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Local Directional Pattern for Face Recognition under Varying Illumination Conditions With Deep Learning Methods

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ABSTRACT

In general, for Face recognition, the most significant problem is complex illumination. In this paper, a novel method was proposed by using deep learning to resolve the adverse impact obligated by variations in the illumination in face recognizing process. In the first step, preprocessing of illumination will be applied to enhance the unfavorable effects of intense illumination modifications on different face images. Secondly, Log Gabor filter will be used to get the feature images of vivid scales and directions after that LBP features (Local binary Pattern) of pictures of sub-block will be extracted. Finally, texture based featured histograms will be formed and send as input into the visual layer of DBN (Deep Belief Network), later categorization and recognition will be accomplished through deep learning techniques in DBN. In this proposed approach, experimental outcomes shows that the best performance when compared with other traditional methods.

Keywords: *Log Gabor Filters, Complex-illumination, LBP features and Deep learning.*

INTRODUCTION

From past two decades, outstanding of its expediency and responsiveness, face recognition became a trending research topic in pattern recognition as well as in image processing. Various algorithms were proposed by different authors. Many researches obtained satisfied results under consistent illumination conditions by taking anterior face images. Though, it is still challenging research field, because images of sane person will be differed by its illumination, occlusion, expression, and variation in his poses which causes sharp decline in rate of identification. In field of AI (Artificial Intelligence) and computer vision still it is difficult task to enhance the face recognition in intricate light environment. From past few years many scholars presented different illumination processing algorithms and succeeded to obtain the good results in face recognition under complex illumination surroundings.

What is Face Recognition?

Facial recognition is Biometric identification by scanning a person's face and matches with collection of known faces. It's a computer application procedure for automatic identification of a person from their digital images or video frames. Generally, this will be done by comparing the preferred facial features from different images or datasets. Mostly it was used in security systems and compare with other biometrics like iris and fingerprints.

About Face Recognition

Earlier, law enforcement agencies are the main users of these software's to identify the selected persons in crowded areas. Some countries are using these applications to remove the fake voters. US-Visit program was prepared by US government to identify the foreign travelers who entered in their country by taking their biometrics they will observe the movements of suspected persons and check with their databases.

LITERATURE SURVEY

In this section, different methods of face recognition will be discussed. Traditional methods as well as computer recognizing techniques will be converse on system

evaluation, illumination problems, works on different psychophysical crams and variations in gestures or poses.

Between 1960-70's first semi-automated face recognition system was developed. For this before measuring the distances and rations with respect to a reference point, administrator should locate the ears, eyes, nose and mouth on photos. After that they compare them with reference or existed database. Main problem with these early methods were measurements will be calculated manually.

In 90's Kirby and Sirovich applied PCA (principal Component Analysis), for face recognition predicament. It was a milestone. They took less than 100 values for their algorithm to detect the normalized and suitably aligned face image [1]- [4].

After many research works, scholars believed that face recognition is not similar to other object identifications. Face recognition requires some biometrics which gives high accuracy and less intrusiveness. It gives accuracy with physiological methods without intrusive. Based on this, in 70's the researchers more focused on psychology, security and image processing.

Most of the tech critics, states that Newhan Scheme of 2004 in London never identifies the single criminal in existed database. Some other says that it reduces the crime rate 34 % in Birmingham.

In 2006, algorithms of face recognition were evaluated by FRGC (Face-Recognition Grand challenge). In these tests researchers used face images with high resolution, 3D face scans and iris images. New algorithms gave better results which are ten times more accurate when compared with 2002 and it was 100 times accurate than 1995 methods. Some algorithms identify not only the correct persons and identical twins also.

PROPOSED METHOD

Log-Gabor Filter

As an alternative to Gabor function, Field proposed Log-Gabor function. At frequent scales of logarithms, Gauss transfer function expresses natural images in better way. In frequency domain, definition of Log-Gabor filter is as follows

$$G(f) = \exp\left\{\frac{(-log\frac{f}{f_0})^2}{2(-log\frac{k}{f_0})^2}\right\} \quad (1)$$

Where 'f_0'is center frequency of the filter and 'k' resembles control bandwidth. Log-Gabor filter mainly contains two features. First, it doesn't have any DC component. Thus, influence of illumination-conditions on image processing is small. So in face recognition, up to some extent, one can solve the adverse effects of illuminations. Secondly, at high frequency, Log Gabor transfer function always has some extended tail. Therefore, they're able to encode the natural images effectively than regular Gabor functions which normally over represent low frequent components and low representation of high frequency components in encoding [5].

