Performance Evaluation of HVNLBP and SVM for Facial Emotion

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Abstract: **Facial emotion recognition is challenging task as maximum face region expressions are required to be captured in terms of distinctive features. This paper focuses on evaluation of performance of local binary pattern (LBP) and hvnLBP methods for feature extraction capability for face emotion recognition. The conventional classifiers based performance evaluation is done for multiclass classification in which almost 98.5% accuracy of emotion recognition is seen with use of hvnLBP feature and support vector machine classifier.**

Keywords: **LBP, hvnLBP, SVm, performance, Accuracy, Facial Emotion Recognition.**

I. Introduction

Welcome to International Journal for Research in Detailed Facial features plays important role while recognizing the facial emotions. The commonly used local binary pattern (LBP) method can extract features related to locations of eyes, chick, chin, nose and mouth. The detailed variation iwthing two images having different emotional expressions is challenging task.

One of the most crucial processes in picture description is feature extraction. Each feature extraction method has advantages and disadvantages of its own. A thoughtfully combined set of features, retrieved via various methods, can improve an application's ability to describe images [1].

This research suggests a modified Local Binary Pattern-based facial feature extraction technique (hvnLBP). The image is first acquired in this system. The supplied image is then preprocessed to account for changes in illumination. A face-detection algorithm recognizes faces and cuts out the faces. Then, features from the input image are extracted using the suggested LBP.

A modified LBP operator that conducts horizontal and vertical neighborhood pixel comparison is proposed, in order to overcome the drawbacks of original LBP by retrieving the missing contrast information embedded in the neighborhood to generate the initial discriminative facial representation [2].

II. RELATED WORK

In paper [3], producer dissected future face disclosure dataset and introduced WIDER FACE dataset which is extra outstanding and includes a number sorts of appearances which include obstacle, positions, scale, etc. Past dataset like ALFW, FDDB, and PASCAL FACE do not have sufficient arranging information. They alluded to as, unique face vicinity strategies, produce poor models. They motive that WIDER dataset from a range of foundation, chips away at the graph with each poor and effective models. Here producer proposed a multi-scale two-stage flood shape to put together dataset. Different method attracted with the direction of section extraction and specific datasets like Cohn Kanade, AR enlightening assortment, JAFFE data base, and so forth was once proposed in [4].

In [5] the producer dissected about one-of-a-kind calculation, for example, Viola-Jones face affirmation and mind-set expulsion vector. While seeing face in the picture, troubles like brightening, aggravation emerges. To vanquish aggravations, pre-managing ought to accomplish face region. Four kinds of techniques have been examined for face affirmation. They are Template matching primarily based approach, Knowledge-based approach, Appearance-based approach, Feature invariant framework in [6].

To acquire excessive precision in face depiction Nianyin Zenga et al in [7] proposed Deep Sparse AutoEncoders (DSAE). The DSAE gain is, it take out characteristic questioning about free learning. It shops essentially indispensable data. [6] To dispense with specific phase in the human face is a sizable occupation in characteristic extraction. Various structures have been evaluated like Principal Component Analysis (PCA), Gabor wavelet, Linear Discriminant Analysis (LDA), Discrete Wavelet Transform (DWT), Bezier distort. A excessive layered solidify, via becoming a member of look and numerical parts. The maker in [9] used direction of motion of face datasets like MMI, CK+,FERA, DISFA, SFEW,

 DOI : 10.35291/2454-9150.2022.0456

MultiPIE. [9] In this paper, the maker proposed a response with the aid of becoming a member of photo preprocessing steps and Convolutional Neural Network.

[10] Author used PCA, LBP and HOG for contain extraction techniques are used for depiction of face. The shut through elements are taken out in every aspect the use of Gabor wavelets with picked scales and path have been proposed by using the maker Ithaya et al [11]. These components are exceeded to a get-together classifier for seeing the region of face locale. The made method is carried out 98% exactness the use of CK dataset.

III. Proposed Work

The general steps in facial emotion recognition system are shown in figure 1.

