IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 11, November 2015

Image Compression by using Morphological Operations and Edge-Based Segmentation Technique

Sanjana Mathew [1], Shinto Sebastian[2]

M.Tech Scholar, Dept of Electronics and Communication, Amal Jyothi College Of Engineering, Kerala, India

Assistant Professor, Dept of Electronics and Communication, Amal Jyothi College Of Engineering, Kerala, India

Abstract: Image compression is the application of Data compression on digital images. In DCT-based compression standards such as conventional JPEG algorithm, an image is divided into eight-by-eight blocks and then the 2-D Discrete cosine transform (DCT) is applied to encode each block. Another DCT based algorithm called as Modified JPEG compression algorithm [1], overcomes the limitations of conventional JPEG by dividing an image into trapezoid and triangular blocks according to the shape of the objects and achieves a higher compression ratio. This makes the JPEG algorithm much more flexible. There are many compression standards available nowadays to compress images with a higher compression ratio. But here, a new compression technique is proposed that is much like the Modified JPEG compression with certain modifications. In this method, edge detection algorithms followed by morphological operations are used to segment the original image into interior part and the exterior part. The proposed method is compared and is found to be better than the existing compression standard such as JPEG. The simulation result shows that the proposed algorithm outperforms JPEG with a high Bpp vs PSNR graph.

Keywords: JPEG, SA-DCT, Morphological operations.

I. INTRODUCTION

Image Compression is of fundamental importance as the demand for the transmission of multimedia data through telecommunication network is increasing at a faster pace. The images that are captured in digital camera are very large and can occupy vast amount of memory space. If we consider a gray-scale image, it has 256*256 pixels and has 65,536 elements to store and if we take into account a colour image, it has 640*480 pixels and requires nearly a million elements to store. Downloading these files from internet will consume a lot of memory in the hard-disk and is a very time consuming process. Therefore, development of efficient image compression techniques has become a necessary task. The pixels in an image are highly correlated and contain redundant information. The basic goal of image compression is to transform the image so that the pixels become less correlated.

There has been tremendous advancement over the past decade in many fields of digital technology especially devices that are used for image capturing, data storage, bit-mapped printing and display [6]. Use of digital images often is not a viable option due to high storage and high transmission costs. Image Compression is possibly the only solution to overcome the obstacle of large storage and high transmission costs. The most popular graphic image formats employed for compression are the JPEG format and the GIF format. JPEG compression standard is based on Discrete cosine transform (DCT). DCT is widely used in the area of image processing for the purposes of feature selection in pattern recognition and scalar-type Wiener filtering [2].Though JPEG is a widely used compression standard it suffers from certain drawbacks.

The main problem with the block coding scheme is the appearance of blocks in compressed images at higher compression ratio's, also called as Blocking Artifacts. To overcome these drawbacks of JPEG another standard is used which is called as JPEG 2000.

JPEG 2000 outperforms JPEG in many ways and is said to provide a superior image quality as compared to JPEG [5]. JPEG 2000 uses discrete wavelet transform (DWT). This compression standard overcomes blocking artifacts that is a major issue in JPEG. It also provides resolution hierarchy, localisation, SNR scalability and other interesting features [7]. However it has certain disadvantages. It is very difficult to effectively make DWT adaptive to local images. JPEG 2000 image coding may result in ringing artifacts especially in image blocks that contain edges. To overcome the ringing artifacts of JPEG 2000, a new video coding standard H.264/AVC uses a 4*4 block that reduces the ringing artifacts at edges. Both JPEG and JPEG 2000 compression standards can achieve a significant amount of compression but it is not suitable for objects having irregular shapes as it cannot be well approximated by rectangular blocks. Therefore it is reasonable to divide an image according to the object's shape. Based on this concept some Shape-Adaptive Image compression (SAIC) algorithms were proposed [3]-[4].

The Proposed Algorithm that is discussed in this paper outperforms JPEG with a higher peak to signal ratio. This method makes the conventional JPEG algorithm very much flexible, as here the original image is first segmented into interior part and the exterior part which is

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 11, November 2015

then processed separately unlike JPEG where the original image is divided into 8*8 blocks.

II. PROPOSED METHODOLOGY

In this methodology / algorithm, an image is divided into interior part and the exterior part, instead of 8*8 blocks as in JPEG. Compared with JPEG, this algorithm is better and achieves higher compression ratio as compared to JPEG.

A. Concept of the Proposed Algorithm

In this algorithm the original image is segmented into objects. The segmentation of an image into objects employs many morphological operations such as closing, opening, filling operations followed by edge based segmentation to segment the object from the image, then it is followed by dividing the segmented object into the interior part and the exterior part of the image. Here Lena image is taken as the test image as shown in Fig. 1.

