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Effect of Image Compression with Frame Size and DCT compression using Local Binary Pattern

Padmaja V.K.[1] and Jeevan K.M.[2]
[1]Assistant Professor, Department of Electronics and Communication,
GITAM Deemed to be University, (Bangalore Campus) Karnataka, India.
[2]Assistance Professor, Department of Electronics and Communication,
GITAM Deemed to be University, (Bangalore Campus) Karnataka, India.

(Corresponding author: Padmaja V.K.)
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ABSTRACT: Most of the times, large information exist in the database images requires large storage area and the processing time. To reduce storage and processing time, images sizes can be compressed. By compressing the image sizes, there will be loss of information. Due to loss of information, sometimes face recognition algorithms failed to recognize the subjects of the images. Also major issue is compressed images to be decompressed while using in face recognition. Decompressing a compressed image requires a considerable amount of resources like time, processing power, large memory. So, the face recognition systems would benefit by avoiding this full decompression. That means, the face recognition is implemented with the images in the compressed mode, so that to increase computation speed and overall performance of a face recognition system. The contribution made here is the development of unique method of reducing the frame size for face recognition in place of DCT and DWT transformation techniques.

Keywords: Compression ratio, DCT, Frame size reduction, Histogram, Local Binary Pattern, Percentage recognition.

Abbreviations: DCT, Discrete Wavelet Transform; DWT, Discrete Wavelet Transform; LBP, Local Binary Pattern; JPEG, Joint Photographic Experts Group; FERET, The Facial Recognition Technology.

I. INTRODUCTION

A facial recognition system [7, 8] identifying or verifying an image from a digital image or a video frame from a video source. Many methods are used in facial recognition systems as shown in Fig. 1, but in general, all systems follow by comparing selected facial features from given image with faces within a database.

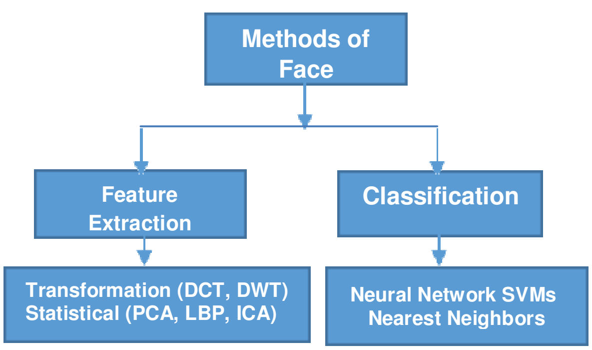

Fig. 1. Face Recognition Methods.

Suppose the original data set of a person need to be hidden at a secret or secured place and only its reference image stored in a computer that can be accessed by a person who is not in actual need of the original data. For instant, airport security guard required to identify only those people who are under surveillance and handover them to investigating agencies if the stored and probe images matches.
Assume that the crime agent does not want to store the original images of the people in the computers because that computer generally operated by security guards. This is a difficult job because the reference image need not be beneficial to face recognition and it may lead to failure.
The above two problems can be solved with a single solution which is explained in this paper. First file size to be decreased by using regular transformation method. Later reduce the frame size of the image. By this way, image size can be reduced [2]. By reconstructing the reduced image, we arrive to the original image during face recognition. When an image reconstructed from lower frame size to higher frame size, the quality of the image changes [4] and it may affect its face recognition capability. In this work it is proven that face recognition technique recognizing the faces even if the images are compressed to smaller % size of the original size.
These reconstructed images can be stored at the computers held by security agencies. When images reconstructed from smaller % size back to its original size the quality of the reconstructed images become blurred. In this work, it is verified with the face recognition algorithms, based on local feature recognition, LBP. Later, on these size compressed images, again DCT is applied for further compression and their face recognition is tested and important conclusions are drawn.

II. LOCAL BINARY PATTERNS (LBP)

Local Binary Pattern used like a visual descriptor in computer vision. Texture classification is the powerful feature of LBP and determined when LBP is added with the Histogram of oriented gradients (HOG) descriptor, that improves the detection performance considerably on some data sets [3]. A comparison of several improvements of the original LBP in the field of background subtraction was made in 2015 by Silva *et al.,* [1]. A full survey of the different versions of LBP can be found in Bouwmans *et al*., [6].