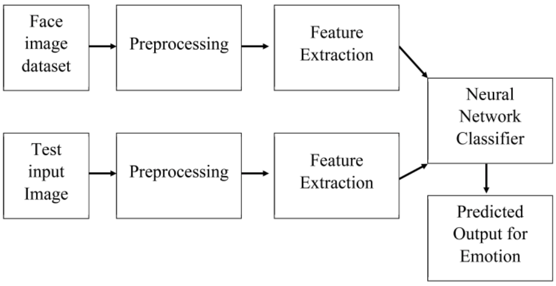

Figure 1: Block diagram of Proposed System

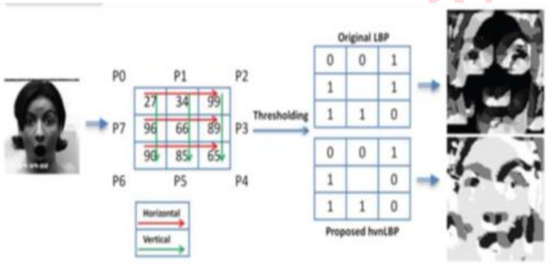

Figure 2: hvnLBP operator vs LBP.[2]

Procedure:

The Facial Feature Extraction as shown in the block diagram is as follows;

1. Image Acquisition: The first step of image acquisition is capturing image through camera interface. The dataset images can also be used which are captured using same camera.
2. Preprocessing: During image capture different light conditions in the environment are seen. The changes in illumination are required to be brought at uniform level which is achieved in the preprocessing stage.
3. Face Detection: For detection of facial features, face region from image is required to be located. The face region location can be done by using haar cascade classifier model. The detected face region then cropped from the image and processed further for feature extraction.
4. Modified-Local Binary Pattern (hvnLBP): In this stage modified-LBP feature extraction is performed due to which the discriminative facial features are extracted.
5. Classifier: The proposed system for facial emotion recognition consist of SVM classifier. The results of different classifiers are also used for comparative analysis as explained in results and analysis section.

Adaptive Histogram Equalization

In contrast to standard histogram equalization, adaptive histogram equalization computes many histograms, each corresponding to a different region of the image, and uses them to disperse the image's brightness values.

LBP (Local Binary Pattern)

Local binary pattern is created in the following manner:

- It first creates cells out of the window being viewed (each cell is, for instance, 16*16 pixels).
- Compare each pixel in a cell to each of its eight neighbors (on its left-top, left-middle, left-bottom, right-top, etc). Circularly, either clockwise or counterclockwise, move the pixels.
- Write "0" in cases when the value of the center pixel is higher than that of its neighbor. If not, type "1". Thus, an 8-digit binary number is produced (which is usually converted to decimal for convenience).

This way from input image, facial images are obtained.

hvnLBP (Modified Local Binary Pattern)

LBP [20], a well-known texture descriptor, uses a circular neighborhood to extract features. The contrast information between the neighborhood pixels is likely to be lost because the original LBP operator compares only the core pixel and the eight pixels around it. We suggest using hvnLBP to fill in the gaps in the neighborhood pixels' contrast information in order to resolve this issue. hvnLBP uses horizontal and vertical neighborhood pixels for direct comparison in place of the central pixel as in the original LBP to obtain the ensuing textural descriptions. [2].

As an example, we employ

P = {pi}| i=1:9

to represent the eight neighborhood pixels in LBP, as shown in Fig. 2. In either vertical or horizontal comparison, the values of the vertical or horizontal neighboring pixels are compared with one another. A 1 is assigned to the pixel with the highest value and a 0 is assigned to the remaining pixels. This horizontal and vertical comparison process can be conducted in any order, i.e., horizontal comparison followed by vertical comparison, or vice versa. Moreover, in both vertical and horizontal comparisons, we do not include the center pixel for comparison. Referring to Fig. 2, as an example, for horizontal comparison, we first compare the pixel sets of {p0, p1, p2}, {p7, p3}, and {p6, p5, p4}. Subsequently, we conduct the vertical comparison with the pixel sets of {p0, p7, p6}, {p1, p5}, and {p2, p3, p4}.

