Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IMAGE COMPRESSION FUNCTION USING ADAPTIVE DISCRETE COSINE TRANSFORM

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

2022

APPROVAL

I hereby declare that I have checked this projecct report and in my opinion, this porject report is adaquate in terms of scope and quality for the award of Bachelor degree of Computer Engineering Technology (Computer Systems) with Honors.

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DECLARATION

I declare that this project report entitled "DEVELOPMENT OF IMAGE COMPRESSION FUNCTION USING ADAPTIVE DISCRETE COSINE TRANSFORM" is the result of my own research except as cited in the reference. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Tajuk Project: Development of image compression function using adaptive discrete cosine transform

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ABSTRACT

Images compression is a frequent technique that follows the completion of digital image processing. Using transformations, you can reduce the amount of duplication between pixels on an image. In this research paper, I discuss a concept for compressing images utilising MATLAB and fully working in the DCT (Discrete Cosine Transform). The method can be used as a stand-alone image compression tool or as part of a block based DCT compression framework like JPEG. Throughout the paper, the Discrete Cosine Transform (DCT) method for two-dimensional images is described. The proposed image compression methodology produced equivalent or higher performance in several instances when compared to the various JPEG-standards without loss. The general goal is to reduce image size while maintaining good image quality. The DCT performance was outstanding in both the before and after compression processes.

ABSTRAK

Pemampatan imej adalah teknik yang kerap berlaku setelah selesai pemprosesan gambar digital. Dengan menggunakan transformasi, kita dapat mengurangkan jumlah penduaan antara piksel pada gambar. Dalam makalah kajian ini, saya membincangkan konsep untuk memampatkan gambar menggunakan MATLAB dan berfungsi sepenuhnya dengan DCT (Discrete Cosine Transform). Kaedah ini boleh digunakan sebagai alat pemampatan gambar yang "stand-alone" atau sebagai sebahagian daripada kerangka pemampatan DCT berasaskan blok seperti JPEG.Sepanjang makalah, kaedah Discrete Cosine Transform (DCT) untuk gambar dua dimensi dijelaskan. Metodologi pemampatan gambar yang dicadangkan menghasilkan prestasi yang setara atau lebih tinggi dalam beberapa keadaan jika dibandingkan dengan pelbagai standard JPEG tanpa kerugian. Tujuan umum adalah untuk mengurangkan saiz gambar sambil mengekalkan kualiti gambar yang baik. Prestasi DCT sangat baik dalam proses pemampatan sebelum dan sesudah.

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m - Matrix m

n - Matrix n

dim – Dimension

DC – coefficient with zero frequency in both dimension

AC – remaining 63 coefficients with non-zero frequencies

LIST OF ABBREVIATIONS

DCT	-	Discrete Cosine Transform
MATLAB	-	MATrix LABoratory
PNSR	-	Peak-Signal-To-Noise Ratio
CR	-	Compression Ratio
JPEG	-	Joint Photographic Experts Groups
PNG	-	Portable Network Graphics
JPG	-	Joint Photographic Group
DWT	-	Discrete Wavelet Transform
2-D	-	2-Dimensional
GIF	-	Graphics Interchange Format
TIFF	-	Tag Image File Format
SVG	-	Scalable Vector Graphics

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CHAPTER 1

INTRODUCTION

1.1 Background

Digital images have become a significant part of our life in recent years. Graphics such as photos and movies abound in today's media. The increased demand for multimedia data and the requirement for fast transmissions, including digital images and films, has sparked a lot of interest in compression techniques to reduce the physical size of the image. In these circumstances, an efficient compression technique is used to create photos with higher resolution and smaller file sizes while maintaining about equivalent information.

Image compression serves a variety of purposes and is essential for storing and transmitting images. Image compression is used to reduce the amount of redundant data in an image. Reduced storage capacity allows a large number of files to be stored in a little amount of storage or memory.

The discrete transform cosine (DCT) represents a sequence of data points in terms of a sum of cosine functions at various frequencies. Data is compressed into separate DCT blocks collections using DCT compression, commonly known as block compression.

DCT blocks come in many sizes, including the standard 8x8 pixel DCT. The DCT has a powerful "energy compaction" capability that has resulted in excellent data compression ratios and high quality. There will be a small loss of quality in this procedure, but it will not be noticeable, thus it is OK to make a minor concession on image quality.

1.2 Problem Statement

Higher resolutions mean more pixels per inch (PPI), which means more pixel information and a higher-quality, crisper image. However, the time it takes to send the photos increases as well. As a result, the user must wait a lengthy time for the data to be transferred.

One approach to tackle this difficulty is to use compression, which allows the database and transmission sequence to be successfully encoded. Only when the information is typically displayed in a manner that is longer than necessary can compression be achieved.

Image data, for example, is connected to a specific amount of duplication. New image compression solutions that achieve a low bit rate while keeping the fidelity of raw photographs are being developed worldwide. As a result, image encryption could save time, money, and space during long-distance transmission.

