Asian Journal of Information Technology 16 (1): 148-152, 2017
ISSN: 1682-3915


# Improving the Performance for Edge Based Image Compression Using Various Techniques

[1]Y. Arockia Raj and [2]P. Alli
[1]Department of Computer Science and Engineering,
PSNA College of Engineering and Technology, Dindugul, Tamil Nadu, India
[2]Department of Computer Science and Engineering,
Velammal College of Engineering and Technology, Madurai, Tamil Nadu, India

**Abstract:** The significant information about the images is known with the help of edge information. An analysis is made for image using information extracted over the edges using a technique which compresses the image in a lossy way. The color values from the edges are obtained and computed by making use of detectors or using traditional technique like JBIG. While translating the information the computed data are improved by differential equations. As added a multiple channel algorithm is discussed for producing a simple mechanism for computing and decoding of image in real time environment. It is perceived that the cartoon images perform better as compared to the traditional standards and it proves to be the successor of all these techniques.

**Key words:** JBIG, differential equations, algorithm, traditional standards, multiple channel

## INTRODUCTION

It is to be noted that an important role is played by edges in image processing but also in human perception and computer vision. Various algorithms make use of edges where their role is indispensible. It acts as a middle man between pixel based and image representation using relationship between the image pixels. This forms the base for introducing these methods into human perception so that they can be translated into image codes (Reid *et al*., 1997). Using this method it is possible to extract areas which tend to be important for vision neglecting the remaining portions thus resulting in a lossy method for information extraction. Due to this drawbacks techniques like JPEG (Pennebaker and Mitchell, 1992), JPEG2000 (Taubman *et al*., 2002) does not depend on these techniques.

The image coding can be clearly understood by human begins since they can well understand cartoons and line representation. It is easier to describe an image using few outlines rather using a pixel which provides a major advantage that this edge information can be utilized well for compressing an image.

From many hypothesis and experiments is proven that an image can be very well reconstructed using edge information (Hummel and Moniot, 1989; Grattoni and Guiducci, 1990; Mallat and Zhong, 1992; Saloma and Haeberli, 1993; Elder, 1999). But not only the information and location of edges are sufficient for reconstructing an image. There are ample of techniques available for including diverse information in order to obtain a complete reconstructed image and it is also possible to make use of slope information also. All these techniques do not guarantee that they will compulsorily produce pleasing results.

It is possible to extract numerous cartoon images over the search engines compressed and provided by JPEG. It is to be noted that compression using JPEG often results in lossy compression.

The main focus of the study is to reconstruct a cartoon image with high quality for edges with color values. The missed out information can be calculated by computing a balanced state in uniform transmission process. Two different techniques were employed for locating the edges and for their color values (Kunt *et al*., 1985). This suitably performs well and produces a good quality output when compared with standard compression standards like JPEG 2000 in terms of compression rate.

## MATERIALS AND METHODS

**Computation:** The computation is actually a three step process. Initially, the edges are removed for computing the position of nearby color values. Second is to compute these positions well and the last step deals with computing the color values.

**Corresponding Author:** Y. Arockia Raj, Department of Computer Science and Engineering,
PSNA College of Engineering and Technology, Dindugul, Tamil Nadu, India

**Recognition of edges:** The computation of an image begins with the recognition of edges and so many devices are been invented for recognizing the edges. The main focus of the study is upon traditional recognition of edges like David Marr for recognizing the edges. It is possible to describe the edges using zero crossings of Mexican Hat Wavelet for an image. The Mexican Hat Wavelet over a multiple channel can be defined as $i = (i_1, ..., i_n)^P$ and also their sum over the multiple channel n is given as:

$$\Delta_i = \sum_{n=0}^{N} \Delta i_n = \Delta \left( \sum_{n=0}^{N} i_n \right) \quad (1)$$

David Marr edge recognition is combined with Canny Detection algorithm for which it is necessary to define the size of edges in terms of length where the slope $\Delta i_n$ in multichannel is calculated using a 2 dimensional map with slope at each and every point (Logan, 1977). It is not needed to bind this to a particular edge recognition technique. But comparisons with every other techniques can be performed in order to visualize that the zero crossings used for edge recognition provides better results for cartoon images.