 DOI : 10.35291/2454-9150.2022.0456

ISSN : 2454-9150 Vol-08, Issue-07, Oct 2022

If a pixel has conflicting outputs in the horizontal and vertical comparisons (e.g., the highest value in the horizontal comparison but not in the vertical comparison, or vice versa), then the highest value (i.e., 1) is used as the final output, since the pixel is regarded as important, which contains valuable contrast information in the dimension that generates the highest value. The mathematical representation of this proposed hvnLBPp,r operator is illustrated as follows:

$$hvnLBP_{p,r} = \{S(\max(l0, l1, l2)), S(\max(l7, l3)), S(\max(l6, l5, l4)), S(\max(l0, l7, l6)), S(\max(l1, l5)), S(\max(l2, l3, l4))\} \quad ...(1)$$

where p is the number of neighborhood pixels, and r is the radius. Li represents the ith neighborhood of pixel l while S denotes the comparison operation, as follows:

$$S(\max(lj, lk, lm)) = \begin{cases} 1 & \text{if maximum} \\ 0 & \text{if non\_maximum} \end{cases} \quad ...(2)$$

where lj, lk, and lm represent the neighborhood pixels in a row or column.[2]

As we compare conventional LBP with hvnLBP i.e. modified LBP, the results indicates that modified LBP is more capable of capturing discriminative contrast information (corners and edges) among neighborhoods.

IV. Results and Analysis

Facial Region Extraction

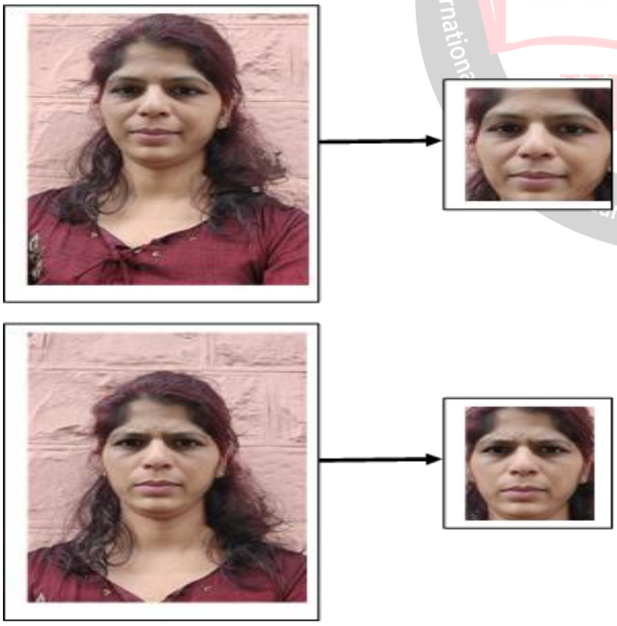

Figure 3: Facial Region Extraction

Classification:

The proposed face emotion recognition system is implemented using SVM, decision tree, Naïve Bays and ANN classifiers. The comparative results are obtained for classification of 5 classes of emotions. The classification accuracy is seen better for SVM model. The one against all type of classification configuration is done as these classifiers are used generally for binary classification. The multiclass classification along with LBP and hvnLBP results are analyzed. The performance outcome is shown in table 1 and 2 along with graphical results in figure 4 and 5 with LBP and hvnLBP features respectively.

Table 1: Classification performance with LBP features

Classifier	Accuracy	Specificity	Sensitivity
SVM	96.5	85	89
DT	91	81	80
NB	87	75	81
ANN	89	81	80

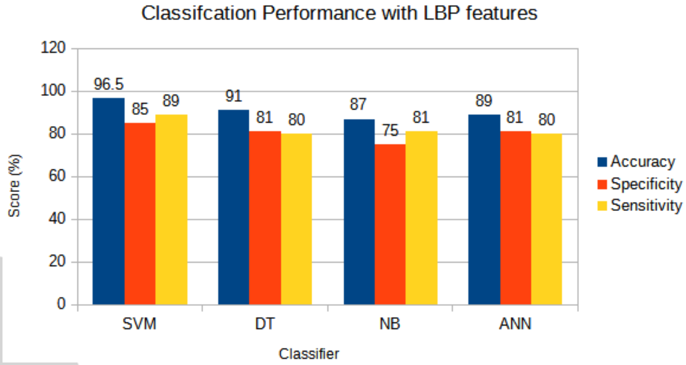

Figure 4: Classification performance with LBP features

Table 2: Classification performance with hvnLBP features

Classifier	Accuracy	Specificity	Sensitivity
SVM	98.5	91	92
DT	92	86	84
NB	89	81	85
ANN	91	86	84

