UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMAGE COMPRESSION USING DISCRETE COSINE TRANSFORM (DCT)

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours.

by

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TAJUK: **IMAGE COMPRESSION USING DISCRETE COSINE TRANSFORM (DCT)**

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DECLARATION

I hereby, declared this report entitled “Image Compression Using Discrete Cosine Transform (DCT)” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering Technology (Industrial Electronic) with Honours. The member of the supervisory is as follow:

……..

(Ts. DR. ROSTAM AFFENDI BIN HAMZAH)

Project Supervisor

ABSTRAK

Pemampatan imej adalah teknologi penting dalam penghantaran dan penyimpanan imej digital kerana data besar yang berkaitan dengannya. Ia boleh ditakrifkan sebagai proses untuk mengeluarkan maklumat berlebihan dari imej supaya hanya maklumat penting yang boleh disimpan untuk mengurangkan saiz storan, jalur lebar penghantaran dan masa penghantaran. Maklumat penting diekstrak oleh banyak teknik transformasi supaya ia dapat direkonstruksi tanpa kehilangan kualiti dan maklumat imej. Projek ini mencadangkan skema pemampatan imej baru dengan cadangan pemangkasan berdasarkan „Discrete Cosine Transform" (DCT). Keberkesanan algoritma ini telah berpatutan ke atas beberapa imej sebenar dan prestasi algoritma telah dibandingkan dengan piawaian mampatan biasa yang lain. Perisian Matlab adalah platform penting bagi projek ini untuk menulis program dan melaksanakan kemajuan fasa projek secara fasa untuk mencapai hasil yang diharapkan.

ABSTRACT

Image compression is a vital technology in transmission and storage of digital images because of huge data associated with them. It can be defined as process to remove the redundant information from the image so that only essential information can be stored to reduce the storage size, transmission bandwidth and transmission time. The essential information is extracted by numerous transforms techniques such that it can be reconstructed without losing quality and information of the image. This project proposes a new image compression scheme with pruning proposal based on discrete cosine transformation (DCT). The effectiveness of the algorithm has been reasonable over some real images and the performance of the algorithm has been compared with other common compression standards. Matlab software is an important platform for this project in order to write a program and perform the progress of project phase by phase to achieve the expected result.

DEDICATION

To my beloved parent, family, friends and me.

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It is always a pleasure to remind the fine people in Universiti Teknikal Malaysia Melaka (UTeM) for their sincere guidance and support I received to uphold and making this project successfully done.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

MRI / FMRI	-	Function Magnetic Resonance
DWT	-	Discrete Wavelet Transform
DCT	-	Discrete Cosine Transform
SPIHT	-	Set Partitioning in Hierarchical Trees
JPEG / JPG	-	Joint Photographic Experts Group
BMP	-	Bitmap
GIF	-	Graphic Interchange Format
GIF89a	-	animated GIF
PNG	-	Portable Network Graphic
SVG	-	Scalable Vector Graphic
TIFF	-	Tag Image File Format
USB	-	Universal Serial Bus
LL	-	low-low
HL	-	high-low
LH	-	low-high
HH	-	high-high
YCbCr	-	Luminance; Chroma: Blue; Chroma: Red
RGB	-	Red, Green and Blue
YUV	-	Luminance and Chrominance component
EZW	-	Embedded Zero-tree Wavelet
LIS	-	List of Insignificant Sets
LIP	-	List of Insignificant Pixels
LSP	-	List of Significant Pixels
WT	-	Wavelet Transform
CR	-	Compression Ratio
PSNR	-	Peak Signal-Noise to Ratio
MSE	-	Mean Squared Error
MATLAB	-	Matrix Laboratory

GUI	-	Graphical User Interface
GUIDE	-	Graphical User Interface Development Environment

CHAPTER 1

INTRODUCTION

1.0 Introduction

In this new era, photo or image had become one of the crucial things in our daily life. Due to that, image compression is important for many uses for various applications that consist of huge storage of data and recovery such as for multimedia, documents and medical imaging. According to Sonal Chawla et al. (2014) and Kitty Arora et al. (2014), the purpose of image compression technique is to decrease size of the image data with the intention of to store or transfer data in an efficient method because uncompressed images have need of large storage capacity and transmission bandwidth. Moreover, the maintainable of the quality of image are the most important thing in compressing the image. Nowadays, there are numerous tools through the internet for compressing the image such as using JPEG Optimizer, Optimizilla, ImageRecycle and others. Other than that, image processing or compression also widely used in medical imaging such as X-ray, MRI / FMRI (Function Magnetic Resonance), Dynamic 3D Ultrasound and others. Due to that matter, there are several image compression methods such as Discrete Wavelet Transform (DWT), Set Partitioning in Hierarchical Trees (SPIHT) and other required methods. All of them had same main goal which is to reduce the size of image.

