights. The paper gives an effective way to deal with grin recognition, in which the force contrasts between pixels in the grayscale confront pictures are utilized as highlights. This approach gives 85% precision by looking at 20 sets of pixels and 88% exactness with 100 sets of pixels. Soetedjo (Aryuanto Soetedjo,2011)utilized the strategy in light of the standardized RGB chromaticity chart for distinguishing the grin. The paper utilizes the mainstream Viola-Jones identification technique to distinguish the face. Once the face is recognized, the lip area is limited utilizing the straightforward geometric run the show. Further, the red shading thresholding in view of the standardized RGB chromaticity graph is proposed to remove the lip. The projection technique is utilized for identifying the grinning state. Dixit(Pinky Rai,2013)recognizes grin utilizing Bezier bend taking mouth intrigue focuses as a component. The Face is identified by the well known Viola-Jones calculation and mouth corner focuses are removed by the strategy for Shi and Tomasi through least eigenvalue of the lattice and furthermore assess with other corner recognition calculation. Zhang and Ji(Y. Zhang and Q. Ji.,2005)proposed a multi-highlight procedure that depends on the recognition of facial focuses and edges in the brow region. In their technique, facial highlights are separated by partner every AU with an arrangement of developments and afterward grouped utilizing a Bayesian system demonstrate.

3. Facial Expression Recognition Methodology

3.1. Skin Color Segmentation

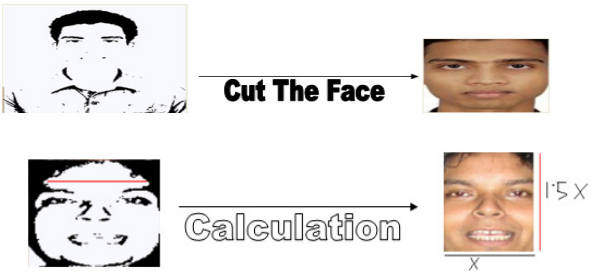
In the beginning, the image is contrasted and skin color segmentation (Son Lam Phung, Abdesselam Bouzerdoum, and Douglas Chai,2003) is executed. Then, the largest connected region is found and verified whether it has the possibility to become a face (R. L. Hsu, M. A. Mottaleb, and A. K. Jain,2002)of the largest connected region or not. If it is true then it will create a new form with the largest connected region. If the largest connected regions height & width is larger or equal to 50 and the ratio of height/width is between 1 and 2, then it will be a face.

3.2. Face Detection

In case of face detection (M. Bichsel and A. P. Pentland,1994), at first RGB image is converted into a binary image. By calculating the average RGB value for each pixel, the image is converted into the binary image. If the calculated value is smaller than 110, it is replaced by black pixel, if not then replaced by a white pixel. After that, scan begins from the center of the image to get the temple, then consecutive white pixels are found following a consecutive black pixel. The highest width of the white pixel is searched left along with the right side perpendicularly. Next, if the new width is smaller half of the previous highest width, then the search is stopped. This situation will arise only if eyebrow is detected. Then the face is cut from the initial point of the temple and height will be 1.5 times of its width. X will be equal to the highest width of the temple in Fig 2.

ISBN: 978-1-925488-60-9

Figure 1 : Detection of face(Cutting the face and calculating the face height according to the width)



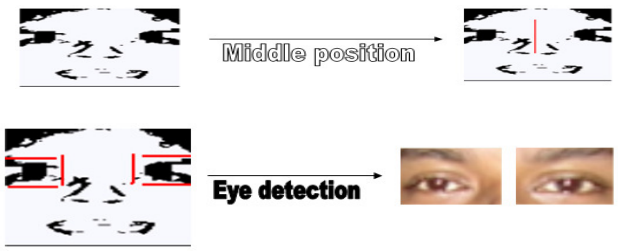
Then the image will contain eyes, nose along with lip. Finally, the RGB image is cut in accordance with the binary image.