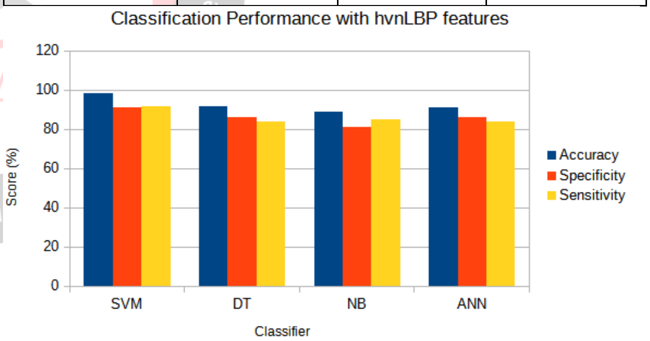

Figure 5: Classification performance with hvnLBP features

V. Conclusion

This paper contributes the performance evaluation of LBP and hvnLBP features with different conventional neural network classifiers. The performance of support vector machine (SVM) is seen well with 96.5 % accuracy for LBP classifier. Almost 2% accuracy is seen to have improved with hvnLBP features due to detailed features of the face. Almost 98.5% accuracy is seen for facial emotion recognition system with use of hvnLBP features and SVM classifier.

 DOI : 10.35291/2454-9150.2022.0456

ISSN : 2454-9150 Vol-08, Issue-07, Oct 2022

The performance of SVM is seen better which can further be enhanced with use of deep features using deep learning classifier.

References

[1] Stefanos Zafeiriou, Cha Zhang and Zhengyou Zhang , "A Survey on Face Detection in the wild: past, present and future" Computer Vision and Image Understanding Volume 138, September2015, Pages 1-24.

[2] A survey of face detection algorithms Ankit Srivastava,Suraj Mane, Aaditya Shah, Nirmit Shrivastava, Prof. Bhushan Thakare,2017 IEEE International Conference on Inventive Systems and Control.

[3] "WIDER FACE: A Face Detection Benchmark", Shuo Yang1 Ping Luo, Chen Change Loy, Xiaoou Tang, IEEE Conference on Computer Vision and Pattern Recognition

[4] "Literature survey on Face and Face Expression Recognition", Anil J, Dr. L. Padma Suresh, 2016 International Conference on Circuit, Power and Computing Technologies.

[5] "Facial Expression Recognition: A Literature Survey", Assoc Prof. Mrs. Jyothi S Nayak, Preeti G, ManishaVatsa, Manisha Reddy Kadiri, Samiksha S International Journal of Computer Trendsand Technology (IJCTT) – Volume 48 Number 1 June 2017.

[6] "A Review: Facial Expression Detection with its Techniques and Application", Neha Bhardwaj and Manish Dixit, International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.9, No.6 (2016), pp.149- 158

[7] "WIDER FACE: A Face Detection Benchmark", Shuo Yang1 Ping Luo, Chen Change Loy, Xiaoou Tang, IEEE Conference on Computer Vision andPattern Recognition

[8] "Literature survey on Face and Face Expression Recognition", Anil J, Dr. L. Padma Suresh, 2016 International Conference on Circuit, Power andComputing Technologies.

[9] "Facial Expression Recognition: A Literature Survey", Assoc Prof. Mrs. Jyothi S Nayak, Preeti G, ManishaVatsa, Manisha Reddy Kadiri, Samiksha S International Journal of Computer Trends and Technology (IJCTT) – Volume 48Number 1 June 2017.

[10] "A Review: Facial Expression Detection with its Techniques and Application", Neha Bhardwaj and Manish Dixit, International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.9, No.6 (2016), pp.149-158

[11] "Facial expression recognition via learning deep sparse autoencoders", Nianyin Zenga ,Hong Zhanga , Baoye Song, Weibo Liuc , Yurong Li d,e , Abdullah M. Dobaief, Neurocomputing ·September 2017.

DOI : 10.35291/2454-9150.2022.0456