**Computing the shape location:** The chapter above discusses about recognition of edges since they are needed to locate the pixels for later computation. This chapter focuses fully on computing these positions effectively. It is possible to perceive the edges in an image as two levels such as using black color for pixels over the edges and white color for pixels over the background (Yuille and Poggio, 1986). The image with such combination can be called as an image on edge and there are several techniques available for compressing these images.

The techniques namely JBIG is used for compressing these two level images which for example used in transmission over fax which is a combination of text and line representation. The similar method is used in the proposed work also. The technique named JBIG-KIT1 is used to extract an optimal result using the available information by using symbols. Here the text data are clustered as symbols which are already present inside the dictionary (Rotem and Zeevi, 1986). The computations over the dictionary are performed using numerical calculations which purely depend on a portion in information. Using which the location is predicted using the symbols by influence of this method over an image (Carlsson, 1988). This technique allows retrieving information without any loss (Table 1).

Table 1: Comparison of compression ratio and computation and decoding time for images

| Images | JBIG | JBIG2 |
|---|---|---|
| **Compression ratio** | | |
| Cartoon images | 0.089 | 0.101 |
| Ships | 0.200 | 0.150 |
| Signs | 0.040 | 0.063 |
| **Computation time (msec)** | | |
| Cartoon images | 2.00 | 3.000 |
| Ships | 1.00 | 7.000 |
| Signs | 2.00 | 4.000 |
| **Decoding time (msec)** | | |
| Cartoon images | 2.00 | 3.000 |
| Ships | <1.00 | 4.000 |
| Signs | 2.00 | 1.000 |

**Computing the outline pixel values:** The study focuses on storing the color values. The position of these pixel values are calculated using the edge positions. Based on the edges the areas are divided into different colors and so it is also to be noted the pixel value which directly lie on the edges should be avoided. It is to be focused that the values should be extracted from both the sides in order which they occur. As added the pixel values that lie onto the boundary of the image areas are also be extracted which provides good results during image reconstruction for lost pixels at the time of decoding.

These techniques yields a one dimensional signal holding the required pixel values with which it is possible to build a plan p with all its pixels which are neighbor to the edges and also the boundary pixels of the image. These pixels are visited on a row to row basis until the end is reached after which the below mentioned algorithm is used for every pixel y:

1. For a pixel y in plan p it is placed into the line L1
2. In case, if L1 is not found empty, then
(a) Obtain the pixel y from L1 and take it out from L1
(b) In case, if y is present inside L1, then proceed with Step 2
(c) Place y on L2 and take it out from p and append the pixel value of y to one dimensional signal and set its last to y
(d) In case, if L2 is not found empty, then
(i) Obtain the pixel y from L2 and take it out from L2
(ii) For each and every adjacent pixel $y_a$ which is assumed to be in $p_a$ adjacency positions of y
which is also in p also, do
Compute the distance over space between $p_a$ and last of y
In case if they are found to be $>s_d$, then
Place $p_a$ into line L1
Else
Place $p_a$ into line L2 and take it out from p
Append the pixel value of $p_a$ to one dimensional signal and set to y last to y

The line L1 holds the pixels which is been identified but the value for one dimensional signal has not been added. In contrast the line L2 contains pixels where the pixel values are already been added to the one dimensional signal but the adjacent areas are not been identified. The traversal along row-to-row over the entire pixels is assured not to be missed out. Upon removal of pixels that are been added to one dimensional signal from p the algorithm assures termination.

This technique aims to gather the pixel values at the edges directly but also it focuses on $s_d$ since pixel values can also be found at a reasonable distance from the edges. This can be viewed as an advantage because there is chance that the edges that are close enough to one another can contribute to the pixel values.

It is necessary to reduce the gathered pixel values for which the reduction in data is achieved through sub sectioning and applying small input values to large set of values. These results in loss in pixel values the edges for which the values present at the edges are scattered in order to decrease the resolution within the area. Identical sub sectioning can be performed using a one dimensional signal. A parameter $s_d$ is used for sectioning $s_d \in \{1, ..., 255\}$ where $s_d$ is utilized over a multiple channel and it stores each and every values obtained. It is previously discussed that the pixel values over the edges are subjected for marginal change and so it also influences the one dimensional signal. The lost pixels can be constructed again by making use of linear polynomials and this fails to work between pixels of different edges. As a result the values of pixels can differ considerably. It is essential to sub section the pixel values of these different edges alone.