A. Face Recognition with LBP algorithm

The local binary pattern face recognition algorithm used in such a way that the local features in face recognition compared to the global features of face recognition algorithms like PCA [5, 9], ICA and LDA. This algorithm consists of four parts.

– The Tan and Triggs [19] illumination normalization algorithm used initially. So that the changes in the illumination can be avoided.

– The local binary patterns are computed for each pixel as shown in Fig. 2. The LBPs are same as textural description of the image.

– The histograms are generated for the local features.

– Histograms of both the probe image and database images are compared in order to recognize the faces.

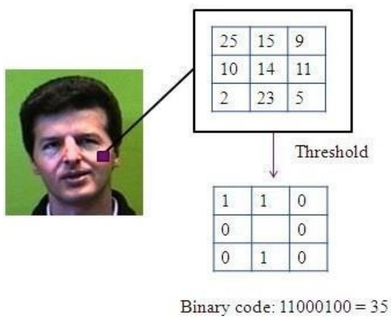

Fig. 2. LBP Binary Pattern.

Local binary pattern method is an easy and very efficient texture operator that labels the pixels of an image by thresholding the neighbors of each pixel and replace the results with a binary number. When LBP is combined with histograms it the detection accurate image on datasets.

Using LBP [15] histograms together we can identify the face images with simple data vector.

LBP is a visual descriptor that can be used for face recognition tasks explained with the following steps.

– We have facial image in color can be converted into grayscale.

– The part of this grayscale image represented as a block of 3 × 3 pixels.

– This 3 x 3 matrix containing the intensity of each pixel (0 –255).

– Central value of this matrix used as the threshold.

– With reference to this threshold value we find the new binary values for the 8 neighbors.

– This binary value set to 1 if each neighbor pixel value equal or higher than threshold and set to 0 if the values lower than threshold.

– The matrix now contains only binary values by discarding the central value. We concatenate each and every binary value by considering each pixel position and line by line and finally arrive to a new binary value.

– Convert this new binary value to a corresponding decimal value and set as a central value of the matrix.

– Finally, we get a new image with a better characteristic than that of an original image.

– Using this new image, we find Grid X and Grid Y parameters that divide the image into multiple Grids is the histogram of the image.

– Each grid generates each histogram and this histogram contain only 256 positions (0-255) represents intensity levels of each pixel.

– Now we have to concatenate each histogram to get a new and bigger histogram. This final histogram gives the characteristics of the original image.

– Each histogram created, used to represent each image from the dataset from the database.

– For the probe image we approach the same method to get a new image and find a histogram which identify the original image.

– Histograms of both images compared to find the matched image that will give a closest histogram.

– Euclidean distance obtained by calculating the distance between the two histograms using the following formula. With this equation we can get an output that is closest to the original image.

$$D = \sqrt{\sum_{i=1}^{n} (hist_1 - hist_2)^2}$$

A. Baseline Method

Fig. 3 shows various stages involved in the compression of images. Some of the steps may be optional. Two methods are popular in image compression [10] namely DCT and DWT.

In the baseline method based on DCT (JPEG standard) approach, images are compressed using the standard DCT transformation [16, 17]. The image pixel values are converted into high frequency and low frequency components. Toward the right bottom of the DCT matrix, the high frequency components are placed. The high frequency components are eliminated by applying quantization. The remaining elements of the DCT matrix are encoded using an encoder. When the image needed to be recognized, the encoded set of pixel values are decoded back, dequantized and inverse DCT is applied to prepare the image for the face recognition. Similarly, DWT may be used in the place of DCT.

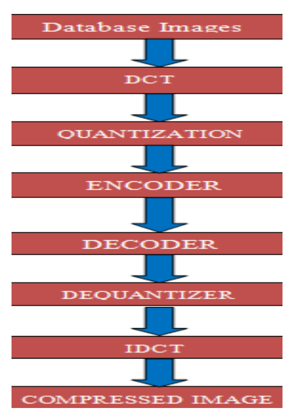

Fig. 3. Face recognition of the baseline DCT compressed images.

Discrete Wavelet Transform (DWT) is one more best compression technique that gives a mathematical way of encoding information. The redundancy coefficients of DWT reduced with thresholds as well as through Huffman coding. In this work, the images are compressed with reduction in frame size than with that of the DCT [13, 14].