Fig.1. Lena Image is taken as the Input image

B. Coding method of the proposed algorithm

In a conventional JPEG algorithm, the coding process involves dividing/ segmenting an image into 8*8 blocks, performing the transformation of these blocks by using 2-D DCT, followed by quantisation, zigzag scanning of the AC terms and encoding using Huffman coding. But in the proposed algorithm, the shape adaptive image compression (SAIC) concept is used, where the original image is segmented into the interior and the exterior part. Then each region undergoes block DCT process.

C. Pre-processing stages prior to segmentation

The original image first undergoes certain pre-processing step such as finding the gradient of the image. Before an image can be segmented, the object present in the image must be detected and roughly classified as to shape and boundary characteristics. Some techniques used to detect objects, use a gradient operator to locate potential object boundaries or edges [10]. The gradient operator applied to a continuous function produces a vector at each point whose direction gives the direction of the maximum change of the function at that point and whose magnitude gives the magnitude of this maximum change. The gradient of the image is found by using first order Gaussian derivative and then it is followed by the binarization of the gradient image as shown in Fig. 2.
Then edge based segmentation of the binarized gradient image is performed.

Fig2. Gradient image and the Binarized gradient image

D. Edge-Based segmentation

The Edge of an image is the basic component of an image and it contains most of the internal information of the image [9]. Therefore detecting edges is one of the key research works in image processing. Image segmentation, segments an object from its background to read the original image properly and identifies the content of the image correctly [8]. In this step the original image is segmented into objects. After performing the Pre-processing stages, edge based segmentation is done. Here Sobel operator is used for edge detection purpose. The edge based image is followed by morphological operation i.e. closing operation, filling and opening operation. The result of the morphological operation on the edge based image gives the segmented object as shown in Fig. 3.

Fig.3. Edge detected image using Sobel operator

E. Morphological operations

The edge detected image using sobel operator undergoes closing operation. The closed image is subjected to filling operation, i.e. a flood fill operation is performed on background pixels by filling holes on the input binary image as shown in Fig. 4.

Fig.4. Closed Image and Binary Image with filled holes

DOI 10.17148/IJARCCE.2015.41117

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 11, November 2015

The resultant image of this operation is a binary image with filled holes. It is then subjected to Morphological opening of the binary image to remove small objects in the image. The opened binary image further undergoes filling operation resulting in the finally filled image with holes as shown in Fig. 5, in order to properly get the object which is to be segmented.

Fig.5. Opened image and finally filled image with holes

F. Dividing object to interior and the exterior part

After the object is successfully segmented, the next step is to find out the interior part and the exterior part of the object. The interior part of the object is obtained by performing multiplication operation of the original image and the finally filled image with holes. After the interior part of the object is found, then the external part is found out by subtracting the interior part of the object from the original image. This step successfully extracts the interior part and the exterior part of the segmented object as shown in Fig. 6. The interior part and the exterior part then undergo the usual block DCT process.

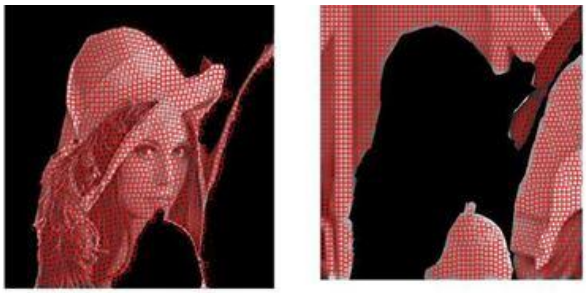

Fig.6. Interior and the Exterior part of the segmented object

III. SIMULATION RESULTS

This section clearly shows, the results of the simulation that was obtained while compressing the Lena image which is taken as the test image using the Proposed algorithm. The evaluation of the proposed algorithm is done using Bpp (bits per pixel). It is used to find the data size of the compressed image. Another parameter called the PSNR (Peak Signal-to-noise ratio) is also used to evaluate the quality of the reconstructed image

An image compression technique is said to be better if it has less Bpp when PSNR is fixed or achieves high PSNR, when Bpp is fixed. Lena image is taken as the test image as shown in Fig. 1. The original image undergoes certain pre-processing steps as defined in the previous section and then is segmented into objects. The segmented object is further divided into interior part and the exterior part. Both the interior and the exterior separately undergoes transformation techniques. The compressed lena image and the reconstructed image using the proposed method is shown in Fig. 7.

Fig.7. Compressed Image and the Reconstructed Image using the proposed method

The proposed algorithm as well as the JPEG standard was applied on Lena image and the resulting Bpp vs PSNR graph of the two algorithms was plotted on a single graph to perform a comparison between the compression techniques as shown in Fig. 8.

