Histogram Based Block Classification Scheme of Compound Images: A Hybrid Extension

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***Abstract*— The proposed paper aims in developing an efficient block classification using histogram for compressing compound images that contain graphics, text and picture images. In this paper, the given compound image is segmented into 8x8 blocks and these blocks are used for the image classification. The segmented blocks are classified into blocks of four different types: background blocks, text blocks, mixed blocks and picture blocks. The efficiency of block classification is observed to be of 97% for compound and computer generated images. The proposed block classification method is very simple and effective in compressing compound images. This paper discuss about the block classification of compound images using MATLAB.**

Index Terms— Compound image, Image Segmentation, Block Classification, Image compression

I. Introduction

A picture can say more than a thousand words. Unfortunately, storing an image can cost more than a million words. This isn't always a problem, because many of today's computers are sophisticated enough to handle large amounts of data. Sometimes however you want to use the limited resources more efficiently. Digital cameras for instance often have a totally unsatisfactory amount of memory, and the internet can be very slow. Mostly in internet, it is necessary to send the digital type of images using digital camera, personal computers. It contains more and more compound images. While sending the compound images, it occupies more size and takes large amount of time to attach. In such conditions, compound image compression is needed and thus requires rethinking of our approach to compression.

In this paper, the block based segmentation approach is considered and it gives the better result. In the case of object based approach, complexity is the main drawback, since image segmentation may require the use of very sophisticated segmentation algorithms. In layer based segmentation, the main drawbacks are mismatch between the compression method and the data types, and an intrinsic redundancy due to the fact that the same parts of the original image appear in several layers. But in the block based segmentation it gives the better mismatch between the region boundaries and the compression algorithms, and the lack of redundancy. The proposed block classification algorithm has low calculation complexity, which makes it very suitable for real-time application. From a practical point of view it is important to differentiate between the computer-generated images and a scanned or otherwise acquired images [2]. The main difference is that the acquired images will have a higher level of inherent noise. This will impact both the segmentation strategy, and the selection of the compression method. Blocks of different type are distinct in nature and have different statistics properties. Background blocks are very flat and dominated by one kind of color. Text blocks are more compact in spatial domain than that in DCT domain. The picture block is mainly concentrated on low frequency coefficients when they are DCT transformed. Mixed blocks, containing mixed text and picture images, cannot be compactly represented both in spatial and frequency domain.

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II. Block Based Compression

Compressing the compound image is the hard problem because it contains the combination of text, picture, background and mixed types of blocks. It is well addressed in JPEG2000 standard. In the past, compression research has been on developing better algorithms, the future focus is likely to be on the methods of combining various algorithms to achieve the best compression performance for the given types of images. A lot of algorithms have been designed to compress compound images with different types. Run length coding is well suitable for compressing the background blocks. The Lempel-Ziv algorithm is designed to compress pure text images, which only have text on the pure color background in the whole images. As the text blocks are images itself rather than text, implementing Lempel-Ziv algorithm is not feasible and more complex. Wavelet compression is suitable to compress the text blocks. The JPEG algorithms are suitable for pure picture images. One popular video coding standard H.264 [1] gives better performance for the mixed blocks.

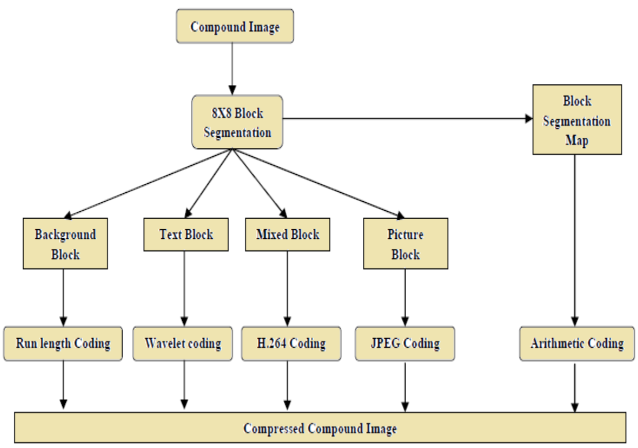

Fig.1 Block Based Compression

The framework of the block-based compression scheme is shown in Fig.1. The compound image is first divided into 8x8 blocks. Then blocks are classified into four types:

background, text, mixed and picture according to their different statistical characteristics. Blocks of different type will be compressed with different algorithms. The proposed scheme can effectively compress the mixed blocks, which are not well handled by some block-based algorithms. The proposed scheme achieves good coding performance on text images, picture images and compound images. It also outperforms DjVu on compound images at high bit rate [3]. The block type map is compressed using an arithmetic coder.

