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Comparison of Layer and Block Based Classification in Compound Image Compression

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Abstract **- The compound image compression normally based on three classification methods that is object based, layer based and block based. This paper presents a comparison of layer and block based classification methods. For secure transmission, an encryption algorithm was used to encrypt the compressed image .Experimental results were conducted to analyze the performance of the two compressors.**

Keywords- **Compound Image, Layer based, Block based, Image compression.**

I. INTRODUCTION

The most common communication medium today is the internet, fax etc. In these Medias the information is in digital form. Digital form of documents is transmitted within a fraction of seconds. The transmission requires high compression and bit rates, to avoid expenses and delay. So the data compression becomes inevitable. Electronic document images often contain mixed data types, which are text, background, and foreground. These types of images are termed as Compound images [1][2][3]. To compress these types of documents, it is necessary to detect layout and structural information from the image. Such Techniques are called as image compression techniques .The quality requirement of compound image coding is different from general image coding because users cannot accept the quality if text is not clear enough to recognize [4].In this paper two of such coders under layer and block based classification are explored and analyzed in terms of compression ratio, PSNR, Compression and decompression time.

This paper organized as follows: Section 1 have the brief introduction of compound image compression. Section 2 discuss about the classification of compound image. The sections 3 discuss in detail about the layer based classification. Section 4 has the discussion of block based classification. Section 5 discuss about the experimental results of the two methods. The Section 6 has the conclusion.

II. COMPOUND IMAGE COMPRESSION TECHNIQUES

Compression of a compound image [5] [6] is more critical than natural image. Basically a compound image is a combination of text, graphics and pictures. Most methods use different algorithms for various functionalities. Compound image compression normally based on the following categories.

1.Object Based
2.Layer Based
3.Block Based

Each and every method has its own merits and demerits. Most of the recent researches in this field mainly based on either layer based or block based.

In object based method a page is divided into regions, where each region follows exact object boundaries. An object may be a photograph, a graphical object, a letter, etc. The main drawback of this method is its complexity.

In layer-based method, a page is divided into rectangular layers. Most of the Layer based methods follow the 3-layer MRC model. The basic three layers MRC model represents a color image as two color-image layers [foreground (FG), background (BG), and a binary layer (mask)]. The mask layer describes how to reconstruct the final image from the FG/BG layers.

In block-based method a page is divided into rectangular blocks where each block follows exact object boundaries. The advantages of this approach are simplified segmentation, better match between region boundaries and the compression algorithms, and the lack of redundancy.

The following section 3 discuss in detail about the layer based classification technique.

III. LAYER BASED CLASSIFICATION

Most layered coding algorithms use the standard three layers Mixed Raster Content (MRC) representation. In this segmentation the image is segmented into text, mask and graphics layer. Each layer is compressed using different compressors. The mask layer contains the contours of text and other fine image structures.

JBIG (Joint Bi-level Image Experts Group) algorithm is used to losslessly compress the mask layer .The Text layer is compressed using token based coder[7], mask layer is compressed using JBIG coder and the graphics layer is compressed using the JPEG coder.

IV. BLOCK BASED CLASSIFICATION

The first model uses the AC coefficients introduced during DCT to segment the image into three blocks, background, text/graphic and image blocks [8]. The background block has smooth regions of the image while the text / graphics block has high density of sharp edges regions and image block has the non-smooth part of the compound image.

AC energy is calculated from AC coefficients and is combined with a user defined threshold to identify the background block initially. Next, from the luminance value, the feature vectors from the rest of the blocks are extracted and collected. From this, the non-smooth block is classified into two classes, text and image, using k-means

clustering algorithm. Different algorithms are then used to compress the three regions of a compound image.

V.EXPERIMENTAL RESULTS

The system was evaluated using various aspects like Compression Ratio, and Peak Signal to Noise Ratio (PSNR).

A. Test Images

The following images are tested, Which are shown in Figure 1.

Ima1 Ima2 Ima3 Ima4 Ima5 Ima6

Figure 1: Test Images

B. Performance Metrics

The compression ratio can be measured as the ratio of the number of bits required to represent the image before compression to the number of bits required to represent the same image after compression and is given by the formula,

CR = size of input image / size of output image(1)

From the above equation, it is obvious that as the compression ratio increases the compression technique employed is more effective.

PSNR is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed, or reconstructed image. To compute the PSNR, the block first calculates the mean-squared error using the following equation:

$$MSE = \frac{\sum_{M,N}[I_1(m,n) - I_2(m,n)]^2}{M * N} \qquad (2)$$

In the previous equation, *M* and *N* are the number of rows and columns in the input images, respectively.

The PSNR for color images with color components, R, G and B is given as below:

$$PSNR = 10 \log_{10} \frac{255^2}{\frac{MSE(R) + MSE(G) + MSE(B)}{3}} \qquad (3)$$

In the previous equation, *R* (=255) is the maximum fluctuation in the input image data type.

C. Results

The results for the two classification techniques are presented in this section. The following TABLE I shows the compression ratio Layer and block classification.

TABLE I COMPRESSION RATIO(%)

Images	Layer based	Block based
Ima1	40.39	38.77
Ima2	39.15	37.89
Ima3	39.08	40.55
Ima4	38.99	39.99
Ima5	44.09	42.79
Ima6	45.75	44.07

From the above table, the layer classification achieves better compression ratio for images 1,2,5,6. The block classification achieves good results for images 3 and 4.

The following Table 2 shows the performance of PSNR.

TABLE II PEAK –SIGNAL TO –NOISE RATIO

Images	Layer Based	Block Based
Ima1	42.86	38.94
Ima2	43.26	40.96
Ima3	38.73	40.08
Ima4	38.88	41.97
Ima5	43.36	40.79
Ima6	43.07	39.54

With respect to PSNR again layer based classifications shows better results when compared to block-based classification.

VI.CONCLUSION

This paper attempts to compare layer and block based classification techniques. The performance metrics, which is the PSNR, Compression Ratio are tested for each method and the results are evaluated. From the results for some of images the layer based method gives better results and for some images the block based method gives better results.

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