3.3. Eye Detection

In case of eye detection (Amer Al Rahayfeh And MiadFaezipour, 2013) , the RGB face is converted into a binary face. The scan starts from the wid/4 to (wid-wid/4) to determine the center point of the two eyes. Then the higher point of the two eyebrows is searched perpendicularly. For the left eye, the scan starts from wid/8 to center and for the right eye, the scan starts from center to wid–wid/8. Here wid is the width of the face. Some white pixels amid the eyebrow and the eye (SayaniGhosh, TanayaNandy and NilotpalManna, 2015) can be found. For making the eyebrow and eye connected, a number of consecutive black pixels are placed perpendicularly from eyebrow to the eye. For the left eye, the perpendicular black pixel-lines are located amid center/2 to center/4 and for the right eye, the lines are amid center+ (wid-center)/ 4 to center+3*(wid-center)/ 4.

Then the lower point of the two eyes is found by detecting black pixel perpendicularly. For the left eye, the scan starts from the center/4 to center- center/4 width. And for the right eye, the scan starts from center+(wid-center)/4 to center+3*(wid-center)/ 4 width from image lower end to the initial point of the eyebrow. Then the right region of the left eye is found via scanning black pixel parallel from the center point to initial point of black pixels amid the higher point and lower point of the left eye. And left region for the right eye is searched from center to the initial point of black pixels amid the higher point and lower point of the right eye. The left region of the left eye is the initial width of the image and the right region of the right eye is the finishing width of the image. Now the higher point, lower point, left region and the right region of the two eyes of the RGB image are cut.

Figure 2: Eye Detection (Finding the center position and separating the eyes)



ISBN: 978-1-925488-60-9

3.4. Lip Detection

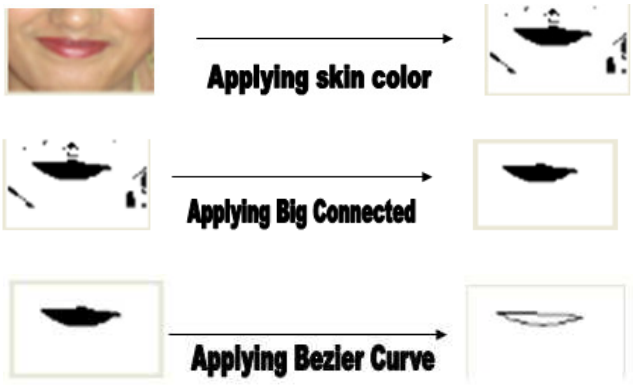
In case of lip detection, at first the lip square is determined and it is considered that lip lies within the lip square. Distance is calculated amid the temple and eyes. Next, this calculated distance is added with the lower height of the eye. By doing this we can find the higher height of the square that has the lip. The initial point of the square will be the ¼ position of the left eye square and finishing point will be the ¾ position of the right eye square. So, this square will contain only lip and some part of the nose. Finally, the RGB image is cut in accordance to the square.

Figure 3: Detection of lip (Adding the distance after calculating it and obtain the lip box)

3.5. Apply Bezier Curve on Lip

The lip square contains lip and some part of the nose. The region of the square contains skin color or the skin. So, the skin pixel is converted into white pixel and other pixels into black pixel. Again those pixels which are alike to skin pixels are converted to the white pixel. If the difference between two RGB pixels is less than or equal 10, they are named similar pixel. Histogram is used for calculating the distance between the lower and higher average RGB value. If the distance is below than 70, then value 7 is used to detect similar pixel and if the distance is greater than or equal to 70 then value 10 is used to detect similar pixel. So, the value to detect similar pixel depends on the class of the image. Then big connected region is applied for detecting the black region which contains lip in the binary image. Lip is the big connected region as in the lip square; lip is the biggest thing which is not similar to skin. Then the Bezier curve is applied on the binary lips. To apply Bezier curve (M.Dixit, S.Silkari, 2015), the initial and ending pixel of the lip in parallel is detected. Next two tangents on the upper lip from the initial and ending pixel are drawn

Figure 4: Applying skin color, big connected and then bezier curve on lips.



