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DCT Image Compression for Color Images

Priya Kapoor[*1], Sunaina Patyal[2]
[1] M.Tech Research Scholar, GIMET, Amritsar
e-mail:priyakapoor91290@gmail.com
[2] M.Tech Research Scholar, GIMET, Amritsar

***Abstract*--**Image compression attempts to condense the number of bits obligatory to digitally symbolize an image while maintaining its apparent visual excellence Image compression is a procedure that is very vastly used for the integral and resourceful convey of data. It not only reduces the dimension of realistic file to be transferred but at the equivalent time reduces the storage space requirements, cost of the data transferred, and the time required for the transfer. It makes the diffusion progression faster, provides superior bandwidth and security beside illegitimate use of data. Image compression involve two types lossy image compression and lossless image compression. In lossy image compression there is no loss of data. However lossless image compression is used to retain original multimedia object The main objective of this research work is to implement 1DCT, 2DCT and True compression in MATLAB by using grey scale images .The comparison among the selected algorithms will also be drawn in order to get better result.

Keywords*--*DCT 1, DCT2, True Compression

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1. Introduction

In the case of video, compression causes some information to be lost; some information at a detail level is considered not essential for a reasonable reproduction of the scene. This type of compression is called lossy compression. Audio compression on the other hand, is not lossy. It is called lossless compression.

Type of compression

Various type of compression are a follow

Lossless Compression

Lossless techniques compress data without destroying or losing anything during the process. When the original document is decompressed, it's bit-for-bit identical to the original. Lossless is a term applied to image data compression techniques where very little of the original data is lost. It is typically used by the photographic and print media, where high resolution imagery is required and larger file sizes aren't a problem. In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only achieve a modest amount of compression.

Lossy Compression

Lossy is a term applied to data compression techniques in which some amount of the original data is lost during the compression process. Lossy image compression applications attempt to eliminate redundant or unnecessary information in terms of what the human eye can perceive. As the amount of data is reduced in the compressed image, the file size is smaller than the original. Lossy schemes are capable of achieving much higher compression. Under normal viewing conditions, no visible loss is perceived (visually lossless).

Lossy image data compression is useful for application to World Wide Web images for quicker transmission across the Internet. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information.

Typical Image Coder Consist Of Following Components

A typical lossy image compression system which consistsof three closely connected components namely

(a) Source Encoder
(b) Quantizer, and
(c) Entropy Encoder.

Compression is accomplished by applying a linear transform to decorrelate the image data, quantizing the resulting transform coefficients, and entropy coding the quantized values.

a Source Encoder (or Linear Transformer)

Over the years, a variety of linear transforms have beendeveloped which include Discrete Fourier Transform (DFT),Discrete Cosine Transform (DCT) , Discrete Wavelet Transform (DWT)and many more, each with its own advantages and disadvantages.

b. Quantizer

A quantizer simply reduces the number of bits needed to store the transformed coefficients by reducing the precision of those values. Since this is a many-to-one mapping, it is a lossy process and is the main source of compression in an encoder. Quantization can be performed on each individual coefficient ,which is known as Scalar Quantization (SQ). Quantization can also be performed on a group of coefficients together, and this is known as Vector Quantization (VQ). Both uniform and non uniform quantizers can be used depending on the problem at hand.

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c. Entropy Encoder

An entropy encoder further compresses the quantized values lossless to give better overall compression. It uses a model to accurately determine the probabilities for each quantized value and produces an appropriate code based on these probabilities so that the resultant output code stream will be smaller than the input stream. The most commonly used entropy encoders are the Huffman encoder and the arithmetic encoder, although for applications requiring fast execution, simple run-length encoding (RLE) has proven very effective.

