# IMPROVED WATERMARKING SCHEME BASED ON BEST COLOR CHANNEL SELECTION USING DISCRETE SLANTLET TRANSFORM

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This dissertation is dedicated to my family for their endless support and encouragement.

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# ABSTRACT

Digital watermarking is a process to embed the secret information into digital data for verifying identity of the owners by making assertion about the data and image authentication applications that provide security to watermark, W which is converted to a sequence of random binary R of size n adopted to encrypt the watermark. The adaptation process uses a pseudo-random number generator to determine the pixel to be used on a given key. The digital watermarking is created as a method to solve this kind of problems. There are two issues which are embedded watermark image in the host image without causing any kind of degradation, achieve and improve both imperceptibility and robustness of watermarked image before and after attacks. In this thesis, The RGB colour image watermarking is proposed using by Discrete Slantlet Transform (DST) to generate higher degree of robustness and imperceptibility of watermarked image. After applying 2-level DST on the host image to divided Red, Green and Blue select the best channel to embedding. The experimental results show that the proposed approach provides extra imperceptibility, robustness and security against JPEG compression and different noises attacks compared to the previous methods. The robustness of the proposed image is evaluated by calculating the Normalized Cross Correlation (NCC) value of watermarked before and after the image process. After applying the proposed approach the results proved that the way The Peak Signal-to-Noise Ratio (PSNR) and NCC values were greater than 30 db and 0.6, respectively.

# ABSTRAK

Mekatronik Digital adalah satu proses untuk menerapkan maklumat rahsia ke dalam data digital untuk mengesahkan identiti pemilik dengan membuat penegasan tentang data dan aplikasi pengesahan imej yang menyediakan keselamatan untuk watermark, W yang ditukar kepada rentetan perduaan R rawak saiz n pakai untuk menyulitkan watermark. Proses penyesuaian menggunakan penjana nombor pseudo-rawak untuk menentukan pixel yang akan digunakan pada Mekatronik digital key. The diberikan diwujudkan sebagai satu kaedah untuk menyelesaikan ini jenis masalah. Terdapat dua isu yang tertanam imej watermark dalam gambar tuan rumah tanpa menyebabkan sebarang kemusnahan, mencapai dan meningkatkan kedua-dua imperceptibility dan kekukuhan imej tera air sebelum dan selepas serangan. Dalam tesis ini, The RGB warna imej Mekatronik adalah dicadangkan menggunakan oleh Slantlet MPEG (DST) untuk menjana tahap yang lebih tinggi keteguhan dan imperceptibility imej tera air. Selepas menggunakan DST 2-tingkat pada gambar tuan rumah untuk dibahagikan Merah, Hijau dan Biru pilih saluran yang terbaik untuk menerapkan. Keputusan eksperimen menunjukkan bahawa pendekatan yang dicadangkan memperuntukkan imperceptibility tambahan, kemantapan dan keselamatan terhadap pemampatan JPEG dan bunyi yang berbeza serangan berbanding sebelumnya kaedah. Keteguhan imej yang dicadangkan adalah dinilai dengan mengira Korelasi Cross (NCC) Nilai Dinormalkan daripada tera air sebelum dan selepas proses imej. Selepas menggunakan pendekatan yang dicadangkan keputusan membuktikan bahawa cara Nisbah Isyarat -Hingar Puncak (PSNR) dan nilai-nilai NCC adalah lebih besar daripada 30 db dan 0.6.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| **DCT** | Discrete Cosine Transform |
| **DFT** | Discrete Fourier Transform |
| **DST** | Discrete Slantlet Transform |
| **DWT** | Discrete Wavelet Transform |
| **ECC** | Error Correction Codes |
| **HVS** | Human Visual System |
| **IDST** | Inverse Discrete Slantlet Transform |
| **MSB** | Most Significant Bits |
| **MSE** | Mean Square Error |
| **NCC** | Normalized Cross-Correlation |
| **NTSC** | National Television System Committee |
| **PSNR** | Peak Signal Noise Ratio |
| **RGB** | Red Green Blue |
| **SWT** | Standard Widget Toolkit |

# LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Nowadays, most of the transactions and operations have been done in the digital form due to the rapid growth of internet. With the speeding evolution of technology, multimedia applications field and distribution of multimedia contents are getting more advanced. Multimedia data has become less protected in this digital world. With this continued rise of sharing internet, everybody could access these digital data easily through internet and may use them without permission from original owner. Many copyright violations happened recently. Thus, owners need to protect their media contents from theft, reproduction and bad representation. Digital watermarking is a solution to this kind of problems and help to protect the copyright of multimedia data or bad representation.