III. RESULTS AND DISCUSSION

The experimental results of the face recognition using SIZE as well as JPEG compressed images using LBP is mentioned here. In this work, the SIZE compressed images are usually stored in the JPEG format after compression with appropriate quantization. Those images can be retrieved with inverse DCT [14] and verified for the face recognition using LBP [12]. The images are size compressed first to 50%, 25%, 10% and 5% and they are compressed again using DCT with appropriate quantization and stored. These images are decompressed using IDCT and then reconstructed back to different algorithms to compare with LBP.

Table 1: Percentage recognition of the images for LBP-DCT algorithms for several reconstruction methods.

LBP-DCT	Image Reconstruction Method							
	Box	**Triangle**	**Nearest**	**Cubic**	**Bilinear**	**Bicubic**	**Lanczo s2**	**Lanczo s3**
Original	93	93	93	93	93	93	93	93
50% Size	81	**84**	81	**84**	**84**	**84**	**84**	**84**
20% Size	**53**	50	**53**	51	51	50	51	50
10% Size	**3**	2	**3**	2	2	2	2	2
5% Size	2	**3**	2	1	**3**	1	1	2

Table 1 shows the percentage recognition of the images for LBP-DCT algorithm for FERET images. Images of 50% size are verified for face recognition against the original probe images. It can be seen that when TRIANGLE, CUBIC, BILINEAR, BICUBIC, LANCZOS2 and LANCZOS3 methods are used for reconstruction, only 84 out of 100 images are successfully recognized with LBP-DCT and hence the maximum percentage of recognition is 84%. Similarly, for 25% size, the best yield comes from BOX, and NEAREST methods for LBP-DCT which is 53% maximum. For the case of 10% and 5% size the successful recognition is almost negligible.

Table 2: Percentage recognition of the images for LBP-DCT algorithms for several reconstruction methods on COLOR FERET.

LBP - DCT	**Image Reconstruction Method**							
	Box	**Triangle**	**Nearest**	**Cubic**	**Bilinear**	**Bicubic**	**Lanczo s2**	**Lanczo s3**
Original	**89**	**89**	**89**	**89**	**89**	**89**	**89**	**89**
50% Size	89	89	89	89	89	89	89	89
25% Size	30	28	30	**31**	29	**31**	29	29
10% Size	**33**	30	**33**	**33**	30	**33**	32	32
5% Size	**6**	2	**6**	**6**	2	**6**	5	3

Table 2 shows the percentage of the images that recognized by LBP-DCT algorithm for COLOR FERET database. Images of 50% size are verified against the original probe images recognized 89%. Similarly, for 25% size, the best yield comes from CUBIC method for LBP-DCT which is 31% maximum. At 10% size, BOX, NEAREST, CUBIC and BICUBIC yielded 33% recognition rate, which is lightly higher than that of 25% size case. For the case of 5% size the successful recognition is almost negligible.

Table 3: Maximum percentage recognition of the images for LBP-DCT algorithms Vs bpp for COLOR FERET.

Model	**Actual size with respect to original size**	**Number of rows**	**Number of columns**	**Number of pixels before compression**	**Number of pixels after compression**	**DCT Compression**	**Compression ratio**	**bpp**	**LBP-DCT**
Original	**100%**	**300**	**200**	**60000**	**60000**	**7500**	**8**	**3.00**	**89**
50%	**50%**	**150**	**100**	**60000**	**15000**	**1875**	**32**	**0.75**	**89**
25%	**25%**	**75**	**50**	**60000**	**3750**	**469**	**128**	**0.19**	**31**
10%	**10.40%**	**30**	**20**	**60000**	**600**	**79**	**756**	**0.03**	**33**
5%	**5.20%**	**15**	**10**	**60000**	**150**	**21**	**2809**	**0.01**	**6**