III. BLOCK SEGMENTATION

Segmentation subdivides an image into its constituent regions or objects. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity or texture [4]. Adjacent regions are significantly different with respect to the same characteristics. General approach to compress the compound image includes the image segmentation into the regions of similar data types. Bandwidth is a very important limiting factor in application of image segmentation [5]. In this paper the given image is segmented into 8x8 blocks and then that blocks are used for the image classification process.

IV. BLOCK CLASSIFICATION SCHEME

Block classification is defined as to classify the blocks into individual blocks. Classification is performed by using the histogram values. A histogram is a graphical representation, showing a visual impression of the distribution of experimental data. Based upon the histogram, it is necessary to set the threshold values. The threshold values classify the blocks as text, picture, background and mixed blocks. A fast and effective classification algorithm based on three features: histogram, gradient of the block and the anisotropic values. The entire block classification flow is shown in Fig.2. Here the blocks are classified into four types: background, text, mixed and picture. Blocks of different type are distinct in nature and have different statistics properties. The background blocks contain only the low histogram pixels and show one peak at the low histogram pixels. Text blocks always shows several peaks in low histogram value (LHV) and the high histogram values (HHV) as shown in Fig.3. Only a few mid-histogram values (MHV) are observed in text blocks. If the block contains large numbers of high histogram and mid histogram values, it will be identified as mixed blocks. The block mainly consisting of mid histogram values are declared as picture blocks. Here thresholds T1-T4 is chosen to determine the block type.

V. BLOCK CODING

Block Coding consists of four algorithms to compress the individual blocks. They are Wavelet, Run length encoding, JPEG2000 algorithm, H.264 algorithm to compress the text, background, picture and mixed blocks. Then by using arithmetic coder all the individual blocks are get added [6]. Thus the compressed images are obtained. Then by using decompression algorithm the original images is obtained without any affects. Blocks of different type are distinct in nature and have different statistics properties. Background blocks are very flat and dominated by one kind of color (white color). Text blocks are more compact in spatial domain than that in DCT domain. The picture block is mainly concentrated on low frequency coefficients when they are DCT transformed. Mixed blocks containing mixed text and picture images cannot be compactly represented both in spatial and frequency domain.

A. Background Block Coding Algorithm

The coding of background blocks is straightforward. Background blocks are dominated in the white region at only one point and gray scale levels are limited to the given threshold values. All the values in the background block regions are quantized to the most frequent color, which is coded using run length encoder [7]. Run-length encoding (RLE) is a very simple form of data compression in which runs of data i.e. sequences in which the same data value occurs in many consecutive data elements are stored as a single data value and count, rather than as the original run. This is most useful on data that contains many such runs: for example, simple graphic images such as icons, line drawings, animations and white spaces. It is not useful with files that don't have many runs as it could greatly increase the file size. Run-length encoding performs lossless data compression and is well suited to palette-based iconic images. It does not work well at all on continuous-tone images such as photographs, although JPEG uses it quite effectively on the coefficients that remain after transforming and quantizing image blocks.

B. Text Block coding Algorithm

Wavelet coding is used to compress the text blocks. Wavelet theory intends to analyze and transform data. It can be used to make explicit the correlation between neighboring pixels of an image, and this explicit correlation can be exploited by compression algorithms to store the same image more efficiently [8]. Wavelets can even be used to transform an image in more and less important data items. By only storing the important ones the image can be stored in an amazingly more compact fashion, at the cost of introducing hardly noticeable distortions in the image. As the text blocks are images itself rather than text, implementing Lempel-Ziv algorithm is not feasible and more complex [9]. Wavelet based compression overcomes this problem and provides efficient compression of text blocks.

