International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-6, Issue-7, July 2018 E-ISSN: 2347-2693

# Selective Block Local Binary Pattern Based Algorithm for Face Recognition

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**Available online at: www.ijcseonline.org**

Accepted: 06/Jul/2018, Published: 31/Jul/2018

***Abstract* -** This paper presents the selective block local binary pattern algorithm for human face recognition. Various LBP methods were used to improve the recognition rates. The most important step in face recognition is the feature extraction. Tolerance to illumination variation and computational simplicity is made LBP a very popular method for pattern recognition system. Traditional LBP method is compared with the selective blocks LBP methods by conducting the experiments using ORL and UMIST datasets.

***Keywords* -** Local Binary Pattern, Selective Block, Pattern Recognition, Feature Extraction, Histogram, Face Recognition.

## I. INTRODUCTION

The different types of biometrics techniques are iris, signature, retina, voice, finger prints, hand, ear and face. Out of these techniques, facial recognition is considered as one of the most universal, collectable and accessible systems. It is a very big challenging task as it includes variety of parameters such as illumination, changes in pose, face background i.e. hair, expressions, head size etc. On human face recognition many research is going on and it is an active research area. Features of images used for recognition and matching of two images. Local Binary Pattern (LBP) is one of the feature extraction technique used for classification, clustering and segmentation [1]. The LBP technique was discussed for texture classification [2] using basic LBP as well as other extended methods. Beauty of the algorithm is calculation part. The variation of the algorithm was used for different applications [3]. So the aim is to design a face recognition system which can give a better result than the traditional LBP method.

## II. LITERATURE SURVEY

Survey shows that Local features focuses on the local parts of the face, which helps to recognize the face more accurately using the unique detail details whereas global features focuses on whole face image. LBP works on the basis of local features. It is the ordered set of binary comparisons of pixel intensities between the centre pixel and its surrounding pixels.

The face images are divided into several small blocks and descriptor of that block is calculated using Local Binary Pattern. T. Ahonen, A. Hadid, and M. Pietikainen, "Face Description with Local Binary Patterns: Application to Face Recognition"[16]proposed same method for the face recognition which concatenates all those block features to describe the face. Same approach was used by Md. Abdur Rahim, Md. NajmulHossain, Tanzillah Wahid & Md. ShafiulAzam, "Face Recognition using Local Binary Patterns (LBP)"[4] which is used to consider shape and texture information of face images for person independent face recognition. Histograms of extracted LBP were concatenated to get the feature vector. Face recognition can be done with the help of this efficient feature vector. The component based framework for face identification and detection was proposed by Thomas Serre*et al.*[14] This framework consists of two layers of classifiers one layer with a set of component classifier and other layer with a single combination classifier. The component classifier independently identifies facial parts in the image. The output obtained from the component classifier is passed to the combination classifier to identify the face. The experiments compare the detection and identification systems to standard global approaches. Results show that the component-based approach is better than the global approaches.

Rest of the paper isorganized as follows, Section I contains the introduction of face recognition and feature extraction technique, Section II contain the related work of literature survey, Section III contain the concepts of local binary pattern, Section IV contain the description of datasets being used, section V explains the proposed methodology

with the results, Section VIconcludes research work with future directions.

## III.LOCAL BINARY PATTERN

LBP stands for Local Binary Pattern, which is proposed by Ojala in 1990. LBP method is easy and efficient to extract the local features from given input face. LBP has wide application in face recognition as well as it used in real time environment because of its two important properties. They are (i) LBP features are computationally simple and (ii) LBP features are able to work for various illumination conditions. LBP feature vector can be calculated with the help of neighbourhood as-

- Divide the examined window into cells.
- Consider a centre pixel in cell, compare this central pixel with its eight surrounding neighbours pixels. Follow the pixels either a clockwise or anticlockwise along the circle.
- If the value of the centre pixel is greater than the neighbour's pixel value then consider it as "0" or if the value of the centre pixel is lesser than the neighbor's pixel value consider it as "1". It gives results of binary number which is of 8 digits, and thenconverts binary number into decimal number.
- Histogram which is of 256-dimensional are computed based on the obtained feature vector over the cell.

**LBP Features:**

Labelling of pixels of an image with the decimal numbers is done by the LBP operator is known as LBP codes or Local Binary Pattern. It helps to encode the local structure around each pixel. Fig1 below shows an example of LBP operator, which gives complete details how LBP works on the input image. Here in a 3x3 neighborhood, each pixel is compared with its 8 neighbour pixels by subtracting the central pixel value. If the value of the neighbor pixel is greater than the centre pixel then it is encoded as '1' else it is encoded as '0'. By concatenating the entire neighbor binary codes either in a clockwise or anticlockwise we obtain a result of binary number and its corresponding decimal number, which is used as feature value for the particular pixel of an image.