It is to be noted that the method for collecting the pixel values has been studied. While making use of repetitive search it is to be imagined that the already gathered pixels belongs to same section. For each and every edge section it is possible to obtain a different one dimensional signal. This technique does not demand to store any added information regarding the image.

The sectioning hypothesis can be used to analyze the quality of the created signal for improvement by flattening the obtained original signal. The proposed technique allows flattening individual one dimensional signal by mean filters with deviation of standard 1 believing the pixels to have size of 1×1. The expectation of this technique is to eliminate minor gaps for improving the rate of compression. As added some adjacent information are also included into the sectioned pixels.

The next reduction state for data is algebraic functions for the pixel values. Initially the image will be holding 256 different pixels values one for each channel where the reduction in areas to L different pixel values takes place. The technique is called as tread of a stairway quantization which is an identical technique for quantization which permits construction of small and large values for the original image.

Let $i_f \in \{0, \ldots, 255\}$ is the value of a pixel for an one dimensional signal and let x: = 255/(L-1). The value after quantization is:

$$i_g = \left\lfloor \frac{i_f}{x} + \frac{1}{2} \right\rfloor \quad (2)$$

Here, $i_g \in \{0, \ldots, L\text{-}1\}$. For constructing the image again it is necessary to calculate:

$$i_f \sim x.i_g \quad (3)$$

The image used for processing is separated into L intervals with a size x but not the initial and last one possessing a size x/2. The pixel values of the initial one are set to 0 after the images are constructed again whereas the pixels of the last one are set to 255 (Galic *et al*., 2008). The other values of the pixels are set to the middle value. In case of color images the technique permits storing the quantization of each channel individually. The main focus is to adjust the size to the possibilities using which the values of pixels happen in the one dimensional signal.

These steps are rotated again and again until the borders attain a level that does not transform anymore. The points for constructing the images are noted and good reconstructions of image are obtained (Schmaltz *et al*., 2009). These points are needed as added in order to construct again the value of pixels during decoding.

**Decoding:** The decoding of a computed image is performed using all the steps done for computation. Here, the last step is completely different from the last step of computation process for attaining the final image and the lost pixels are constructed again using a distribution process.

**Decoding of shape location and values of pixel:** The decoding process is initiated using the title information where the computed edge image from the encoded color values is translated using suitable translators. The result of this translation is binary edge image producing the final image (Galic *et al*., 2005). On the other side, it is possible to obtain a quantized color value for reconstruction. Repetitive searches are performed on the edge image and the color values are scattered. The lost pixels along the edge sections are filled by linear polynomials which produces an image holding translated colors on both the edges. The color values of remaining pixels are not known and so its improvement has to be focused. For constructing the image again the lost pixels between the

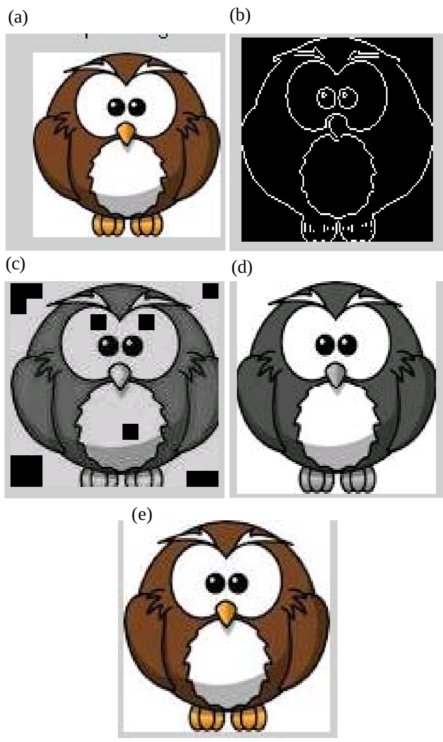


Fig. 1: a) Input image; b) Edged image; c) Reconstructed image; d) Flattened image and e) Peak signal to noise ratio of compressed image (29.16)

edges it is possible to make use of identical differentiation for polynomials (Liu *et al*., 2007). This technique is easy for calculation by using partial derivatives. The ultimate merits of using this method are; it is to be noted that it is one of the well understood technique where it is necessary to select the polynomial data proportional to the modulus of the differential operator of an image. This modulus shows that the pixels are stored for the polynomial with identical differentiation (Xiong *et al*., 2007). While considering the cartoon images this approaches move down to the pixels left and right of an image shape. Hence, upon selecting the identical differentiation and the neighborhood pixels along the edges the hypothesis meets the expected results to some extent (Belhachmi *et al*., 2009).