1.3 Project Objective

The main aim of this project is to propose a systematic and effective methodology to reduce the pixelation of an image so save space. Specifically, the objectives are as follows:

1. To remove unnecessary data from an image so that only important data can be preserved to save space
2. To reduce the size of the reconstructed image.
3. To see the effectiveness and performance of the algorithm over real image.

1.4 Scope of Project

The scope of this project are as follows:

a) Image compression on JPEG and PNG images using Discrete Cosine Transform on MATLAB.

b) Reduce image pixel while maintaining image quality to save space.

c) Using many transforms technique on image without losing any important data on image

1.5 Summary

The increased demand for multimedia data and the requirement for fast transmissions, including digital images and films, has sparked a lot of interest in compression techniques to reduce the physical size of the image. Image compression is used to reduce the amount of redundant data in an image. Data is compressed into seperate DCT blocks collections using DCT compression, commonly known as block compression.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature reviews for the associated project were discussed and presented in this chapter.The association between the previous study and the current study is discovered during a literature review, which is a part of the research branch. This is a crucial chapter because it identifies the gap in the literature that the research can fill. This chapter is based on previously published research, essays, theses, journals, or other forms of knowledge that have been passed around in circles and are outside the scope of the project.Researchers will also contribute to the project's success in this area, and more information, insights, and researchers can be gleaned from the planning project findings.

2.2 A Fast and Improved Image Compression Technique Using Huffman Coding

From this paper the author covers the Huffman coding approach as it is more fluid and quicker. Image compression is an important task because it is simple to implement and uses less memory. The focus of this article is to look at the Huffman coding technique, which is basically used to remove redundant bits in data, by looking at different characteristics or specifications such as Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE), Bits Per Pixel (BPP), and Compression Ratio (CR) for various input images of various sizes, as well as a new method of splitting an input image into equator images.

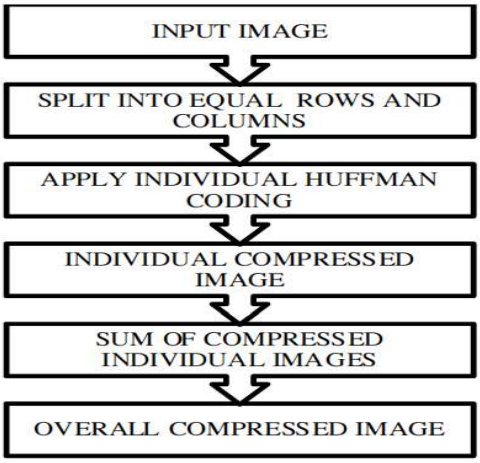

Figure 2.1: Flow chart of Huffman technique

2.3 IMAGE COMPRESSION USING WAVELET ALGORITHM

This study introduces an image compression using wavelet algorithm. The Wavelet Algorithm consists of three processes: transformation, quantization, and lossy entropy coding. Wavelets are data analysis functions that allow data analysis of signals or images based on scales or resolutions. They provide a powerful and remarkably flexible set of tools for dealing with fundamental problems in science and engineering, such as signal compression, image de-noising, image enhancement, and image recognition. In general, a Wavelet transform image compression system has three stages: transformation, quantization, and entropy coding. The encoding and decoding operations are depicted in Figure 2, with the reversed stages being used to create a decoder. The only element of the decoding process that differs is the de-quantization, which is followed by an inverse transform to resemble the original image.

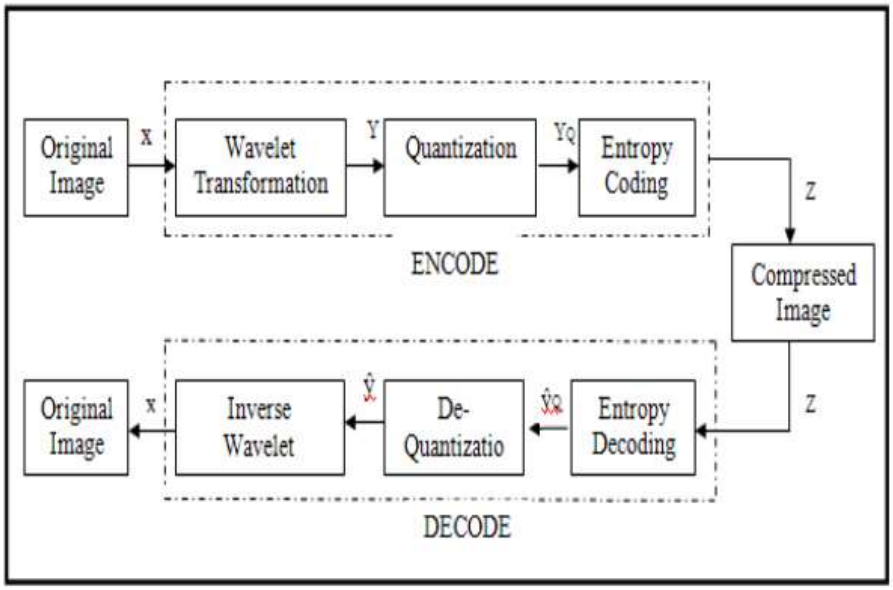

Figure 2.2: Block Diagram of Encode and Decode Process by using Wavelet Transformation Algorithm.