C. Mixed Block coding Algorithm

The latest video compression standard, H.264 (also known as MPEG-4 Part 10/AVC for Advanced Video Coding), is expected to become the video standard of choice in the coming years. H.264 is an open, licensed standard that supports the most efficient video compression techniques available today. Without compromising image quality, an H.264 encoder can reduce the size of a digital video file by more than 80% compared with the Motion JPEG format and as much as 50% more than with the MPEG-4 Part 2 standard. Context-adaptive binary arithmetic coding (CABAC) is a form of entropy coding used in H.264/MPEG-4 AVC video encoding. It is a lossless compression technique. It is notable for providing much better compression than most other encoding algorithms used in video encoding, and is one of the primary advantages of the H.264/AVC encoding scheme [10]. Implementation of H.264 CABAC coding makes efficient compression of mixed blocks.

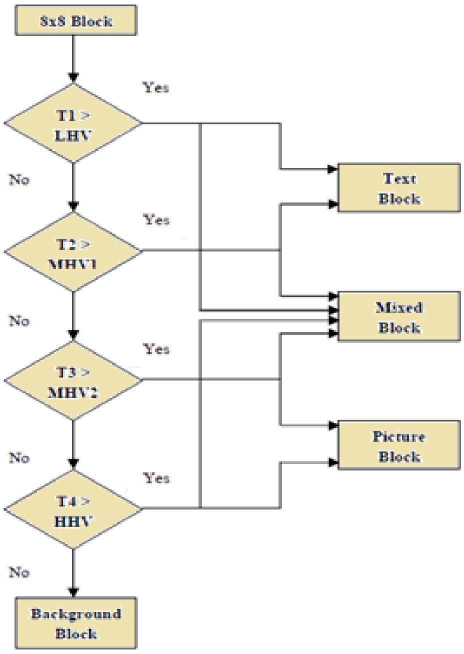

Fig.2 Block Classification Scheme

D. Picture Block coding Algorithm

The aim of JPEG 2000 is not only improving compression performance over JPEG but also adding (or improving) features such as scalability and editability [9]. In fact, JPEG 2000's improvement in compression performance relative to the original JPEG standard is actually rather modest and should not ordinarily be the primary consideration for evaluating the design. Very low and very high compression rates are supported in JPEG 2000. In fact, the graceful ability of the design to handle a very large range of effective bit rates is one of the strengths of JPEG 2000. For example, to reduce the number of bits for a picture below a certain amount, the advisable thing to do with the first JPEG standard is to reduce the resolution of the input image before encoding it [11]. That's unnecessary when using JPEG 2000, because JPEG 2000 already does this automatically through its multi-resolution decomposition structure. Compared to the previous JPEG standard, JPEG 2000 delivers a typical compression gain in the range of 20%, depending on the image characteristics. Higher-resolution images tend to benefit more, where JPEG-2000's spatial-redundancy prediction can contribute more to the compression process [12-14]. In very low-bitrate applications, studies have shown JPEG 2000 to be outperformed by the intra-frame coding mode of H.264. Implementation of JPEG2000 makes compression of picture blocks more easy and effective.