The theorem for shape based sealing process allows the viewers for observing the intensity and color of observation (Dron, 1993). As closure the identical differentiation provides a good performance as per the algorithm (Fig. 1a-e).

## RESULTS AND DISCUSSION

**Implementation:** The analysis for the proposed method is performed in order to provide a clear and well defined

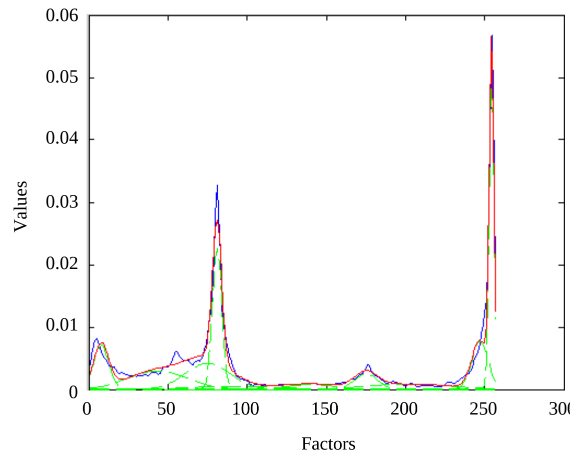


Fig. 2: Multi channel image observed for intensity

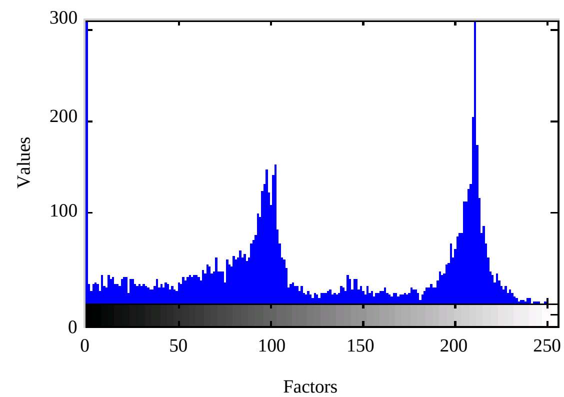


Fig. 3: Multi channel image observed for color

Table 2: Comparing the computation and translation time for different images along with different methods

| Images | Signs | Ships | Cartoon images |
|---|---|---|---|
| Rate of compression | 0.30 | 0.12 | 0.18 |
| **Peak sound to noise ratio** | | | |
| JPEG | 24.22 | 21.12 | 22.15 |
| JPEG 2000 | 27.45 | 26.68 | 25.25 |
| Proposed method | 29.19 | 29.12 | 29.16 |
| Encoding | 0.06 | 0.09 | 0.10 |
| Decoding | 0.12 | 0.30 | 0.45 |

technique. The quantization technique makes use of peak signal to noise ratio for computing the errors that commonly arise with the compressed images (Rane *et al*., 2003). The peak value in our technique is 255 and $i_n$ represents the number of pixels over an image and $i_m$ represents the number of channels and $i_f$, $i_g$ represents the pixel values of the image given as input into multiple channels (Fig. 2, 3 and Table 2):

$$\text{Peak signal to noise ratio} = 10\log 10\left(\frac{1}{i_m.i_m}\right)\left(i_f - i_g\right)^2 \quad (4)$$

## CONCLUSION

The study proposes a simple but effective way for compressing the cartoon images by obtaining the edges and neighborhood pixel values by computing them in a good manner and making use of identical differentiation for constructing the images again. This proves to work better under the previous techniques. The results clearly prove that the cartoon images require a technique which is different from the traditional methods where the preservation of edges and minor information along with multiple channel algorithm provides a solution. There by it is possible to compute and decode the images in a real time environment.