For Table 3, Compression Ratio and bpp are calculated as follows:
Compression ratio for 25% compression for both size compression and DCT is given by

$$\text{Compression} = \frac{\text{Number of bits per pixel}}{\text{Compression ratio}}$$

$$= \frac{60000}{469} = 128$$

bpp of color image for 25% = 24 bpp/128 = 0.19

Tables 3 show the recognition rates Versus bpp for LBP-DCT for COLOR FERET images. It can be observed that when DCT is used along with size compressed images, the successful recognition rate falls drastically after 25% of the size on COLOR FERET images.
In this work, the frame size reduction and JPEG compression with DCT technique is used to store the compressed images. The images are considered from

database COLOR FERET. Again, face recognition algorithm LBP is verified for face recognition capabilities at four levels of size compression, viz. 50%, 25%, 10% and 5% of the original frame size. The size reduced images are then subjected to the DCT compression and then stored in the database. On COLOR FERET database, at 50% compression level LBP producing 89% recognition. At 25% compression level, LBP is yielding 31%. At 10% compression level, LBP provides 33% recognition rate. At 5% compression level, LBP results 6% recognition rate. Overall, above 25% of original frame size, the LBP performs better but below 25%, LBP performs very poor.

IV. CONCLUSION

In this paper, new image compression techniques are developed for the cause of face recognition. In order to achieve this, current compression techniques [11] are investigated along with the face recognition systems. The new image compression is based on reducing the frame size of the images to store them in the database to mitigate the limitations of the compressions based on transformation techniques like DCT or DWT. The DCT compression is carried out on the frame size reduced images which will provide the double benefit of compression based on frame size reduction and DCT. Face recognition system LBP is used to analyze successful face recognition rates with DCT compressions.

In this work, the frame size reduction techniques are used to determine the face recognition percentages on a larger database COLOR FERET that has 100 images. The images are compressed to 4 levels namely 50%, 25%, 10% and 5% of the original frame size. Eight different interpolation algorithms are used to reconstruct the smaller frame size images to that of the original frame size of probe images.

This work shows, the face recognition rates of COLOR FERET database for different compression levels and various interpolation techniques namely BOX, TRIANGLE, NEAREST, CUBIC, BILINEAR, BICUBIC, LANCZOS2 and LANCZOS3 with face recognition algorithm LBP is simulated.

That means Local feature recognition is suitable for sizes more than 25%. This is because of the reason that when the size is less than 25%, the variation in pixels of features are lost when compressed and reconstructed back [12] and hence LBP cannot yield a good success rate. BICUBIC reconstruction method produces good recognition rate if used with LBP.

In order to add the benefits of the JPEG compression to the novel techniques developed in this work, the DCT compression carried out on the already reduced frame size images in train database. Once the DCT compression carried out, after proper quantization, the DCT compressed images subjected to Inverse DCT. The IDCT images stored in train database still in smaller frame sizes but with DCT/IDCT compressions. Now, the images in train databases attempted for the face recognition with LBP and by using the reconstruction interpolation algorithms.

It can be noticed that when the size reduction and DCT compression both are considered; the recognition is successful only when the size reduction is around 25% when LBP is used. For cases, below 25%, DCT compression is not useful. Similarly, for 0.19 bpp, on the FERET database, LBP yielded around 31 %, which is less but still better than the one proposed as 0.2bpp.

In 2001, Blackburn et al studied the performance of the JPEG when the uncompressed known images are tested with compressed unknown images for the face recognition capability. The unknown images were compressed to 0.8, 0.4, 0.25 and 0.2 bpp. It has been claimed that the face recognition rate does not change significantly when the images were compressed up to 0.2bpp. But the face recognition accuracy and percentages of the face recognition was not quantified with respect the compression ratio [17, 18]. In this work it is possible to reach up to 33% with 0.06 bpp for COLOR FERET.

In this work, it is shown that the recognition rates Vs bpp for the LBP-DCT algorithms for various compression levels. LBP performs better, above 25% compression levels. Below 25%, LBP not so good since local features will be lost as the compression levels increase. Similarly, when LBP-DCT are used, similar observations can be made.

In this work the contribution is made in the development of the unique, new and innovative method of compression using the frame size reduction for the purpose of face recognition instead of the traditional transformation techniques like DCT and DWT. For the purpose of frame size reduction and reconstruction, standard interpolation techniques are used. Also, algorithms are developed to combine the compression techniques of both the frame size reduction and DCT and are tested with LBP.

V. FUTURE SCOPE

The work can be extended for further improvement in future in the following areas:

– To extend the size reduction based face recognition to other global and local feature face recognition systems other than LBP.

– Face recognition with other techniques like ICA, LDA etc.

– Face recognition with Convolutional neural networks.

– Face recognition of the persons moving different speeds.

– Face recognition in the 3D domain like the 3D volume faces or 3D surface faces.

