**BORANG PENGESAHAN STATUS TESIS**

JUDUL: SATELLITE IMAGE COMPRESSION USING RUN-LENGTH ENCODING AND HUFFMAN ENCODING TECHNIQUES.

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# SATELLITE IMAGE COMPRESSION USING RUN-LENGTH ENCODING AND HUFFMAN ENCODING TECHNIQUES.

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This report is submitted in partial fulfillment of the requirement for the Bachelor of Computer Science (Computer Networking)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2013

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**DECLARATION**

I hereby declare that this project entitled

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**DEDICATION**

Dear Parents

Thank you for your giving me the big support and encouragement. Your biggest support and care have helped me to achieve the final task in my university life.

Dear Lecturer, Supervisors and Evaluator

Thank you for your guidance, encouragement and knowledge.

Dear BITC Friends, Friends

Thank you for your sharing information, supporting and encouragement when facing difficulties.



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## ABSTRACT

The research is about satellite image compression when using different techniques to compress the image information. The research is focuses on the lossless compression with the two different techniques: Run-Length Encoding and Huffman Encoding. As image compression is one of the applications that widely used nowadays, example like CCTV. Thus the research is necessary to know the how the compression work and which of the techniques can produce the better output after compress the satellite image. Other than that, the research will give us to compare between the two different techniques so that it will give the user convenient to know which is best for the image compression. The research is carried out using Matlab R2009a and the research take about 6 month to finish it. At the end of this research, the result will show which techniques will produce the better output after compress.



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## ABSTRAK

Kajian ini adalah mengenai pemampatan satelit imej dengan mengguna teknik yang berbeza untuk memampatkan maklumat imej. Kajian ini tertumpu kepada Lossless compression dengan kedua-dua teknik yang berbeza: Pengekodan Run-Length dan Pengekodan Huffman. Sebagai pemampatan imej adalah salah satu aplikasi yang digunakan secara meluas pada masa kini, contoh seperti CCTV. Oleh itu, kajian ini adalah perlu untuk mengetahui bagaimana kerja mampatan dan yang mana satu teknik yang boleh menghasilkan output yang lebih baik selepas memampatkan imej satelit. Selain daripada itu, kajian ini akan memberikan kita untuk membandingkan antara kedua-dua teknik yang berbeza supaya ia akan memberi pengguna yang mudah untuk mengetahui yang terbaik untuk pemampatan imej. Kajian ini dijalankan dengan menggunakan Matlab R2009a dan penyelidikan yang mengambil masa 6 bulan untuk menyelesaikannya. Pada akhir kajian ini, keputusan akan menunjukkan yang teknik akan menghasilkan output yang lebih baik selepas memampatkan.



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## LIST OF ABBREVIATIONS

| ALPHABET | WORD | EXPLANATION |
|---|---|---|
| C | CR | Compression Ratio |
| R | RP | Research Problem |
| R | RQ | Research Question |
| R | RO | Research Objective |
| R | RLE | Run-Length Encoding |
| T | TIFF | Tag Image File Format |
| U | uint 16 | Unsigned 16-bit |
| U | uint 8 | Unsigned 8-bit |



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# CHAPTER I

## INTRODUCTION

Nowadays, image compression techniques is been widely used in the security field. Here are some of the example recognition faces, fingerprints, and car plates. The widespread and dramatically increasing use of image information requires increasing capacity of either transmission channels or retrieving devices. The image compression techniques give some recommendation toward this problem but there are some shortcomings to be avoided. In order to overcome the problem, it is a needed to find out which technique is the suitable or best for image compression. The information from remote sensing satellite has been recorded remotely and transformed into remote sensing images (Mohd, Suryanna, Sahibuddin, & Mohd Faizal Abdollah, 2012). The information that may be generated is directly linked the related characteristics of the images and produces spatial resolution (pixel size), spectral resolution (wavelength ranges utilized) and spatial extend (ground area represented) (Mohd, Suryanna, Sahibuddin, & Mohd Faizal Abdollah, 2012). Besides, some of the techniques of image compression will change the data of image and it was a need to differentiate each of the technique before compress data. To overcome the problem, the analysis was conducted using Run-Length Encoding and Huffman Encoding. The aim of the techniques is to confirm the ratio of the image is smaller after going the process. The expected outcome in this project is to find out the best technique, analysis the procedure of both of the technique and which techniques after compress data the ratio was smaller than the original image. There have the advantages and disadvantages for both of the technique for image compression and were come out a result which was the best techniques for the given image.