A **discrete cosine transform** (**DCT**) expresses a finite sequence of data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. JPEG) (where small high-frequency components can be discarded), to spectral methods for the numerical solution of partial differential equations. The use of cosine rather than sine functions is critical in these applications: for compression, it turns out that cosine functions are much more efficient (as described below, fewer functions are needed to approximate a typical signal), whereas for differential equations the cosines express a particular choice of boundary conditions

VARIOUS FORMS OF DCT

In this project we explain various forms of the DCT.

a) 1DCT

b) DCT

c) TRUE COMPRESSION

1 LEVEL DCT

the discrete cosine transform (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain

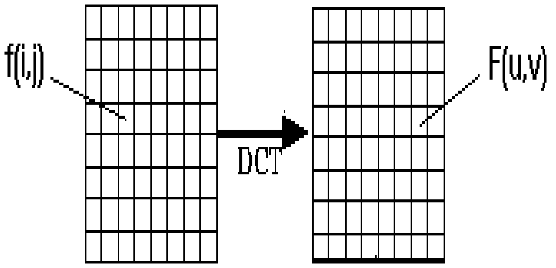

Fig 1: 1 Level DCT[9]

In this case firstly we select the input image by clicking the browse button and after that we apply 1 dct to the input image by compression factor of 2,compression factor of 4,compression factor of 8 to get the compressed form of the image.

In case of compression factor of 2 we get the compressed image but in case of compression factor of 4 we get more compressed image.and in case of compression factor of 8 we get extremely compressed image.but the quality of the image that is obtained from the compression factor 2 is better than image we obtained from compression factor 4 and compression factor 8.

This type of compression is obtained by applying the DCT to each row .and we get compressed form of the image.

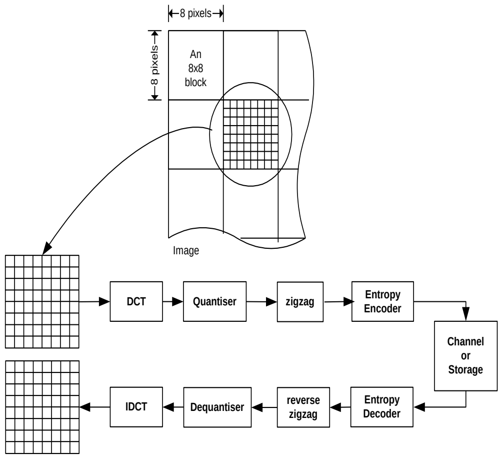

Fig 1.2: compression and decompression [9]

- The coefficients are then reordered into a one-dimensional array in a zigzag manner before further entropy encoding.
- The compression is achieved in two stages; the first is during quantisation and the second during the entropy coding process.
- JPEG decoding is the reverse process of coding.

Factoring reduces problem to a series of 1D DCTs apply 1D DCT (Vertically) to Columns

- apply 1D DCT (Horizontally) to resultant Vertical DCT above.
- or alternatively Horizontal to Vertical.

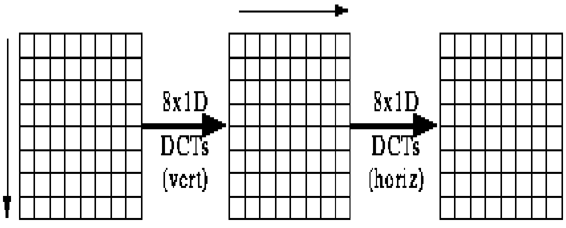

Fig 1.3 2 Level DCT [9]

In this case we apply 2 dct to the image by compression factor of 2*2,compression factor of 4*4,compression factor of 8*8 to get the compressed form of the image.

In case of compression factor of 2*2 we get the compressed image but in case of compression factor of 4 *4 we get more compressed image .and in case of compression factor of 8*8 we get extremely compressed image. but the quality of the image that is obtained from the compression factor 2*2 is better than image we obtained from compression factor 4*4 and compression factor 8*8.

This type of compression is obtained by applying the 2 DCT to each row and column..and we get compressed form of the image.

- One of the properties of the 2-D DCT is that it is separable meaning that it can be separated into a pair of 1-D DCTs.
- To obtain the 2-D DCT of a block a 1-D DCT is first performed on the rows of the block then a 1-D DCT is performed on the columns of the resulting block.
- The same applies to the IDCT.
- This process is illustrated on the following slide.

\TRUE COMPRESSION

In this type of compression we compress the image by using two methods .first one is by 2 color component and secondly by using 3 color component

In first case we remove one color component of the image and in second case we remove two color components of the image.and get the compressed form of the image,in this case the image that is obtained after the second case is the compressed form of the image.