– Hybrid Face recognition where the traditional compression techniques based on transformation and the one proposed in the research work is combined.

Conflict of Interest. There is no conflict of interest.

REFERENCES

[1]. Silva, T. Bouwmans, & C. Frelicot (2015). An extended Center-Symmetric Local Binary Pattern for Background Modeling and Subtraction in Videos. VISAPP 2015, Berlin, Germany.

[2]. Zhang, K., Zhang, L., & Yang, M. H. (2014). Fast compressive tracking. *IEEE transactions on pattern analysis and machine intelligence*, *36*(10), 2002-2015.

[3]. Bouwmans, T., Silva, C., Marghes, C., Zitouni, M. S., Bhaskar, H., & Frelicot, C. (2018). On the role and the importance of features for background modeling and foreground detection. *Computer Science Review*, *28*, 26-91.

[4]. Barkan, O., Weill, J., Wolf, L., & Aronowitz, H. (2013). Fast high dimensional vector multiplication face

recognition. In *Proceedings of the IEEE international conference on computer vision* (pp. 1960-1967).
[5]. Mittal, H. S., & Kaur, H. (2013). Face Recognition using PCA & neural network. *International Journal of Emerging Science and Engineering (IJESE)*, *1*(6), 71-75.
[6]. Kaur, S., & Singh, V. R. (2013). DCT Based Fast Face Recognition Using PCA and ANN. *International Journal of Advanced Research in Computer and Communication Engineering*, *2*(5), 2125-2131.
[7]. Krishna Reddy Sangathi, D. Narendra Singh (2013). Design of Embedded Automatic Face recognition system based on ARM9. *International Journal of Latest trends in Engineering and Technology.*
[8]. Fernando Roman, (2013) Digital Image Processing Techniques for Face Recognition, Department of Mathematics, 138 Kansas State University, USA.
[9]. Gunjan Dashore, V. Cyril Raj (2012). An Efficient method for face recognition using Principal Component Analysis (PCA). *International Journal of Advanced Technology & Engineering Research (IJATER),*
[10]. Tripathi, P. (2012). Image compression enhancement using bipolar coding with LM algorithm in artificial neural network. *International Journal of Scientific and Research Publications*, *2*(8), 1-6.
[11]. Kertész, C., & Oy, V. (2011). Texture-based foreground detection. *International Journal of Signal Processing, Image Processing and Pattern Recognition (IJSIP).*
[12]. Trefný, J., & Matas, J. (2010). Extended set of local binary patterns for rapid object detection. In *Computer vision winter workshop* (pp. 1-7).
[13]. Kekre, H. B., Thepade, S. D., & Maloo, A. (2010). Performance Comparison of Image Retrieval Using Fractional Coefficients of Transformed Image Using DCT, Walsh, Haar and Kekre's Transform. *CSC-International Journal of Image processing (IJIP)*, *4*(2), 142-155.
[14]. Kekre, H. B., Thepade, S. D., & Maloo, A. (2010). Image retrieval using fractional coefficients of transformed image using DCT and Walsh transform. *International Journal of Engineering Science and Technology*, *2*(4), 362-371.
[15]. Zhao, G., & Pietikainen, M. (2007). Dynamic texture recognition using local binary patterns with an application to facial expressions. *IEEE transactions on pattern analysis and machine intelligence*, *29*(6), 915-928.
[16]. Heikkila, M., & Pietikainen, M. (2006). A texture-based method for modeling the background and detecting moving objects. *IEEE transactions on pattern analysis and machine intelligence*, *28*(4), 657-662.
[17]. Padmaja Vijay Kumar, B. Chandrasekhar, M.N. Giri Prasad (2015). Face Recognition Capabilities of Global Features and Local Feature Recognition Based Algorithms. *International Journal of Scientific Research, Indexed with International*.
[18]. Padmaja Vijay Kumar, Dr.M.N. Giri Prasad, Dr.B. Chandrasekhar (2013). Image compression effects on Face Recognition for Images with Reduction in size: *International Journal of Computer Applications,* (973-93-80872-62-4), *61*(22), Issue No .10231- 4962.
[19]. Tan, X., & Triggs, B. (2010). Enhanced local texture feature sets for face recognition under difficult lighting conditions. *IEEE transactions on image processing*, *19*(6), 1635-1650.

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