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## 1.1 Project Background

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it (Hossain, 2012). It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image (Hossain, 2012). It was distributing into several parts which include image compression, image segmentation, and image classification and so on. But for this project will only cover on image compression.

Firstly, need to have a clearly view on image compression. Image compression is reducing the size of amount of data used to represent an image by reduce the redundant data, so that the image can be stored in a given total of memory space (Padmaja & Nirupama, 2012). The compressed image files can be done in several ways. TIFF is a file format for storing images; hot between the graphic artists, the publishing industry, and both amateur and skilled photographers in general (Tagged Image File Format, 1992).

According to (Klima, 2004), the image compression techniques were widely applied in the field of security technology such as perimeter supervision, CCTV in facilities, faces, fingerprints, car plates and the widespread and dramatically expanding use of image information requires increasing capacity of either transmission channels or retrieving devices.

Image compression divided into two main categories which were lossless and lossy. According to the category of data that planned for compress was under lossless compression category. In general-purpose lossless compression algorithm were used on any type of data, many are not capable to achieve significant compression on data that was not of the form that they are designed to deal with (Yadav, Singhal, & Bandil, 2012). It was divides into several techniques which were Run-Length Encoding, Huffman Encoding, Arithmetic Encoding, Entropy Coding and Area Coding.



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A lossy data compression method was one where compressing data and then decompressing it retrieves data that may well be different from the original, but is "close enough" to be useful in some way (Shekhar & Xiong, 2008). It was dividing into two techniques which were predictive coding and transform coding.

For this project, it were focus on the lossless compression based on the different techniques; Run-length encoding and Huffman encoding

## 1.2 Problem Statements

Image compression plays an important role in our life and it was needed in all field of study not only in computer science. However, we do not have a clear view on how the image compression works on the real world especially for the satellite image. The quality of image after compression were affected which means the image were differ from the original image. Besides, not much knowledge of understanding the procedure of each technique in image compression and there are too many techniques can apply in image compression. The Research Problem (RP) is listed as Table 1.1 below:

**Table 1.1:** Summary of Problem Statements

| **RP** | **Research Problems** |
|---|---|
| RP1 | Difficulty to choose the suitable or best techniques for image compression. |
| RP2 | Difficulty to differentiate the techniques of image compression work. |
| RP3 | Difficulty to compare the techniques of image compression for the output purpose. |

From the research problem in Table 1.1, three research questions are conducted to identify the research problem. The explanation for each of the Research Problems (RP) is explained as follows:



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**RP1: Difficulty to find the best techniques for image compression.**

This research problem is due to too many techniques in the lossless image compression, so has difficulties to choose the best among the techniques.

**RP2: Difficulty to differentiate the techniques of image compression work.**

This research problem is does not know how the image compression works and the algorithm for each techniques in the lossless compression.

**RP3: Difficulty to compare the techniques of image compression for the output purpose.**

This research problem is based on the RP1 and RP2 research problems, and has a difficulty to compare the technique for the better output if the research problem for RP1 and RP2 didn't solve.

## 1.3 Research Questions

In this study, the research question was identified based on the problem that has been classified in Table 1.2. The research questions were summarizing shown in Table 1.2 below:

**Table 1.2:** Summary of Research Question

| RP | RQ | Research Questions |
|---|---|---|
| RP1 | RQ1 | Which is the best technique for image compression? |
| RP2 | RQ2 | How the techniques of image compression (RLE and Huffman encoding) work? |



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| | | |
|---|---|---|
| RP3 | RQ3 | Between the two techniques which type produce better output? |

Based on the previous research problems and research questions, three research objectives are conducted out in order to solve the research problems and research questions in Table 1.1 and Table 1.2. The explanation for each of the Research Questions (RQ) is explained as follows:

**RQ1: Which is the best technique for image compression?**

This research question is to identify which techniques is the best for image compression for lossless category.

**RQ2: How the techniques of image compression (RLE and Huffman Encoding) work?**

This research question is to find out or analyse the procedure of the both techniques for the image compression.

**RQ3: Between the two techniques which type produce better output?**

This research question is to compare which techniques produce the better output for image compression.

## 1.4 Objective

Based on the research problems and research questions stated in section 1.2 and section 1.3, appropriate research objectives are constructed in Table 1.3.