This true compression is basically used in medical imaging

2. Related work

The design a lossy image compression algorithm dedicated to color still image. After a preprocessing step(mean removing and RGB to YCbcr transformation) ,the DCT transform is applied and followed by an iterative phase(using the bisection method) including the thresholding ,the quantization ,dequantization ,the inverse DCT ,YCbCr to RGB transform and the mean recovering .author done in order to guarantee that a desired quality (fixed in advance using the well known PSNR metric) is checked .For the aim to obtain the best possible compression ratio CR, the next step is the application of a proposed adaptive scanning providing ,for each(n, n) DCT block a corresponding(n_n) vector containing the maximum possible run of zero at its end .the efficiency of proposed scheme is demonstrated by results especially when the method use is block truncation using paper filtering principle.As society has become increasingly reliant upon digital images to communicate visual information, a number of forensic techniques have been developed to verify the authenticity of digital images. Amongst the most successful of these are techniques that make use of an image’s compression history and its associated compression fingerprints. Little consideration has been given, however, to *anti-forensic* techniques capable of fooling forensic algorithms. In this paper, author present a set of anti-forensic techniques designed to remove forensically significant indicators of compression from an image. author do this by first developing a generalized framework for the design of anti-forensic techniques to remove compression fingerprints from an image’s transform coefficients. This framework operates by estimating the distribution of an image’s transform coefficients before compression, then adding anti-forensic dither to the transform coefficients of a compressed image so that their distribution matches the estimated one .Author then use this framework to develop anti-forensic techniques specifically targeted at erasing compression fingerprints left by both JPEG and wavelet-based coders. Additionally, author propose a technique to remove statistical traces of the blocking artifacts left by image compression algorithms that divide an image into segments during processing. Through a series of experiments author demonstrate that anti-forensic techniques are capable of removing forensically detectable traces of image compression without significantly impacting an image’s visual qualitya novel reduced-reference (RR) image quality assessment (IQA) is proposed by statistical modeling of the discrete cosine transform (DCT) coefficient distributions. In order to reduce the RR data rates and further exploit the identical nature of the coefficient distributions between adjacent DCT subbands, the DCT coefficients are reorganized into a three-level coefficient tree. Subsequently, generalized Gaussian density (GGD) is employed to model the coefficient distribution of each reorganized DCT subband. Image compression is a method through which we can reduce the storage space of images, videos will helpful to increase storage and transmission process’s performance. In image compression, we do not only concentrate on reducing size but also concentrate on doing it without losing quality and information of image. In this paper, author describe two image compression techniques a. The first technique was based on Discrete Cosine Transform (DCT) and the second one was based on Discrete Wavelet Transform (DWT). The results of simulation are shown and compared different quality parameters of its by applying on various imagesImage compression is now essential for applications such as transmission and storage in data bases. In this paper author review and discuss about the image compression, need of compression, its principles, and classes of compression and various algorithm of image compression. In paper author attempts to give a recipe for selecting one of the popular image compression algorithms based on Wavelet, JPEG/DCT, VQ, and Fractal approaches. DCT-based image watermarking technique is proposed To improve the robustness of watermark against JPEG compression, the most recently proposed techniques embed watermark into the low-frequency components of the image. However, these components hold significant information of the image. Directly replacing the low-frequency components with watermark may introduce undesirable degradation to image quality. To preserve acceptable visual quality for watermarked images, author propose a watermarking technique that adjusts the DCT low-frequency coefficients by the concept of mathematical remainder. Simulation results demonstrate that the embedded watermarks can be almost fully extracted from the JPEG-compressed images with very high compression ratio.

3. Problem Formulation

A. Problems in existing Work

The DCT method is a type of transform method. Rather than simply trying to compress the pixel values directly, the image is first TRANSFORMED into the frequency domain. Compression can now be achieved by more coarsely quantizing the large amount of high-frequency components usually present. The JPEG standard algorithm for full-colour and grey-scale image compression is a DCT compression standard that uses 8x8 blocks. It was not designed for graphics or line drawings and is not suited to these image types. The Discrete Cosine Method uses continuous cosine waves, like cos(x) below, of increasing frequencies to represent the image pixels.

4. Experimental Setup and Proposed Algorithm

A. Proposed Algorithm

This section consists proposed algorithm's steps. It has given the different steps which are required to implement the proposed algorithm.