LBP Operator

Local Binary pattern had several advantages such as invariance in gray translation, variance in rotations, and easy calculation. LBP texture features effectively implemented and gave better performance in different fields like face recognition, analyzation of image, classification of textures and back ground modeling. By comparing every pixel in image with its neighboring pixels one can obtain texture features of 2D images MxN (x, y) [6][7]. Following equation represents the method of encoding

$$F_l(x,y)_{P,R} = \sum_{p=0}^{P-1} s(g_p - g_c)^{2^P} \quad (2)$$

Deep Belief Network (DBN)

Architecture of deep learning is non- supervised neural network consisting of multi layers. Outcome of the previous layer will be input layer for next layer. Main aim is to construct the information about original input and final output will be similar by building the network architecture and train up the parameters.

Typical deep architectures like DBN and CNN were proposed.[23][24]. In figure 1, DBN consist number of unsubstantiated, Restricted Boltzmann Machines (RBM) [8][9]. For DBN, with L-layer hidden units, joints will be distributed among hidden units and visual units and they can be shown as

$$p\left(v, h^{(1)}, h^{(2)}, \ldots\ldots\ldots h^{(l)}\right) = P(v|h^{(1)}p(h^{(1)}|h^{(2)} \ldots\ldots\ldots P(h^{(l-1)}h^{(l)}) \quad (3)$$

Local Directional Pattern

In 2010, Jabid[10] proposed Local directional pattern method. It was extended and better method for feature extraction. Features extracted by LBP were inherited by this method LDP and it has a good stability for random noise. LDP assigns eight-bit binary code for every pixel in the input image. 8-bit pattern was calculated by comparing the relative edge response pixel values distributed in different directions.

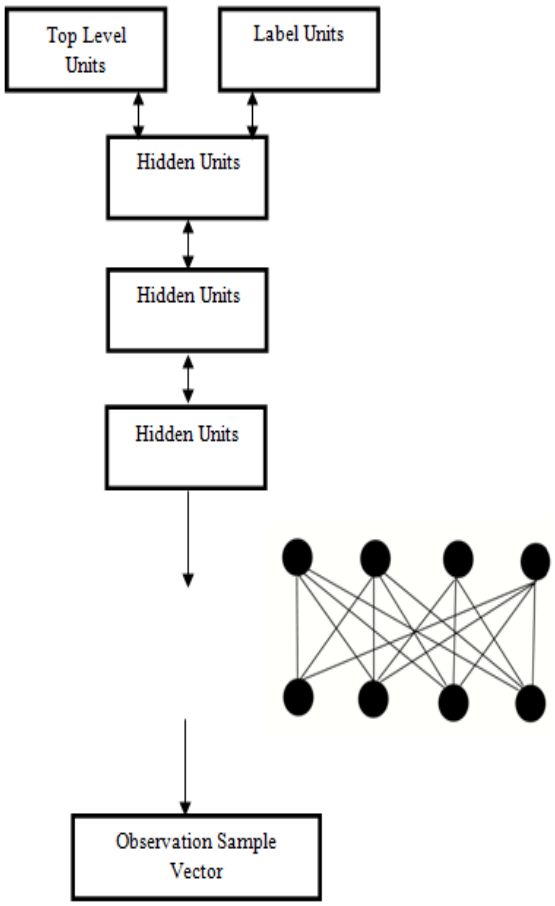

Figure1. *Model of Deep Belief Network*

Thus, this paper calculates the 8 directional edge response values in eight different orientations by using Kirsch masks.