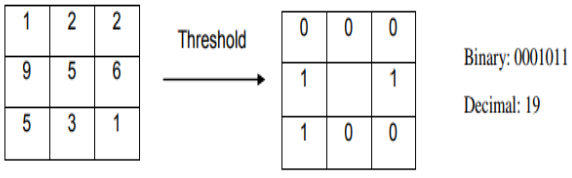



*Fig1: LBP Operator*

Fig2 shows the extended LBP operator; here the notation (P, R) denotes a neighborhood of P sampling points on a circle of radius of R. Circular (8,1.0) shows there are 8 neighbors around the central pixel with a radius of 1, similarly for circular (12,2.5) and (16,4.0) neighborhoods are sown in the figure.

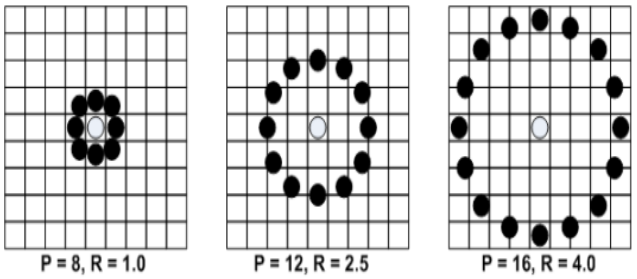



*Fig2: Extended LBP Operator*

The Fig 3 shows how exactly LBP works. At first divide the image window into cells. Then histogram for each cell is calculated. Concatenation of obtained LBP histogram for each cell gives a result of Feature histogram.

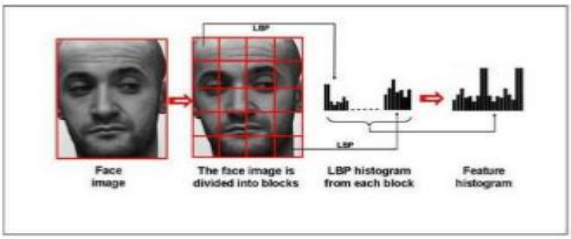
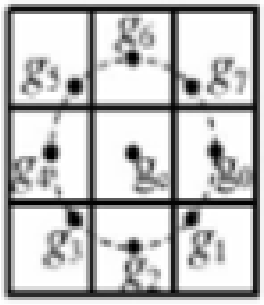



*Fig3: Working of LBP*

LBP calculation for 8 neighbors with the radius 1 is shown below,



$$LBP_{8,1} = S(g_0 - g_c)2^0 + S(g_1 - g_c)2^1 + S(g_2 - g_c)2^2 + S(g_3 - g_c)2^3 + S(g_4 - g_c)2^4 + S(g_5 - g_c)2^5 + S(g_6 - g_c)2^6 + S(g_7 - g_c)2^7$$

*Fig4: Calculating LBP value*

LBP features of a pixel's circularly neighborhoods are denoted by LBPp,r , where p is the number of neighborhood points present on the circle and r is the radius. LBPp,r code is obtained as –

$$LBP_{p,r} = \sum_{p=0}^{p-1} S(g_i - g_c)\,2^i \,, S(x) = \begin{cases} 1 \; if \; x \geq 0 \\ 0 \; otherwise \end{cases}$$

Where $g_c$ is the gray-level value of central pixel, $g_i$ is the grey-level values of surrounding pixels in the circle neighborhood. To reduce the number of possible bins, concept of uniform pattern is introduced. If the binary pattern has at most 2 bitwise transitions from 1 to 0 or vice versa then such type of LBP pattern is known as uniform pattern. For example if the bit pattern 11111111(no transition) or 00110000 (two transitions) are uniform whereas 10101011 (six transition) are
not uniform. The uniform pattern constraint reduces the number of LBP pattern from 256 to 58 and it is very useful for face detection.

## IV. FACE DATASETS

The experiments using LBP are performed on standard ORL and UMIST face datasets. In the experiment, Euclidian distance was used as the similarity measure for classification.

**ORL dataset**
The ORL face dataset consists of gray-scale images of 40 individuals each with 10 samples. They represent some variation in facial expressions, facial details, scale and also limited rotation. All images are cropped to size of 112 x 92 pixels. Fig. 5 shows the subset of one such subject of the ORL dataset.

*Fig5: Ten images of one person in ORL*

**UMIST dataset**
The UMIST face dataset consists of 564 images of 20 people with large pose variations. The Fig. 6 shows 15 such samples of a single person in UMIST dataset.