Encoding System:

- **Step1.** The image is broken into N*N blocks of pixels. Here N may be 4, 8, 16,etc.
- **Step2.** Working from left to right, top to bottom, the DCT is applied to each block.
- **Step3.** Each block's elements are compressed through quantization means dividing by some specific value.
- **Step4.** The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.

Decoding System:

- Step1. Load compressed image from disk
- Step2. Image is broken into N*N blocks of pixels.
- Step3. Each block is de-quantized by applying reverse process of quantization.
- Step4. Now apply inverse DCT on each block. And combine these blocks into an image which is

B. Experimental set-up

In order to implement the proposed algorithm; design and implementation is done in MATLAB using image processing toolbox. In order to do cross validation the proposed algorithm is compared with the existing standard median filter and relaxed median filter. Table 1 is showing the various images which are used in this research work. Images are given along with their format and size. All the images are of different kind and also the filtering evaluation is different for each image.

Sequence No	NAME	FORMAT	SIZE
1	PIC 1	.JPG	73 KB
2	PIC 2	.JPG	128 KB
3	PIC 3	.JPG	147KB
4	PIC 4	.JPG	117KB

5. Experimental results

Figure 2 has shown the input image which is passed to the simulation.

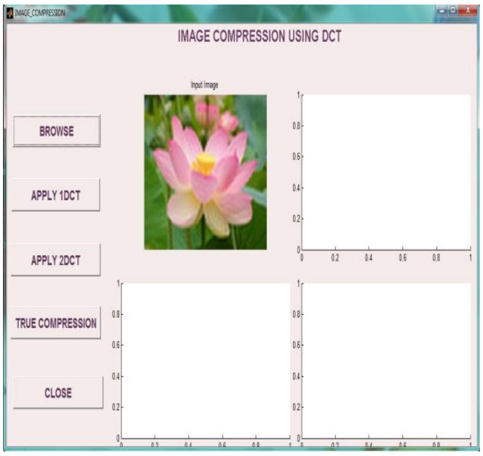

Figure 2 Input image

Figure 3 has shown theimage compression using 1 dct. the input image by compression factor of 2,compression factor of 4,compressin factor of 8 to get the compressed form of the image.

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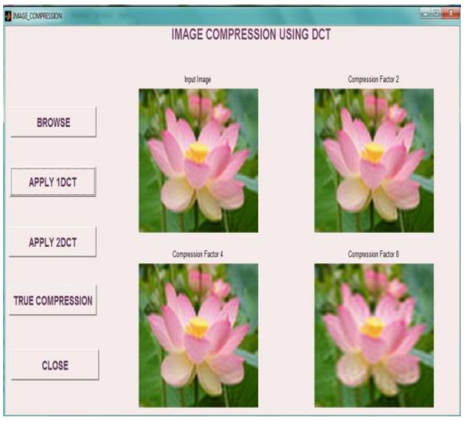

Figure 3 Image Compression Using 1DCT

Figure 4 has shown the Image Compression Using 2 DCT.

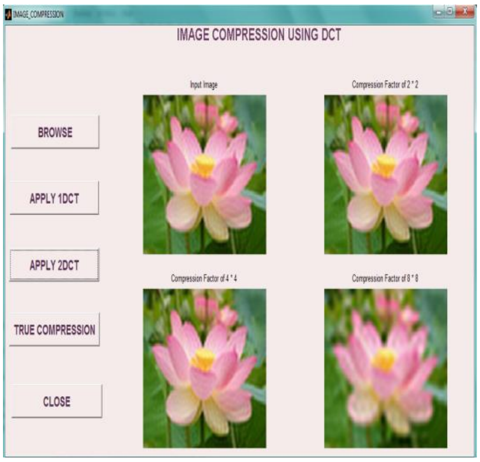

Figure 4 Image Compression Using 2 DCT

Figure 5 has shown true compression**.** In this figure we apply true compression to the input image by compression of 2 color values and 3 color values. This type of compression is used in medical imaging.