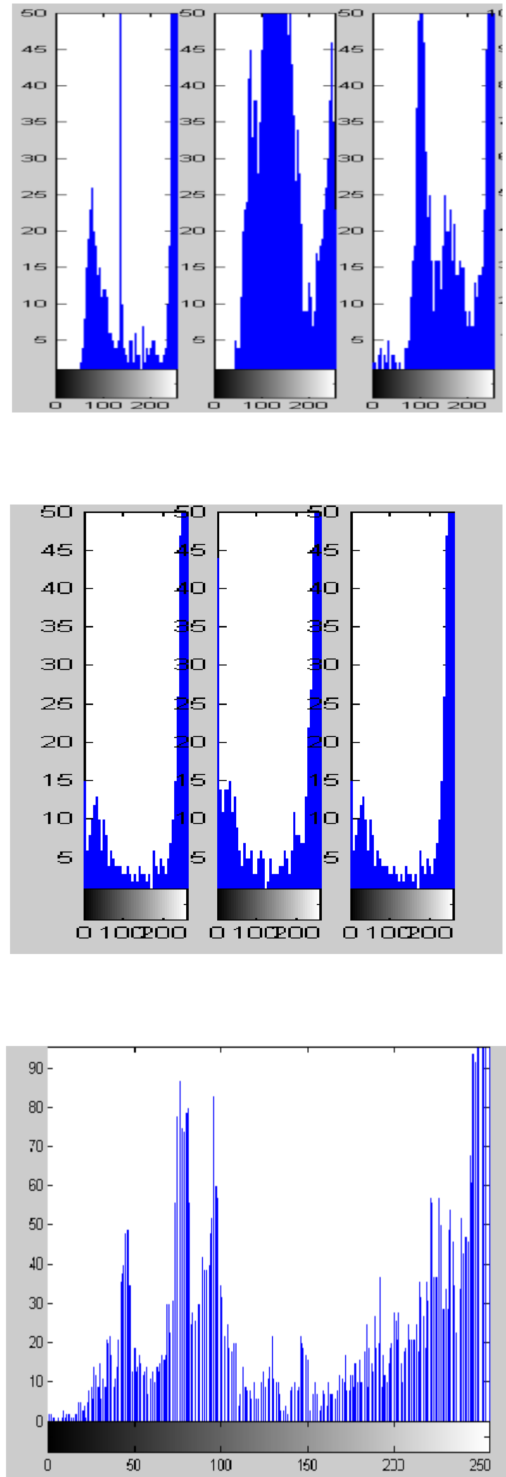

Fig.3 Three histograms of Picture block (top), Text block (middle) and Mixed block (bottom)

VI. Experimental Result

The famous toy store compound image as shown in Fig.4 is taken as the input image to our proposed block classification scheme. The segmented image is shown in the Fig. 5. The block classification for text, mixed, background and picture blocks are shown in the Fig. 6,7,8,9 respectively. The proposed system has been simulated in MATLAB SIMULINK environment.

VII. Conclusion

The block classification scheme was tested for many such compound and computer generated images. It was observed from table1 that the proposed block classification scheme is 97% efficient for compound images. However it failed to make the same consistency for other type of images. Practically there is no need to classify other type of images as they can be effectively compressed as a whole. Considering the fact that sensitivity for human eyes can negotiate this 3% mismatch of block classification, our block classification scheme can be argued to be an efficient block classification scheme for compressing compound images. Our block classification scheme is very simple and effective, reducing the computational complexity.

Fig.4 Input image

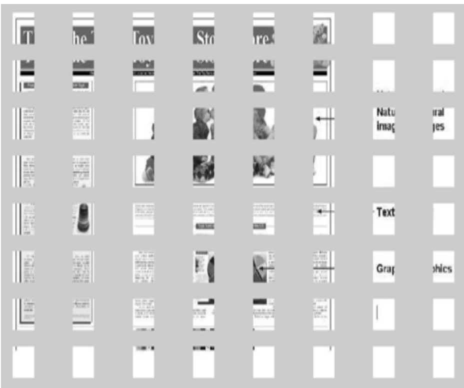

Fig.5 Segmented Image

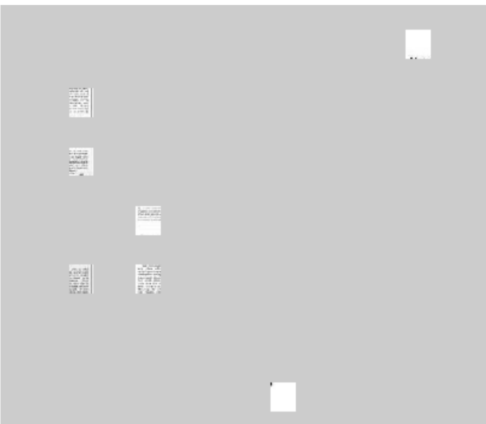

Fig.6 Classified text blocks

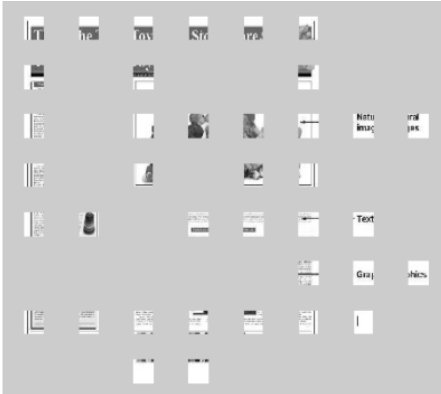

Fig.7 Classified mixed blocks

Fig.8 Classified background blocks

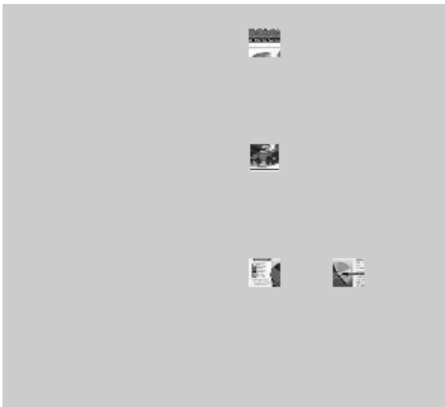

Fig.9 Classified Picture Blocks

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REFERENCES

[1] Cuiling lan, Guangming Shi and Feng wu, "Compress Compound Images in H.264/MPEG-4 AVC by exploiting Spatial Correlation" IEEE Transactions on Image Processing, vol.19 no.4, pp. 946-957, April 2010.