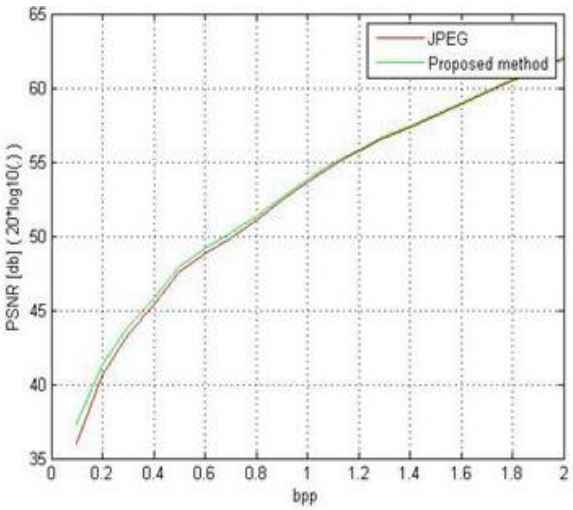

Fig.8. Comparison of Bpp vs PSNR graph of JPEG and The Proposed algorithm

IV. CONCLUSION

In this paper, a novel Image compression technique is proposed. JPEG is widely used in image compression but it has a problem. It suffers from noticeable blocking artifacts at high compression ratio's. Therefore a new compression method is proposed, where it is more reasonable to divide an image first, into objects and then perform the transformation process using DCT. This method uses sobel operator for edge detection. The advantage of Sobel edge operand is its capability of smoothing random noises in images, but still it suffers from certain drawbacks. When an image contains lots of white Gaussian noise, it is very difficult to get the peak of the first derivative because the noise points and the useful signals mix up. However, simulation results show the proposed method based on edge detection and

DOI 10.17148/IJARCCE.2015.41117

morphological operations achieves a higher Peak to signal ratio (PSNR) as compared to JPEG. As a future work, the sobel edge operand can be improved by introducing certain methods that will be useful in eliminating gaussian noise from the images and hence overcomes the limitations of using sobel operator.

ACKNOWLEDGMENT

I would like to thank all my classmates for their support and positive responses. My teachers who supported me at every stage of my research work. My parents for their unending love and support. And God, The Almighty for helping me to fight all the challenges that came on my way.

REFERENCES

[1] J.J.Ding, Y.W.Hyuang, P.Y.Lin and S.C. Pei, "Two-Dimensional Orthogonal DCT Expansion in Trapezoid and Triangular Blocks and Modified JPEG Image Compression", IEEE Tansaction on image processing, Vol. 22, no. 9, 2013

[2] N. Ahmed, T. Natarajan and K. R. Rao, "Discrete cosine transform", IEEE Trans. on Computers, Vol. 23, no. 1, pp. 90-93,1974.

[3] T. Sikora and B. Makai, "Shape-adaptive DCT for generic coding of video", IEEE Trans. on Circuit Systems for Video Technol., Vol. 5, no. 2, pp. 59-62,1995.

[4] W. K. Ng and Z. Lin, "A new shape-adaptive DCT for coding of arbitrarily shaped image segments", Proceedings IEEE International Conference on Acoustic, Speech, Signal Processing, Vol. 4, pp. 2115-2118, 2000..

[5] A. Saffor, A.R. Ramli, K.H. Ng, "A Comparitive study of Image Compression between JPEG AND WAVELET", Malaysian Journal of Computer Science, Vol. 14, no. 1, pp. 39-45, 2001.

[6] G.K. Wallace, "The JPEG Still Picture Compression Standard", IEEE Transaction on Consumer Electronics, Vol. 38, no. 1, 1992.

[7] W. Dai, L. Liu and T. D. Tran, "Adaptive Block-based Image Coding with Pre-/post filtering", Deptartment of Electrical and Computer Engineering, The Johns Hopkins University, Baltimore, MD 21218, USA

[8] Muthukrishnan and M.Radha , "Edge Detection Techniques for Image Segmentation", International Journal of Computer Science Information Technology (IJCSIT), Vol. 3, no. 6, 2011.

[9] Wenshuo Gao, Lei Yang, Xiaoguang Zhang, Huizhong Liu, "An Improved Sobel Edge Detection", ICICT, Beijing, China, 2010.

[10] Nick Kanopoulos, Nagesh Vasanthavada, Robert L. Baker, "Design of an Image Edge Detection Filter Using the Sobel Operator", IEEE Journal Of Solid-State Circuits, Vol. 23, no. 2, 1988.

BIOGRAPHIES

Sanjana Mathew, pursuing Master's Degree in Communication Engineering at Amal Jyothi College of Engineering, Kottayam, Kerala, India. She has obtained her Bachelor's Degree from Biju Patnaik University of Technology, Odisha, India**.**

Shinto Sebastian, works as Assistant professor at Amal Jyothi College of Engineering, Kottayam, Kerala, India. He has obtained his Master's Degree in Communication Engineering at Vellore Institute of Technology (VIT), Vellore. He has obtained his Master's in science in Applied Electronics & Computer Technology at School of Technology & Applied Science, M.G. University, Kottayam. He has got more than 6 years of teaching experience in various engineering colleges.

DOI 10.17148/IJARCCE.2015.41117