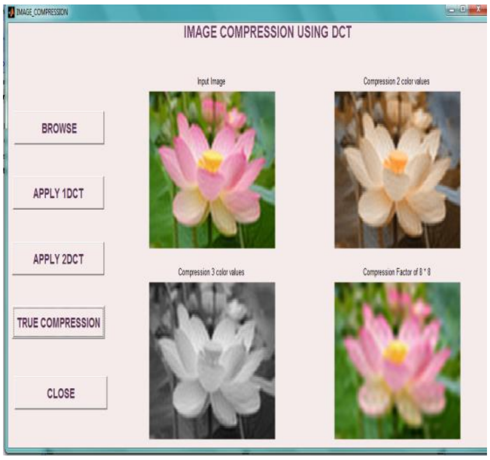

Figure 5 true compression

6. Performance evaluation

Table 2 and Figure 6 are showing the comparative analysis of Image Compression Using 1DCT

Table 2 Image Compression Using 1DCT

SERIAL NO	SIZE OF IMAGE	1 DCT CF2	1 DCT CF4	1DCT CF8
1	73KB	36KB	31KB	26KB
2	128KB	26KB	25KB	22KB
3	147KB	12KB	10KB	9KB
4	117KB	93KB	78KB	65KB

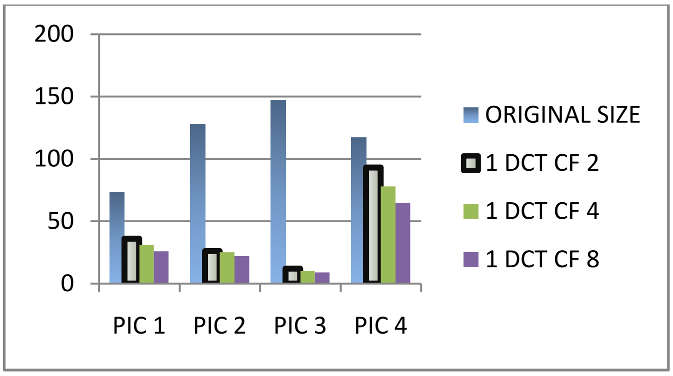

Figure 6 Image Compression Using 1DCT

Table 3 and Figure 7 is showing the comparative analysis of the Image Compression Using 2DCT.

Table 3 Image Compression Using 2DCT

SERIAL NO	SIZE OF IMAGE	2 DCT CF 2*2	2 DCT CF 4*4	2 DCT CF 8*8
1	73KB	33KB	23KB	19KB
2	128KB	26KB	24KB	18KB
3	147KB	11KB	8KB	6KB
4	117KB	83KB	61KB	54KB

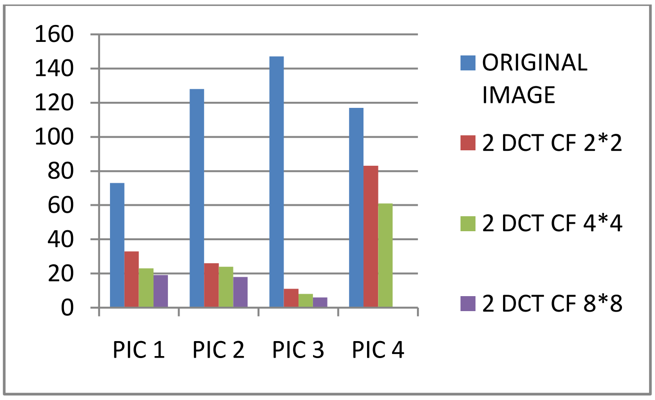

Figure 7 Image Compression Using 2DCT

Table 4 and Figure 8. is showing the comparative analysis of the Image Compression using true compression.

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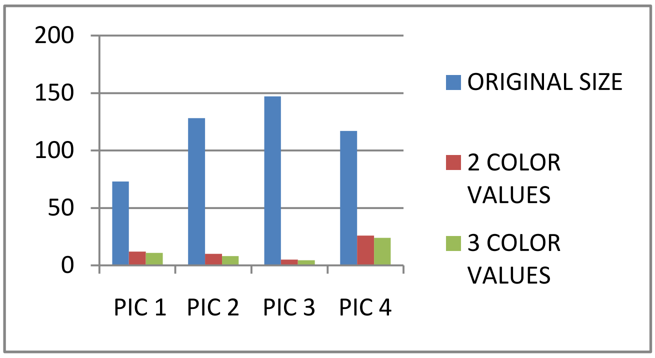
Table 4 True compression