Then two points on the tangent are detected which is not the portion of the lip. For the lower lip, same approach is applied as the upper lip. Cubic Bezier curve (A. N. Sinha and A. D. Udai, 2008) is used for drawing the Bezier curve of the lip. Two Bezier curves for the lip are drawn.

ISBN: 978-1-925488-60-9

3.6. Apply Bezier Curve on Eye

Now applying Bezier curve on eyes, eyebrow is removed from the eye. At first, 1st consecutive black pixel is searched, after that consecutive white pixel and then consecutive black pixel from the binary image of the eye square. Next, the 1st consecutive black pixel is removed from the square and here the eye square has only eye, it has some skin or skin color in the region of the square. Similar skin color like the lip is applied for finding the region of the eye. After that, big connect is applied for locating the largest connected region. Here this is the eye as in the eye square,eye is the major part which is different to the skin color. Afterward Bezier curve is applied on the eye square like the process used for the lip. Finally, the outline of the eye is detected.

Figure 5: Remove eye brow and apply skin color

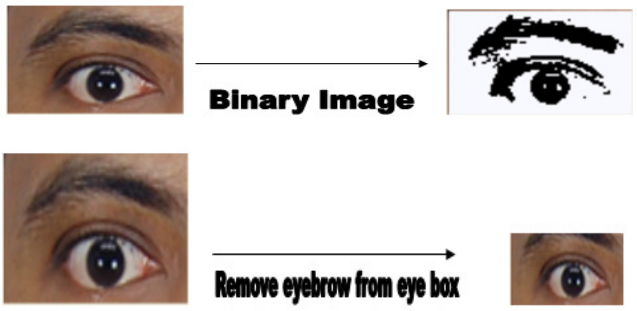


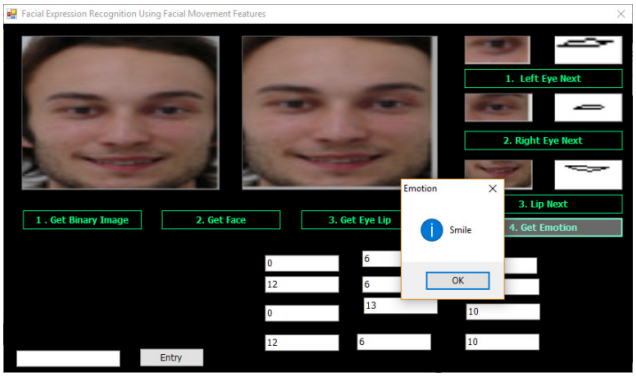
Figure 6: Apply big connected and Bezier curve on eye

3.7. Emotion Detection

To figure out the emotional state (K.Dewoolkar, G.Bhole, A.Mehta, A.Choudhari.)of a face, Bezier curve of the lip, left eye and right eye is found. Then each width of the Bezier curve is converted into 100. Height is calculated in respect of its width.After matching current height with the emotion's height which is available in the database , the output will be the closest emotional state. If the database does not contain the information about that emotion, then the system calculates the average height of each emotion in the database for all people and then gets a result with respect to the average height.

ISBN: 978-1-925488-60-9

Figure 7: Detection of emotion



4. Classification

Classification (Wikipedia,Statistical_Classification)is the plan of arranging to which of an arrangement of classes, a most recent investigation has a place, on the establishment of a preparation set of information having comments whose classification affiliation is recognized.

4.1. Weka

Essentially, WEKA is an arrangement of machine learning calculations for information mining errands. WEKA gives apparatuses which help in – information pre-handling, order, relapse, bunching and perception.

4.2. Artificial Neural Network

By and large, an ANN (J. Hertz, A. Krogh, and R. G. Palmer,1991) (S. H. Lin, S. Y. Kung, and L. J. Lin,1997)comprises of an arrangement of information esteems (xi) related weights (wi).It is a function(g) that sums the weights and plots the result to an output(y).
We have executed ANN in WEKA utilizing Multilayer Perceptron.

