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A Novel Image Compression Using Block Local Binary Pattern (LBP) with LZW

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Abstract: Image compression is aimed at reducing the data quantity, without degrading the image Quality beyond an acceptable threshold. The main advantage of LBP is it can give local texture pattern in an efficient manner. In this LBP values are used for the image compression. The description of image's local pattern results in an eight-bit binary description, but in order to restore the image from such a LBP description, the value of each central pixel is also needed. LZW coding which is simple and lossless technique is used for the LBP data compression. Finally result analysis is made based on performance parameters PSNR, MSE, SSIM.

Keywords: local binary pattern, local texture classification, Lempel-Ziv-Welch (LZW).

I. INTRODUCTION

In recent years, the development and demand of multimedia product grows increasingly fast, contributing to insufficient bandwidth of network and storage of memory device. Therefore, the theory of data compression becomes more and more significant for reducing the data redundancy to save more hardware space and transmission bandwidth. In computer science and information theory, data compression or source coding is the process of encoding information using fewer bits or other information bearing units than an unencoded representation. Compression is useful because it helps reduce the consumption of expensive resources such as hard disk space or transmission bandwidth. Nowadays, an amazing amount of data is generated every minute, e.g. (1) Google will receive 2 million search requests (2) facebook users upload and share more than 6,94,000 pieces of content (3)more than 184.8 billion e-mails are sent and received during a day. From above examples it is understood that image compression is important for many purposes. The Internet population globally has grown 6.59 percent from 2010 to 2011 and now it is all most 2.1 billion people, are using it to communicate, share, or store information. Mainly photos and videos occupy most of the space, with more than 8,000 photos shared each minute, e.g. Instagram share 3,600 new photos. Because of the explosively increasing information of image and video in various storage devices and Internet, the image and video compression technique becomes more and more important. Considering an average of 20MB/photo and a compression rate of 0.15, the predicted quantity of archived information is about 550 billion, 20MB i.e.73 bytes. In this project new method of image compression using LBP is proposed, this will saves more space when compared to the existing compression algorithms.

II. THEORTICAL ASPECTS

A. LOCAL BINARY PATTERN

The concept of Local Binary Pattern (LBP) was introduced by Ojala [1] as a fine texture scale descriptor, used to summarize the local structure of images. LBP labels the image pixels and creates a binary number used for classification in computer vision This method takes each pixel and compares it with its neighbour's colour value. LBP is tolerant to monotonic illumination changes, an important advantage being its computational simplicity, therefore making possible real-time analysis. The LBP description is created by dividing the image into small 3x3 pixel matrices. The colour value of each central pixel is then compared with its eight neighbours whether these neighbour colour values are greater or less than the central point and a binary value is accordingly assigned to the corresponding bit. The algorithm is applied on a 3x3 neighbourhood, so for each central point there are eight neighbours, leading to an eight-bit value and a subsequent distinct label.

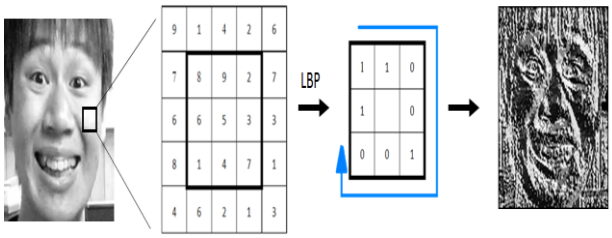

Fig.1 shows the local binary pattern for Small portion considering (3x3) block and its binary values.

B. Lempel-Ziv-Welch (LZW)

LZW is dictionary based algorithm, which is lossless in nature. This method was developed originally by Ziv and Lempel, and subsequently improved by Welch. As the message to be encoded is processed, the LZW algorithm builds a string table that maps symbol sequences to/from an N-bit index. The string table has 2N entries and the transmitted code can be used at the decoder as an index into the string table to retrieve the corresponding original symbol sequence. The sequences stored in the table can be arbitrarily long. A particular LZW compression algorithm takes each input sequence of bits of a given length (for example, 13 bits) and creates an entry in a table

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(sometimes called a "dictionary" or "codebook") for that particular bit pattern, consisting of the pattern itself and a shorter code.

III. BLOCK DIAGRAM

1.The original image can be grey image or colour image if it is greyscale image then no operation is performed ,if suppose it is colour a image is divided into R,G,B pixels separately and converts into bitmap image.

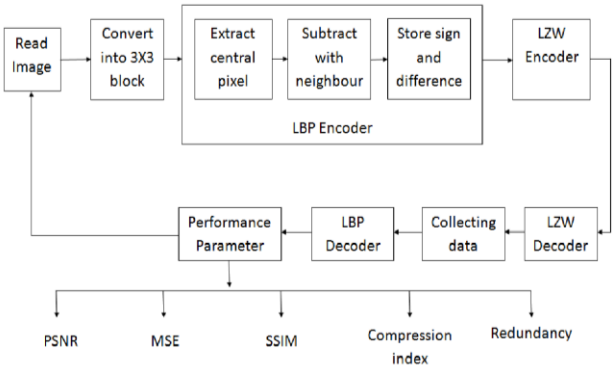

Fig. 2Block diagram of proposed system

2. From original image, two smaller images are created:- one made of LBP codes and other containing the values for neighbourhood's centre pixels.
3. Pixels greyscale image is divided into 3*3 matrices. If it does not divide into image width or height, the borders matrices are filled in with random value 0's.
4. For every 3*3 matrix, the LBP code is calculated for every central grey value in each neighbourhood and results in eight-bit binary code.
5. Eight-bit pattern obtained based on conditions:
a) The value is "1"if pixel value is equal or greater than central pixel.
b) The value is "0"if pixel is less than central pixel.
6. Then its stores the value o central pixels, difference and the sign (i.e binary value).
7. Further LZW encoding algorithm is used to reduce the size of image.
8. Reconstruction can be done by decoding using LZW decoding algorithm. Further data regarding central pixel, sign and differences are collected and LBP decoder is used to retrieve the original information.
9. Finally the performance of original image with proposed model is examined.