2.4 Image Compression Using Discrete Wavelet Transform

This report address the image compression using discrete wavelet transform. The suggested method decomposes an image into sub-band coefficients, which are then compared to a threshold. Relatively low coefficients are set to zero. Finally, the coefficients above the threshold are encoded using a lossless algorithm. Discrete wavelet transforms use a following of 3 step compression method and that is Decompose, Threshold detail coefficients and reconstruct. A test image and compressed images using JPEG, GIF, and the suggested compression methods are shown in Figure 2.4.

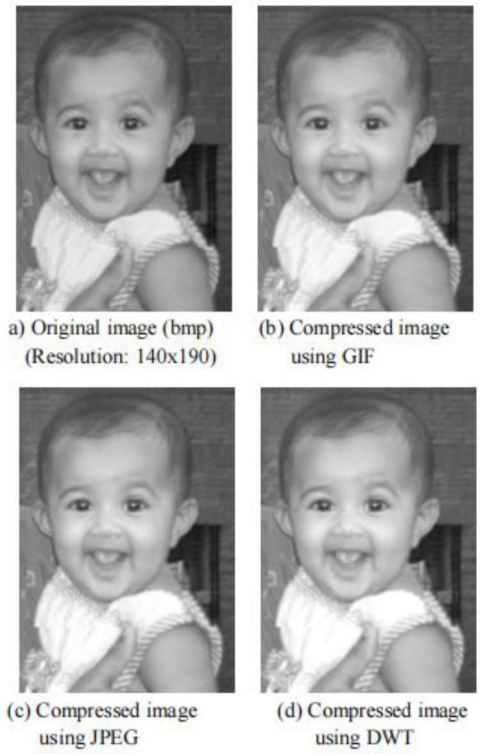

Figure 2.3: A real image and corresponding compressed images with GIF, JPEG, and proposed DWT methods.

2.5 THE JPEG IMAGE COMPRESSION ALGORITHM

The author stated that Discrete Cosine Transform (DCT), which derives spatial frequency information from spatial amplitude samples, provides the foundation for the JPEG algorithm. The visual data from the image that is least perceptually visible is then quantized, minimising the amount of data that must be saved. Quantization, run length, and Huffman coding are used to compress the quantized frequency samples' repetitive attributes.

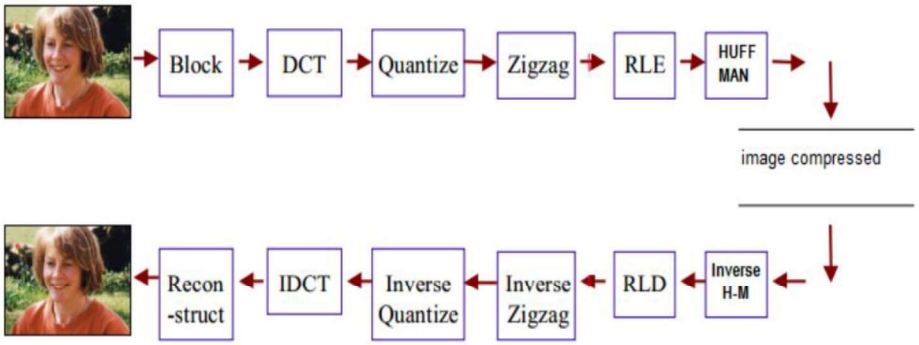

Figure 2.4: The steps of JPEG algorithm in lossy sequential mode

Each of these steps is reversible to the extent that the compressed form can be used to build an adequate replica of the original samples. The JPEG image compression method is a powerful tool for compressing images with minimum quality loss.

2.6 Hybrid Image Compression Based on Fuzzy Logic Technology

The comparison of Hybrid Image Compression techniques and Image Compression using Fuzzy Logic is covered in this study. The Hybrid Comparison Technique combines the DWT and DCT Image Compression techniques into one method. The hybrid compression approach is used when more than one compression approach is used to compress one image for a high PSNR (peak signal to noise ratio) and CR (compression ratio). On the same image, Fuzzy Logic is used to reduce MSE (mean square error) and to improve contrast. Hybrid Image Compression is a transform technique that combines the benefits of DCT and DWT to produce a compressed image. Meanwhile fuzzy logic is used for its knowledge representation and processing. Using a membership transformation function, fuzzy image improvement is based on grey level mapping into a fuzzy plane.

Figure 2.5: The Main Principles of Fuzzy Image Enhancement