1.1 Background

Multimedia images have become an important and universal component in our daily life. In an image, the amount of encoded information is quite big. Although

with the superiority in bandwidth and capabilities of storage, many applications would be too costly and expensive. Essentially, an image is made of rectangular array of dots which named pixels. The size of an image is depends on amount of pixels. Besides, there are several common image file formats online such as JPEG Joint Photographic Experts Group), BMP (Bitmap), GIF (Graphic Interchange Format), GIF89a (animated GIF), PNG (Portable Network Graphic), SVG (Scalable Vector Graphic) and TIFF (Tag Image File Format).

Image compression is encoding process in transforming an image file that reduces space of the original file. This technique applied without affecting or changing the quality of the image to an improper condition. In addition, this technique allows more images to be supplied in a given amount of disk or memory space. Generally, the categories of compression are divided into two types which is Lossless and Lossy compression. A. Alarabeyyat et al. (2012) stated that lossless compression act as maintenance of the image which no data and detail lost. Robert Jessop (2002) and Manjari Singh et al. (2016) specified that Lossy compression can be defined as it produces less than perfect reproductions of the original image. Due to that, an advantage of lossy compression is it able to perform compression at higher levels because the information that needed is less. Due to that matter, this project proposed the Discrete Cosine Transform (DCT) method to compress the size of several selected images with various selected type of format file.

1.2 Problem Statement

In this new era of globalisation, image is an important component in our daily life. At the same time, image also could have been a big problem to the people. Therefore, there are several problems that could occur to lot of people nowadays. Firstly, some people unable to store and transfer the images as they required into the storage devices such as disk memory, flash drive, hard disk and other devices. The reason is the size of images is massive and insufficient space of the storage devices. So, the images stored are lesser than required or cannot store at all because deficient space of storage. Other than that, people also may face the problem to maintain the

quality of image after compressed the image"s size. The quality of image may decrease with using other compression method. Besides, the result of output image that been compressed might be ineffective using other compression method due to the compression ratio or sustainable of image"s quality.

1.3 Objectives

The main purposes of this project are:

1. To decrease the size of the image based on Discrete Cosine Transform (DCT) method.
2. To sustain the quality of an image before and after the compression process.
3. To analyse the effectiveness of the result based on the proposed method.

1.4 Scope

This image compression technique focuses on large community of people based on required condition. Firstly, it focuses on community of people that wants to store the image into certain amount of memory card, USB flash drive, hard disk or other required storage devices. Due to that matter, the smaller size of image, the more image able to store in the required storage. Next, this technique also focuses to the users that have intention to send the image data and download image via Internet. Nowadays, "Whatsapp" is one of the main platforms to transfer data. With smaller size, the time for transfer the image will be reduced and decrease the uses of data plan. In addition, this technique also focuses on the entrepreneur that runs printing services. Due to that matter, the smaller size of image or picture will lessen the time consumed for printing and the quality of image is sustainable. So, a lot of time will be saved and lower the printing costs.

1.5 Structure of Report

Based on this report, it consists of five chapters in order to complete the full report. All the idea, process, flow and the concepts of project will be discussed in the chapter required.

Initially, the first chapter briefly describe the introduction of this proposed project. The review about the basic platform of project concisely explained. This chapter also clarify the background of the project, problem statement, objectives to achieve, and the scope of project.

In the second chapter, the literature review of the related past project is discussed based on the research through journal, paper, news, internet source and others. The most common image compression method is been explained in this section.

For chapter 3, the methodology of project is developed and explained. The construction of flowchart, block diagram and the method used is briefly enlightened. The improvement can be applied by observing the flowchart of project. This chapter also describe the software development of the project

Chapter 4 focuses on result analysis and discussion of the project development. Through this chapter, the graph analysis and the data recorded the results will briefly discussed and explained

Lastly, the final chapter will conclude the overview of overall project process and development. The recommendation for future work also discussed in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Throughout this chapter, the literature reviews of the related project will be presented and discussed. This chapter also will cover about the study and idea based on the preceding as well as the concept to accomplish this project. The software program use for the task will be explaining every section in details.

2.1 Past Related Project Research

At first, there are a number of paper, journal, report and case study of past related project that had been used with the aim of to do research and study about the project in more details. Then, all the important data and idea had been recorded based on the project that associated with image compression.

2.1.1 Image Compression Using Wavelet Algorithm

According to Prabhjot Kour (2015) that had clarified about wavelet transform image compression system, there are three important stages that required which transformation, quantization and entropy coding. In figure 2.1 below, the block diagram defines the encoding and decoding methods which the inverted stages are executed to create a decoder. Then, the de-quantization is only the dissimilar part in the decoding process. It tailed by an inverse transform with the purpose of estimate the original image.