[2] R.Aparna, D.Maheshwari and V.Radha, "Performance Evaluation of H.264/AVC Compound Image Compression System" International Journal of Computer Applications, Vol.1 no.10, pp. 48-54, Feb.2010.

[3] Wenpeng ding, Yan lu and Feng wu, "Enable Efficient Compound Image Compression in H.264/AVC Intra Coding" IEEE Transactions on Image Processing, Vol.10 no.3, pp. 337-340, Sep.2009.

[4] Jagannath D.J and Shanthini Pandiaraj, "Lossless Compression of a Desktop Image for Transmission" International Journal of Recent Trends in Engineering, Vol.2 no.3, pp. 27-29, Nov.2009.

[5] A. Said and A. Drukarev, "Simplified segmentation for compound image compression", Proceeding of ICIP' 2009, pp.229-233.

[6] P. Haffner, L. Bottou, P.G. Howard, P. Simard, Y. Bengio, Y. LeCun, "High Quality document image compression with DjVu", Journal of Electronic Imaging, pp. 410-425 July 2008.

[7] J.Ziv and A. Lempel, "A universal algorithm for data compression", IEEE Trans. on Information Theory, IT-23(3), pp.337-343, May 2006.

[8] B.-f Wu, C.-C Chiu and Y. –L Chen "Algorithms for compressing compound document images with large text/background overlap", IEEE Proc.Vis. Image signal Process, Vol. 151 No. 6, pp.453-459 December 2008.

[9] D.S. Taubman, and M.W. Marcellin, JPEG2000: Image Compression Fundamentals, Standards and Practice, Kluwer Academic Publishers, Dordrecht, Netherlands, 2001.

[10] H. Cheng and C.A. Bouman, "Multiscale Bayesian segmentation using a trainable context model" IEEE Trans.Image Processing, vol. 10, pp. 511–525, April 2001.

[11] D. Mukherjee, N. Memon, and A. Said, "JPEG-matched MRC compression of compound documents," Proc. IEEE Int. Conf. Image Processing, vol. 3, pp. 434–437, Oct. 2001.

[12] S Kumar, "Neural Network Based Efficient Block Classification of Computer Screen Images for Desktop Sharing", IJARCSSE, pp. 703-711, vol.4, issue 8, August 2014.

[13] S Kumar, "Wavelet Sub-band block coding based lossless High Speed Compression of Compound Image", IJARCST, vol.2, issue 3, pp. 259-264, Sept. 2014.

[14] D. Mukherjee, C. Chrysafis, and A. Said, "Low complexity guaranteed fit compound document compression," Proc. IEEE Int. Conf. Image Processing, vol. 1, pp.225–228, Sept. 2002.

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S.No	Compound Image	Background Block		Text Block		Picture Block		Mixed Block		Efficiency
		Actual	Identified	Actual	Identified	Actual	Identified	Actual	Identified	
1.	Comp1	12	12	7	7	5	4	40	41	96.9%
2.	Comp2	20	20	13	12	8	10	23	24	93.8%
3.	Comp3	14	14	16	16	17	16	17	18	96.9%
4.	Comp4	15	15	9	9	10	9	30	31	96.9%
5.	Slide1	10	10	17	17	15	15	22	22	100%
6.	Slide2	11	11	18	18	12	14	23	21	93.8%
7.	Poster1	15	15	10	9	11	11	28	29	96.9%
8.	Poster2	18	18	8	8	8	9	30	29	96.9%
9.	Desktop1	29	29	10	10	10	9	15	16	96.9%
10.	Desktop2	23	23	11	11	9	9	21	21	100%
									Overall Efficiency	96.9%

Table.1 Comparison between the actual and identified background, text, picture and mixed blocks of proposed block classification scheme for different compound images