## REFERENCES

Belhachmi, Z., D. Bucur, B. Burgeth and J. Weickert, 2009. How to choose interpolation data in images. SIAM. J. Appl. Math., 70: 333-352.

Carlsson, S., 1988. Sketch based coding of grey level images. Signal Process., 15: 57-83.

Dron, L., 1993. The multiscale veto model: A two-stage analog network for edge detection and image reconstruction. Int. J. Comput. Vision, 11: 45-61.

Elder, J.H., 1999. Are edges incomplete?. Int. J. Comput. Vision, 34: 97-122.

Galic, I., J. Weickert, M. Welk, A. Bruhn and A. Belyaev *et al*., 2005. Towards PDE-Based Image Compression. In: Variational, Geometric and Level Set Methods in Computer Vision. Paragios, N., O. Faugeras, T. Chan and C. Schnorr (Eds.). Springer Berlin Heidelberg, Berlin, Germany, ISBN: 978-3-540-29348-4, pp: 37-48.

Galic, I., J. Weickert, M. Welk, A. Bruhn and A. Belyaev *et al*., 2008. Image compression with anisotropic diffusion. J. Math. Imaging Vision, 31: 255-269.

Grattoni, P. and A. Guiducci, 1990. Contour coding for image description. Pattern Recognit. Lett., 11: 95-105.

Hummel, R. and R. Moniot, 1989. Reconstructions from zero crossings in scale space. IEEE. Trans. Acoust. Speech Signal Process., 37: 2111-2130.

Kunt, M., A. Ikonomopoulos and M. Kocher, 1985. Second-generation image-coding techniques. Proc. IEEE, 73: 549-574.

Liu, D., X. Sun, F. Wu, S. Li and Y.Q. Zhang, 2007. Image compression with edge-based inpainting. IEEE. Trans. Circuits Syst. Video Technol., 17: 1273-1287.

Logan, B.F., 1977. Information in the zero crossings of bandpass signals. Bell. Syst. Tech. J., 56: 487-510.

Mallat, S. and S. Zhong, 1992. Characterization of signals from multiscale edges. IEEE. Trans. Pattern Anal. Mach. Intell., 14: 710-732.

Pennebaker, W.B. and J.L. Mitchell, 1992. JPEG: Still Image Data Compression Standard. Springer Science & Business Media, New York, USA., ISBN: 0-442-01272-1, Pages: 639.

Rane, S.D., G. Sapiro and M. Bertalmio, 2003. Structure and texture filling-in of missing image blocks in wireless transmission and compression applications. IEEE. Trans. Image Process., 12: 296-303.

Reid, M.M., R.J. Millar and N.D. Black, 1997. Second-generation image coding: An overview. ACM. Comput. Surv. (CSUR), 29: 3-29.

Rotem, D. and Y. Zeevi, 1986. Image reconstruction from zero crossings. IEEE. Trans. Acoust. Speech Signal Process., 34: 1269-1277.

Saloma, C. and P. Haeberli, 1993. Two-dimensional image reconstruction from Fourier coefficients computed directly from zero crossings. Appl. Optics, 32: 3092-3093.

Schmaltz, C., J. Weickert and A. Bruhn, 2009. Beating the Quality of JPEG 2000 with Anisotropic Diffusion. In: Joint Pattern Recognition. Joachim, D., G. Notni and S. Herbert (Eds.). Springer Berlin Heidelberg, Berlin, Germany, ISBN: 978-3-642-03797-9, pp: 452-461.

Taubman, D.S., M.W. Marcellin and M. Rabbani, 2002. JPEG 2000: Image compression fundamentals standards and practice. J. Electron. Imaging, 11: 286-287.

Xiong, Z., X. Sun, F. Wu and S. Li, 2007. Image coding with parameter-assistant inpainting. Proceedings of the 2007 IEEE International Conference on Image Processing, September 16-October 19, 2007, IEEE, New York, USA., ISBN: 978-1-4244-1436-9, pp: II-369.

Yuille, A.L. and T.A. Poggio, 1986. Scaling theorems for zero crossings. IEEE. Trans. Pattern Anal. Mach. Intell., 8: 15-25.