Serial No	Size Of Image	2 Color Values	3 Color Values
1	73kb	12kb	11kb
2	128kb	10kb	8kb
3	147kb	4.9kb	4.5kb
4	117kb	26kb	24kb



. Figure 7 Image Compression Using True compression

7. Conclusion and Future work

- This project work has focused on image compression techniques.
- The survey has shown that the DCT based techniques are quite effective in terms of compression ratio.
- DCT based techniques can preserve the maximum information while doing the compression. So the resultant images are not much blurred or not lost their information after compression.
- Different DCT based compression algorithms are designed and implemented in MATLAB using image processing toolbox by developing a user familiar GUI.
- Different compression factors are selected for comparison purpose. It has been shown that the 2DCT with 4*4 provides quite better results than others.
- However if the resultant images need to be converted into the gray like in medical applications then true color compression is quite effective.

In near future we will extend this work by integrating the 2DCT based compression with run length coding to reduce the size of digital images in efficient manner. However in the discussed work the compression levels are selected manually in near future we will try to find the way in which compression factor can be selected automatically

References

[1] S. Esakkirajan, T. Veerakumar, Adabala N. Subramanyam, and C. H. PremChand. 2011 Removal of High Density Salt and Pepper Noise Through Modified Decision Based Unsymmetric Trimmed Median Filter.IEEE SIGNAL PROCESSING LETTERS, VOL. 18, NO. 5

[2] PriyankaKamboj, Versha Rani. 2013 Image Enhancement Using Hybrid Filtering Techniques. International Journal of Science and Research.Vol 2, No. 6, June 2013.

[3] Shanmugavadivu, EliahimJeevaraj. 2012 Laplace Equation based Adaptive Median Filter for Highly Corrupted Images. International Conference on Computer Communication and Informatics

[4] Shanmugavadivu P and EliahimJeevaraj P S. 2011 Fixed–Value Impulse Noise Suppression for Images using PDE based Adaptive Two-Stage Median Filter. ICCCET-11 (IEEE Explore), pp. 290-295.

[5] K. S. Srinivasan and D. Ebenezer. 2007 A new fast and efficient decision based algorithm for removal of high density impulse noise.IEEE Signal Process.Lett, vol. 14, no. 3, pp. 189–192

[6] V. Jayaraj and D. Ebenezer. 2010 A new switching-based median filtering scheme and algorithm for removal of high-density salt and pepper noise in image.EURASIP J. Adv. Signal Process.

[7] K. Aiswarya, V. Jayaraj, and D. Ebenezer. 2010 A new and efficient algorithm for the removal of high density salt and pepper noise in images and videos. Second Int. Conf. Computer Modeling and Simulation, pp. 409–413.

[8] GnanambalIlango and R. Marudhachalam. 2011 new hybrid filtering techniques for removal of Gaussian noise from medical images.ARPN Journal of Engineering and Applied Sciences.

[9] P. E. Ng and K. K. Ma. 2006 A switching median filter with boundary discriminative noise detection for extremely corrupted images. IEEE Trans. Image Process. vol. 15, no. 6, pp. 1506–1516

[10] Afrose. 2011 Relaxed Median Filter: A Better Noise Removal Filter for Compound Images. International Journal on Computer Science and Engineering (IJCSE) Vol. 4 No. 07

[11] Rafael C. Gonzalez, et al., 2005. Digital Image Processing using MATLAB, second Ed, Pearson Education, India.

[12] Median Filtering, [Last Visited] 18 June 2013 [Online] [Available] www.mathworks.com.

[13] Chan, R. H. Salt and pepper noise removal by median-type noise detectors and detail-preserving regularization. IEEE Trans. on Image Processing, Vol. 14, no. 10, pp 1479-148

[14] H. Hwang and R. A. Hadded. 1995 Adaptive median filter: New algorithms and results.IEEE Trans. Image Process, vol. 4, no. 4, pp. 499–502, Apr. 1995.

[15] J. Astola and P. Kuosmaneen.1997 Fundamentals of Nonlinear Digital Filtering.Boca Raton, FL: CRC, 1997.