LDP returns the values of 8-directional obtains by convolution operation with 8-krich masks such as M_0, M_1, . . ., M_7along with this. We get8 edge response values also like $m_0, m_1, m_2, m_3, m_4, m_5, m_6, m_7$, which were shown in figure 2. For smooth coding purpose, in this paper absolute value of 8edge response values were taken. In response, values are slightly differed in some directions but presence of edge or corner values show high response in selected directions. So we set the values of top from k to 1, and set other values (8-k) to 0.

$$LDP_k = \sum_{i=0}^{7} S_i(m_i - m_k)2^i \quad (3)$$

Here $s(x) = \begin{cases} 1, x \geq 0 \\ 0, x < 0 \end{cases}$, m_k is the k^{th}

Largest edge response value here k=3, and it calculates the consequent LDP histogram by given formula

$$H_{LDP} = \sum_{x,y} f(LDP_k(x,y), c_i) \quad (4)$$

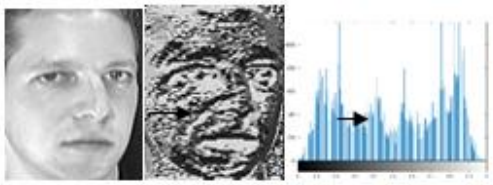

Figure2. *LDP its pattern and its Histogram*

Results and Analysis

To evaluate the performance of the proposed system, it is evaluated with ORL face dataset [11]. Perform pre-processing operation to each image that enhance the contrast of each image and those images are processed for training [12]. The resolution of the images is 119x112 which gray scale images are.

Figure3. *Pre-Process output of the proposed approach*

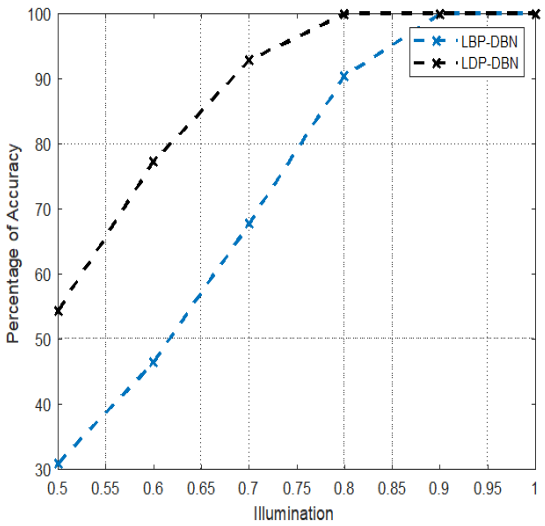

Figure4. *Performance of LBP-DBN and LDP-DBN for varying illumination*

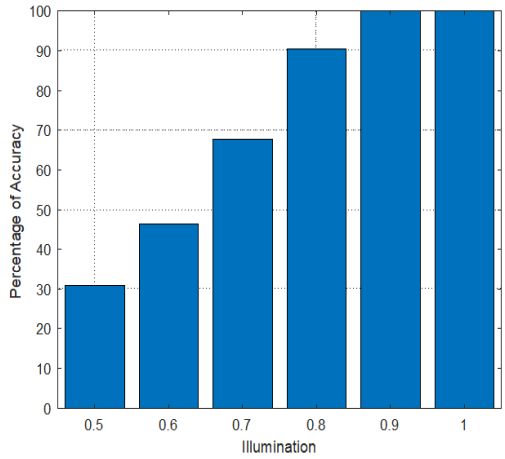

Figure5. *Percentage of Accuracy for LBP-DBN*

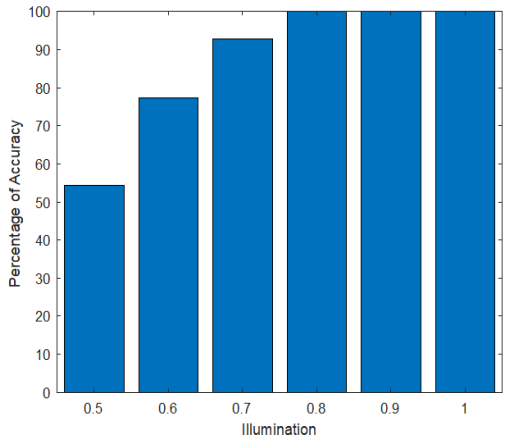

Figure6. *Percentage of Accuracy for LDP-DBN*

From the experimental results it can be observed that the proposed LDP-DBN based approach could able to attain high percentage of accuracy even under the low illumination. This meets the objective of the work which aims to recognize the facial image even under varying and low illumination conditions.

CONCLUSIONS

In this paper, novel method was proposed based on deep learning networks to solve the undesirable impact oblige by illumination variations in face identification. In order to enhance the better results, illumination preprocessing was applied. Log Gabor filter is used to get the Log Gabor feature images of different directions and scales. Along with this LBP features also extracted. After that, these texture features are erudite by DBN network to finish the classification and recognition. Experimental results show the better results when compared with other methods.

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