IV. RELATED WORK ON IMAGE COMPRESSION

Image compression is a method of reducing the data quantity, without degrading the image quality beyond an acceptable threshold. This can be done by removing the redundancy present in the image. In information theory, data compression is the process of encoding information using fewer bits than the encoded representation, with the advantage of reducing the consumption of significant resources such as disk space or transmission bandwidth.
Compression of an image requires storing the image in a bit flow/stream which is in binary 0's and 1's as compact as possible and decoding the image as accurately as possible. The needed elements are an encoder and a decoder. The encoder receives the image and converts it into a series of binary data which are then transmitted or stored. The decoder re-creates the image as accurately as possible. The flow compression is described in Fig. 3.

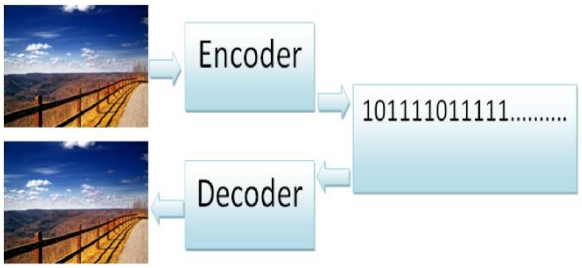

Fig.3 flow of image compression

Types of compression
a. Lossy compression
b. Lossless compression.

a. Lossy compression: It is a technique in which reconstructed image is not same as that of original image. It is irreversible process.
Eg. JPEG, MPEG.

b. Lossless compression: It is a technique in which reconstructed image is same as that of original image. It is reversible process.
Eg. LZW, Huffman coding

The important properties of a compression algorithm are the compression ratio and the reconstruction quality. The compression ratio is the report of bits numbers needed to represent the data before and after compression.

V. PROPOSED MODEL

The main aim of compression is not to degrade the image quality performance but can decrease the data quantity. In this paper the original image can be colour or grey scale image .If the image is colour then it is converted into grey scale image before applying it to LBP encoder.fig.4 shows the colour image and its grey scale.

(a) (b)

Fig 4 : image (a) shows colour image (174kb),image(b) shows grey scale image(174kb).

After converting the image to grey scale, the image is resized to 600*600 to make out blocks easily, then LBP encoding process is carried out where the image is divided into 3*3 blocks and for each block the central pixel value is obtained and their neighbouring pixel values and

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difference is calculated and stored. The fig.5 shows the output of LBP encoder. As the LZW algorithm is dictionary based system it converts decimal value to ASCII values to encode the pixel values.

Fig 5 Output of LBP encoder

(a) (b)

Fig.6 (a) reconstructed image based on 17% uniform distribution. (b) reconstructed image based on 17% of Gaussian distribution.

VI. EXPIREMENTAL RESULTS

The proposed method is implemented and analysis is done in MATLAB. The results are illustrated using different images shown in Fig 7. (a) Portrait image (b) ultrasound medical image

(a) (b)

Fig 7 Shows test images taken to compare the performance

For testing purpose the reconstruction was performed on each image using four different percentage values for dispersion [8]. The uniform and Guassian distribution are considered more the percentage of dispersion more is the pixel variation .Table I summarizes the results.

However, results proved that the lower the percentage, the better the accuracy and similarity between images. An important advantage of the approach is the compression rate, especially when considered in the context of good SSIM values. Table II shows a comparison between the original image and compressed image .PSNR is the peak signal to noise ratio which should be more.MSE is the mean square error should be less. The compression ratio is original image to compressed image

TABLE I QUALITY OF RECONSTRUCTION OF IMAGES WITH STRUCTURAL SIMILARITY INDEX METRIC (SSIM)

Fig 7	Distribution	Limits of dispersion around central pixel			
		17%	9%	6%	2%
(a)	Uniform	0.92457	0.87229	0.81673	0.4834
	Gaussian	0.82878	0.77649	0.72094	0.3876
(b)	Uniform	0.92851	0.87622	0.82067	0.48733
	Gaussian	0.84814	0.79585	0.7403	0.40697

TABLE II COMPRESSION PERFORMANCE COMPARISION BETWEEN ORGINAL IMAGE (Kb) AND COMPRESSED IMAGE (Kb)

Test Image Fig 7	Size of Original Image(Kb)	Size of Compressed Image(Kb)	Compression Ratio	Redundancy	SSIM	PSNR	MSE
(a)	139.477	32.411	4.3034	0.76762	0.92457	35.3852	18.9653
(b)	147.889	24.992	5.9175	0.83101	0.92851	39.1205	8.0248

VII. CONCLUSION

The public internet is a world-wide computer network through which images are sent, received and stored on hard disk or database. The main aim is to reduce the bandwidth and to maintain image quality. The multimedia technology is also developing rapidly. In the recent years, images has been widely used in day-to-day life such as, in financial records, military purpose, medical images, archaeological field. Hence the promising approach is image compression and also requires easy reliable restoration and retrieval. Therefore this paper presents the image compression using local binary pattern technique with LZW algorithm. The drawback can be information losses. SSIM is used to evaluate the quality of restoring i.e. upto 0.92.Apart from this in this proposed algorithm the performance of proposed system's PSNR, MSE, redundancy and compression index values are evaluated with original images it shows proposed method as better reliability and retrieval quality.

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