Multilayer Perceptron:

A multilayer perceptron (MLP) is fundamentally a bolster forward simulated neural system display which plot an accumulation of info information onto an arrangement of appropriate outputs.MLP utilizes an administered learning strategy got back to proliferation (Y. Le Cun, B. Boser, J. S. Denker, D. Henderson, R. E. Howard, W.Hubbard and L.D. Jackel,1989)for preparing the system.

4.3. Naïve Bayes Classifier

It is a characterization procedure organized on Bayes' Theorem with a speculation of freedom among indicators. It is a characterization calculation which settles on the choice for an obscure informational collection.

ISBN: 978-1-925488-60-9

4.4. SVM:

Support Vector Machine assembles a hyper plane or number of hyper-planes in a high-or interminable dimensional space, which can be utilized for grouping or different assignments.

5. Applying the Classifiers and Result Comparison:

5.1. Preparing Dataset:

A dataset is prepared by taking 70 images of four types of facial expressions (Sad, Happy, Normal and Surprised) and then analyzing each single image through the developed software application to find out the major varying facial attributes which will build our dataset. So our total features for our final dataset is (4 control points for Lip, 4 control points for right eye, 4 control points for left eye and expression) total 13 attributes and stored into a database directly from the application. Then final dataset is taken into ".arff" format to be used in WEKA. Firstly we use this total data to build up our training set and test set for the classifiers.

5.2. Building Training and Test Dataset for ANN:

5.2.1. For Building Training Dataset:

Amongst total of 70 entries of final dataset and after loading it into WEKA and using the filter "Remove Percentage 40%", 42 data are chosen and used as the Training Dataset for WEKA.

5.2.2. For Building Test Dataset:

For test dataset total original of 70 entries are used.

5.3. Building Training and Test Dataset for Naïve Bayes:

5.3.1. For Building Training Dataset*:*

Amongst total of 70 entries of final dataset and after loading it into WEKA and using the filter "Remove Percentage-35.0", 45 data are chosen and used as the Training Dataset for WEKA.

5.3.2. For Building Test Dataset

For test dataset total original dataset of 70 entries is used.

ISBN: 978-1-925488-60-9

Table 1: Comparison of Accuracy Factors between Classifiers (Naïve Bayes & ANN)

Comparison Factors	ANN (MLP)	Naïve Bayes
1.Correctly Classified Instances(Out of 70)	61	60
2.Incorrectly Classified Instances (Out of 70)	9	10
3.Training Set Accuracy	97.619%	91.1111%
4.Test Set Accuracy	87.1429%	85.7143%

5.4. Building Training and Test Dataset for accuracy of recognizing a particular expression:

For this amongst 70 data two expression pair "Smile-Normal" consisting of total 19 data for smile and normal are formed for a training dataset and another pair "Sad-Surprise "consisting of total 9 values of sad and surprise as a training dataset for these two expressions. For testing dataset only the data for a particular expression is taken excluding the ones in training dataset and is tested against the training data.

5.4.1. For Building Training Dataset:

Two pairs were considered for building training dataset**.**

5.4.1.1. Normal-Smile Pair : For this dataset first 10 values for expression "Smile" and 9 values for "Normal" were taken respectively from original dataset of 70 data and was converted into ".arff" format. A total data of 19 entries are used here.

5.4.1.2. Sad-Surprise Pair : For this dataset first 2 values for expression "Surprise" and 7 values for "Sad" were taken respectively from our original dataset of 70 data and was converted into ".arff" format. A total of 9 entries are used in this dataset.

5.4.2. For Building Test Dataset:

5.4.2.1. Testing Dataset for Smile: The rest of the 14 data excluding the data used for training dataset, representing "Smile" expression was taken from the original dataset.