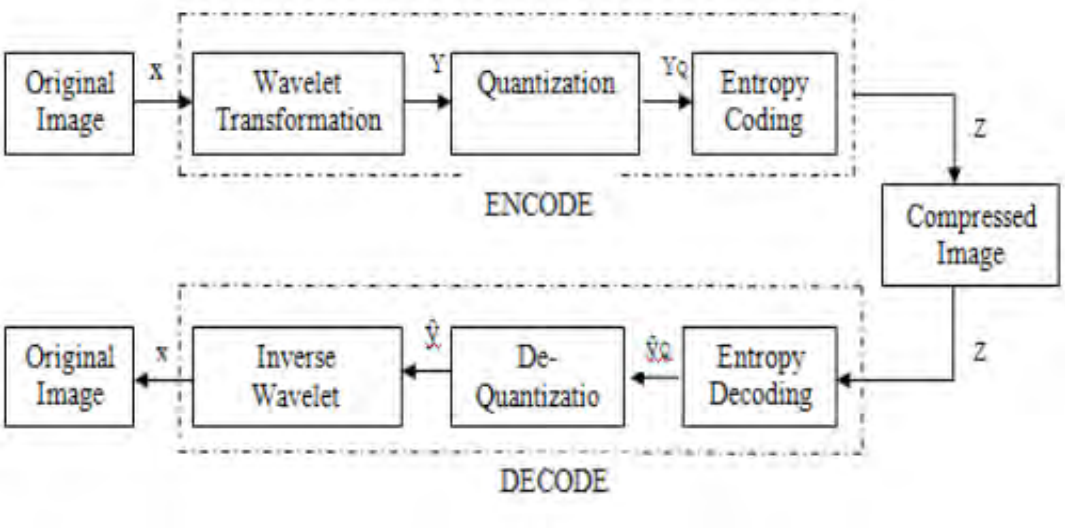

Figure 2.1: Block Diagram of Encode and Decode Process with Wavelet Transformation Algorithm.

With the purpose of compress the image, the information of an image can be divided by using wavelet analysis into estimation and detail sub-signals. The estimation sub-signal show the common trend of pixel values while three detail sub-signals show the horizontal, vertical and diagonal details or modifications in the image. They can be set to zero without significantly changing the image if these details are tiny then. As information, if the values lower than details are considered small enough to be set to zero, it called as threshold. In hypothesis, the size of compression could be huge as the greater the number of zeros. The amount of data maintained by an image after compression and decompression is identified as the energy maintained that relational to the quantity of the squares of the pixel values. The compression called as lossless if the energy retained is 100% as the image can be reconstructed correctly. This happens when the threshold value is set to zero and nothing changed in details. Other than that, lossy compression occurs if any values are changed then energy is lost. In addition, the energy retention and the quantity of zeros will be as great as possible during compression. However, more energy will be lost if more zeros obtained. (Nik Shahidah Afifi Md. Taujuddin, Nur Adibah Binti Lockman, 2011)

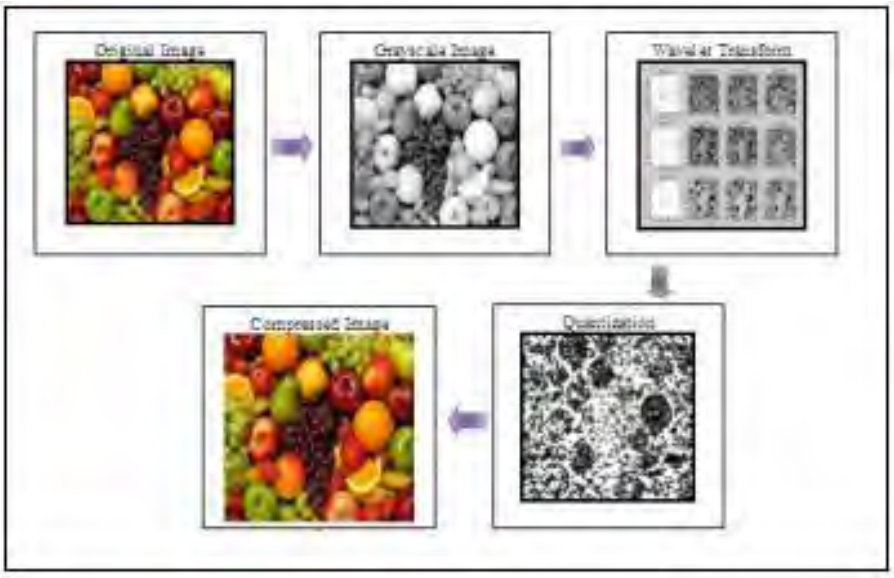

Figure 2.2: Stage by stage transformation of image compression using Wavelet Algorithm.

2.1.2 Analysis of Image Compression Algorithms Using Wavelet Transform With GUI in MATLAB

Dr. Taif Sami Hasan (2017) stated that wavelet transform can permit multi-resolution decomposition. An image that is decomposed can be reconstructed with preferred resolution by wavelet transform. A low pass filter and a high pass filter method are used where the frequency range between themselves are split fifty-fifty. The name of this filter pair is Analysis Filter pair. Then, the low pass filter is used for each row of data and low frequency components of the row are obtained. The output data contains of frequencies only in the first half of the original frequency range since the low pass filter is a half band filter. Based on Shannon's Sampling Theorem, they can be sub sampled by two. This means the output data consists only half the original number of samples that equal to the high pass filter which used for the same row of data. After that, the side of the low pass components detaches and places the high pass components. The process is finished for entire rows.