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**Table 1.3:** Summary of Research Objectives

| RP | RQ | RO | Research Objectives |
|---|---|---|---|
| RP1 | RQ1 | RO1 | To identify the suitable or the best technique for image compression for the lossless category. |
| RP2 | RQ2 | RO2 | To analyze the procedure techniques of image compression (RLE and Huffman Encoding). |
| RP3 | RQ3 | RO3 | To compare which techniques of image compression output is better. |

From the above Table 1.3, with the summary of research problems and research questions (Table 1.1 and 1.2) the research objectives is produced. The explanation for each of the Research Questions (RQ) is explained as follows:

**RO1: To identify the suitable or the best technique for image compression for the lossless category.**

This research objective is to find out the benefits of the image compression for each technique in lossless category.

**RO2: To analyse the procedure techniques of image compression (RLE and Huffman Encoding).**

This research objective is analysing both techniques how its work on the image compression.

**RO3: To compare which techniques of image compression output is better.**

This research objective is to find out the best techniques after the two previous objectives done.



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## 1.5 Scopes

This project is to find out which techniques are best for the image compression. Not only that, this project also were covered analyze the procedure for both techniques RLE and Huffman Encoding.

The scope of this project focusing on the RLE and Huffman Encoding techniques which to compares and find out the suitable image compression that produce the better output. The image is from Malaysia Remote Sensing Agency which using size of 240 x 240 pixels on uint 16 (unsigned integer 16) from QuickBird Satellite Image for June 2010 of Kuala Linggi Mangroves Forest, Alor Gajar Melaka. The software use is Matlab R2009a to do the image compression.

## 1.6 Project Significant

The main purpose of this project was to reduce the size of image. It was to find out how the image compression techniques work to compress a satellite image. Not only that, after compress the image, the ratio will show differ of the original image and compress image. At the end of this project, the best or suitable techniques for the image compression were produced.

## 1.7 Expected Result

By the end of this project, the expected results must achieve the goals of this project:

i. The best image compression technique is identified.
ii. The smaller the different of compression ratio, the better the compression techniques.



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iii. The advantages and disadvantages for each of the image compression techniques should be discovered after carry out the comparison.

## 1.8 Report Organization

In the report organisation, the overall project will divided into six main chapters. In Chapter I: Introduction, eight main topics were discussed which includes the background of the project, problem statements, research question, project objective, project scope, expected result, and report organisation. This chapter is the main chapter which was the idea of the project by the research question and problem statement that stated and solved with the research objective. Besides that, background of the project also important in order to get an idea on how the project flows. The project scope was focus on the main domain of the project such as only two techniques were choosing to compare in this project: RLE and Huffman Encoding. The expected result must achieve the goals of the objective and the report organization was carried out to make sure the report was organising in order.

In Chapter II: Literature Review, there were three topics were discussed which includes related work, analysis of current problem and justification, and proposed solution. The related work was carried out to do some research on the basic concepts of the domain of this project. Next, analysis of current problem that faced in the current situation of the image compression and followed by the proposed solution with each of the problem faced.

In Chapter III: Methodology, two topics were discussed. The topic includes was project methodology and project schedules and milestone. Project methodology was organizing the flows of the overall projects and the further discussion about the five steps flows of the project. For the project schedules and milestone, it was a topic that organizing the schedule time and activities that involves in this project.

In Chapter IV: Implementation, there were two topics to discussed which includes the project requirement and the compression techniques algorithms. In the project requirement, the two main requirements were the software requirement and



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hardware requirement. For the compression techniques algorithms which were discussed the two different techniques works, and the steps for each of the techniques will discussed in this chapter.

In the Chapter V: Testing and Analysis, the topics that includes test plan, test description, and comparison of the two techniques. The test plan was carried out to find out who was the person to testing this project. The test description is the testing steps by steps procedure for the two techniques. The comparison of the two techniques was conducted to find out which techniques is the best in this project.

In the Chapter VI: Project Conclusion, topics that includes observation on weaknesses and strengths, future works and contribution. The observation on weaknesses and strengths was described about the strengths and weaknesses for the overall project. The future work was described the limitation of the current project and the improvement can done for the further studied. The contribution was described the overall project the contribution for whose.

## 1.9 Summary

As a conclusion, this project aims to identify the suitable or the best technique for image compression for the lossless category. This project was controlled by using the MatlabR2009a software to find out which techniques was the best. Besides, this project was also important in term of in any entire field. It can compress the image by reducing the size of the images compared to the original images which were big.

In this chapter, the problem statement explains the problem that lead to the development of this project. The objective and scope of the project was stated clearly so that this project can be developed smoothly and meet its main purposed. The project significant describes the importance to compare the two techniques and the excepted output was the output resulted by find out the best image compression between these two techniques RLE and Huffman Encoding.



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