ISBN: 978-1-925488-60-9

Table 2: Comparison of accuracy for correct recognition for the expression "Smile"

Expression	ANN (MLP)	Naïve Bayes	SVM (SMO)	Comparison Factor
Smile (Training Set: Smile-Normal pair) (Test Set: Only data representing Smile)	14(out of 14 test data)	14(out of 14 test data)	13(out of 14 test data)	1.Correctly Classified
	0(out of 14 test data)	0(out of 14 test data)	1(out of 14 test data)	2.Incorrectly Classified
	100 %	100 %	92.86%	3.Accuracy

5.4.2.2. Testing Dataset for Normal: Apart from the data used in training dataset rest of 9 data representing "Normal" expression in the original dataset were chosen.

Table 3: Comparison of accuracy for correct recognition for the expression "Normal"

Expression	ANN (MLP)	Naïve Bayes	SVM (SMO)	Comparison Factor
Normal (Training Set: Smile-Normal pair) (Test Set: Only data representing Normal)	6(out of 9 test data)	8(out of 9 test data)	7(out of 9 test data)	1.Correctly Classified
	3(out of 9 test data)	1(out of 9 test data)	2(out of 9 test data)	2.Incorrectly Classified
	66.67 %	88.89 %	77.78 %	3.Accuracy

5.4.2.3. Testing Dataset for Surprise*:* For this 4 data representing "Surprise" expression was taken from the original dataset.

Table 4: Comparison of accuracy for correct recognition for the expression "Surprise"

Expression	ANN (MLP)	Naïve Bayes	SVM (SMO)	Comparison Factor
Surprise (Training Set: Sad-Surprise pair) (Test Set: Only data representing Surprise)	4(out of 4 test data)	2(out of 4 test data)	4(out of 4 test data)	1.Correctly Classified
	0(out of 4 test data)	2(out of 4 test data)	0(out of 4 test data)	2.Incorrectly Classified
	100 %	50 %	100 %	3.Accuracy

ISBN: 978-1-925488-60-9

5.4.2.4. Testing Dataset for Sad: Apart from the data used in training dataset rest of 6 data representing "Sad" expression in the original dataset were chosen.

Table 5: Comparison of accuracy for correct recognition for the expression "Sad"

Expression	ANN (MLP)	Naïve Bayes	SVM (SMO)	Comparison Factor
Sad (Training Set: Sad-Surprise pair) (Test Set: data representing Sad)	5(out of 6 test data)	6(out of 6 test data)	5(out of 6 test data)	1.Correctly Classified
	1(out of 6 test data)	0(out of 6 test data)	1(out of 6 test data)	2.Incorrectly Classified
	83.33%	100%	83.33%	3.Accuracy

6. Conclusion

Human detect and identify faces and facial expressions in a scene with little or no effort. Still, development of an automated system that accomplishes this task is rather difficult. A new way for acknowledging the group of facial expression is projected in this paper. Four different facial expressions of a total of 70 persons pictures which have been studied. 3rd order Bezier curve has been used to detect the facial outlines and expressions. The adoption of the Cubic Bezier curves means four control points are used to signify a curve. Though this way has been applied on only some persons, however trial results reveal that this way is dependable providing the images symbolize a diverse outlook of the faces and are low resolution images.

References

Abdesselam Bouzerdoum, Son Lam Phung, and Douglas Chai. "Skin Segmentation Using Color and Edge Information", 0-7803-7946-2/03/2003 IEEE.

A. D. Udai and A. N. Sinha,(2008) "Computer Graphics", *The Mc Graw-Hill Publication*, 1st Ed.

A. Garg,I. Cohen, and T. S. Huang.(December 2000) "Emotion Recognition from Facial Expressions using Multilevel HMM". In Proc.of the 2000NIPS Workshop on Affective Computing,Denver,Colorado,USA.

A. K. Jain and S. Z. Li.(2005) "Handbook of Face Recognition". Springer-Verlag New York, Inc., Secaucus, NJ, USA.

A. K. Jain,R. L. Hsu, M. A. Mottaleb ,(2002) "Face detection in color images". *IEEE Trans. Pattern Analysis and Machine Intell*, 24:696–706.