*Fig6 : Fifteen images of one person in UMIST*

## V. PROPOSED METHOD AND RESULTS

The selective blocks of the face are obtained by dividing the face image into different regions of different size. The nine horizontal and the vertical blocks are obtained as shown in the Fig7. These blocks provides the different features of the face image and also addresses the variations in chin, cheeks, forehead and nose.

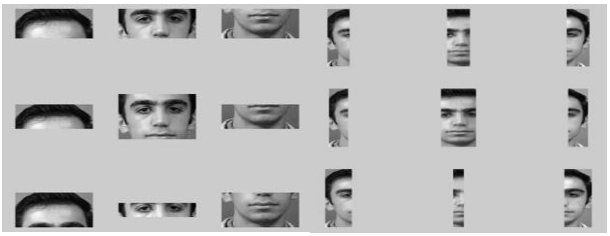


*Fig7 : Face Blocks*

Features are extracted from the horizontal and vertical face image blocks using LBP. Then all these features are used for recognizing the faces. Experiments are carried on these two standard datasets and the results were discussed.

**Experiments on ORL dataset**
The experiments are carried out by varying the number of training samples and testing samples under each subject. In all the cases, the recognition accuracy is measured. The results obtained using traditional LBP on ORL dataset is shown in Table 1.

*Table 1: Recognition Accuracy of LBP on ORL dataset.*

| LBP Algorithm (ORL) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 85.00% |
| 6,7,8,9 | 1,2,3,4 | 81.50% |
| 2,4,6,8 | 1,3,5,7 | 97.50% |

Results obtained using Proposed horizontal face block on ORL dataset are given below.

*Table 2: Recognition Accuracy of Horizontal LBP on ORL data set.*

| Horizontal LBP Algorithm (ORL) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 95.00% |
| 6,7,8,9 | 1,2,3,4 | 98.75% |
| 2,4,6,8 | 1,3,5,7 | 98.75% |

Results obtained using Proposed vertical face block on ORL dataset are given below.

*Table 3: Recognition Accuracy of Vertical LBP on ORL dataset.*

| Vertical LBP Algorithm (ORL) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 85.00% |
| 6,7,8,9 | 1,2,3,4 | 95.00% |
| 2,4,6,8 | 1,3,5,7 | 98.75% |

The combined horizontal and vertical block features are also tested and the obtained results are shown below.

*Table 4: Recognition Accuracy Combined method on ORL dataset.*

| Horizontal +Vertical LBP Algorithm (ORL) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 95.00% |
| 6,7,8,9 | 1,2,3,4 | 100.00% |
| 2,4,6,8 | 1,3,5,7 | 98.75% |

**Experimentation on UMIST face dataset**

Experiments were conducted using alternate samplesas well as continuous samples for training and testing.The recorded recognition rate LBP on UMIST datasetis shown below.

*Table 5: Recognition Accuracy of LBP on UMIST dataset.*

| LBP Algorithm (UMIST) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 70% |
| 6,7,8,9 | 1,2,3,4 | 93% |
| 2,4,6,8 | 1,3,5,7 | 80% |

Proposed horizontal, vertical and combined face block features are used for the recognition and the results are documented as shown in the following tables 6, 7 and 8.

*Table 6: Recognition Accuracy of Horizontal LBP on UMIST data set.*

| Horizontal LBP Algorithm (UMIST) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 78.75% |
| 6,7,8,9 | 1,2,3,4 | 95.00% |
| 2,4,6,8 | 1,3,5,7 | 91.25% |

Table 7: Recognition Accuracy of Vertical LBP on UMIST data set.

| Vertical LBP Algorithm (UMIST) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 70.00% |
| 6,7,8,9 | 1,2,3,4 | 93.75% |
| 2,4,6,8 | 1,3,5,7 | 81.25% |

*Table 8: Recognition Accuracy of Combined method on UMIST data set.*

| Horizontal +Vertical LBP Algorithm (UMIST) | | |
|---|---|---|
| Training Set | Testing Set | Recognition |
| 1,2,3,4 | 6,7,8,9 | 78.75% |
| 6,7,8,9 | 1,2,3,4 | 95.00% |
| 2,4,6,8 | 1,3,5,7 | 88.75% |

## VI. CONCLUSION

In this paper, methodology of Selective Block Local Binary Pattern algorithm was discussed. The two standard face data sets ORL and UMIST are used for conducting the experiments. The results are fairly good using the proposed method in comparison with the basic LBP method. Further results can be improved using the variants of Local Binary Pattern. The main focus was on discriminative capability improvement; enhance robustness and combining different approaches. Many a time combined approaches gives better result than the individual techniques.

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