A. Krogh, J. Hertz, and R. G. Palmer, (1991)"Introduction to the Theory of Neural Computation", Addison-Wesley Publishing Company, Reading, Massachusetts.

A.Mehta,A.Choudhari K.Dewoolkar,G.Bhole,."Facial Expression Recognition using Image Processing".

A. P. Pentland and M. Bichsel.(1994)Human face recognition and the face image setstopology.

Amer Al Rahayfeh And MiadFaezipour (Member, IEEE),(November 2013), Eye Tracking and Head Movement Detection:A State of Art Survey, IEEE.

ISBN: 978-1-925488-60-9

Aryuanto Soetedjo.(June 2011) "EXPERIMENTAL STUDY ON LIP AND SMILE DETECTION,"60JournalIlmu Computer danInformasi, Volume 4, Nomor 2.

A. Tange ,H. Kobayashi,and F. Hara." Real time recognition of six basic facial expressions" *Proceedings of the IEICE General Conference,* 1995:256, 19950327.

B. Boser, Y. Le Cun, J. S. Denker, D. Henderson, R. E. Howard, W.Hubbard and L.D. Jackel,(1989)"Back Propogation applied to handwritten zip code recognition " Neural Computation , vol. 1 pp.541-551.

B. Fasel and J. Luettin "Automatic facial expression analysis: A survey;" Pattern Recognition, vol.36,no. 1, pg.259-275, 2003 Edition

Caifeng Shan."Smile Detection by Boosting Pixel Differences", IEEE TRANSACTIONS ON IMAGE PROCESSING, Volume 21,NO. 1, JANUARY 2012.

Classification :https://en.wikipedia.org/wiki/Statistical_classification

Dong Li ,Shuai Shi Liu, Yan Tao Tian(July 2009) "New Research Advances Of Facial Expression Recognition*",IEEE Proceedings of the Eight international Conference on Machine Learning and Cybernetics*, Baoding, 12-15.

F. B. Claude C. Chibelushi. (2003)"Facial expression recognition: A brief tutorial overview" [Online accessed 20-November-2007].

G. H. and P. M.(2009) "Automatic Temporal Segment Detection and Affect Recognition from Face and Body Display*".IEEE Transactions on Systems, Man, and Cybernetics - Part B*, 39(1):64–84.

J. Bassili. "Emotion recognition: the role of facial movement and the relative importance of upper and lower areas of the face"J Pers Soc Psychol, 37(11):2049{58,1979.

L. J. Lin.,S. H. Lin, S. Y. Kung (January 1997) "Face recognition/detection by probabilistic decision based neural network". *IEEE Transactions on Neural Networks,Special Issue on Artificial Neural Networks and Pattern Recognition*, vol8, no. 1 , pp. 114-132.

M.Dixit,S.Silkari(2005) "Face Recognition Using Approximated Bezier Curve and Supervised Learning Approach",*International Journal of Multimedia and Ubiquitous Ebgineering*. Vol.10,No 4,pp 311-324.

M. Nakano ,Y. Koda, Y. Yoshitomi,and M. Tabuse (September-October 2009). "Facial Expression Recognition for Speaker using Thermal Image Processing and Speech Recognition System". In Proc. of the 18th *IEEE International Symposium on Robot and Human Interactive Communication* (RO-MAN'09), Toyama, Japan, pages 955–960. IEEE.

NilotpalManna,SayaniGhosh and TanayaNandy(2015) "Real Time Eye Detection and Tracking Method for Driver Assistance System", Springer.

Pinky rai, (July-2013,)"Smile detection via Bezier curve of moth interest points" *International Journal of Advanced Research in Computer Science and Software Engineering* 3(7), pp.802-806.

Y. Zhang and Q. Ji.(2005) Active and dynamic information fusion for facial expression understanding from image sequences.IEEE Transactions on Pattern Analysis and Machine Intelligence, 27(5):699 714.