Digital watermarking is a process to embed the secret information into the digital data for verifying the identity of its owners as an assertion about the data (Yongjian Hu, 2004). This digital data may be images, audios or videos and the information watermark embedded could be image or textual data about the owner such as the name of the author. Watermark can be detected and extracted from watermarked image to identify the original owner. Embedding the watermark into

host image is used by owners to claim that the multimedia data which belongs to them as the watermark is not easy to be removed from cover image.

## 1.2 Motivation

Nowadays internet is widely used and there is high possibility that all transactions and operations can been done in the digital form in the future. Many forms such as video, audio and document which can be distributed through internet. Multimedia contents can become worthless if the owners do not protect their multimedia data. It seems that it is important to protect the copyright and content authentication (Cox et al., 2008). Hence, watermarking technique is very useful in our digital life. The research motivation is the widely uses of watermarking to avoid illegal duplication of digital data without the consent of original owner by hiding the watermark in the digital data as a token of ownership. Since there are possible intelligent attacker performed various attacks on the images to remove the watermark for using them unauthorized, thus this study is conducted to improve the imperceptibility and robustness of watermarked image which resists various possible attacks. Further investigation will be carried out to study the possibility to using Discrete Wavelet Transform (DWT) and Discrete Slantlet Transform (DST) to improve the imperceptibility and robustness of image watermarked.

## 1.3 Problem Background

With the wide use of internet, there are endless efforts of copying, tampering and distribution of digital data by public. Multimedia data has become less protected and copyright violations have frequently appeared since everybody could download images from different sources and modify them without authorization (Nour El-HoudaGolea, 2010). Watermarking techniques are used as a solution to this problem by embedding information either text or image in the cover image. Imperceptibility,

robustness and security are the important issues that need to be concerned with in the watermarking.

Imperceptible watermark means that the watermarked content is perceptually indistinguishable to the original content since human eyes cannot differentiate between the watermarked image and the original image. Sun and Zuo,(2009) used Discrete Wavelet Transform (DWT) and achieved the proposed method yields high capacity, good imperceptibility and low bit error rate. Human Visual System (HVS) is used for improving the transparency of data hiding.

A watermark must be embedded in the host image without causing any kind of degradation to prove the quality of watermarking. Robustness means the ability to recover the watermark after performing various signal processing operations or attacks on watermarked image. These attacks include Gaussian noise, cropping, rotation, scaling and JPEG 2000 (compression) and set removal attack. A robust watermarked image will resists a designated class of transformations. The watermarking scheme should be able to preserve watermark, withstanding against the possible attacks and evaluating the quality of the watermark without noticeably altering or degrading the image. The ability to resist unauthorized removal, embedding, or extraction is called security. For intentional attack, it is possible to detect, modify or remove the watermark from the watermarked image and then used for their personally purpose. Hence, it is necessary to prevent unauthorized users to access watermark (Cox et al., 2008).

There are related basic issue which is quite challenging to attain both the desirable robustness and imperceptibility requirements. Some of the technique used to embed the watermark may be degraded after applying various attacks on the watermarked image. The purpose of this proposed technique is to achieve and improve the imperceptibility, robustness and quality of watermarked image which can resist various attacks. Researchers are focusing on Human Visual System (HVS) for the purpose of improving the watermarking systems and fulfilling the basic requirements of watermarking (Jianhong et al., 2009). By concerning HVS, a

maximum hiding level can be obtained with the method of embedding the watermark by keeping the visible image distortions to a minimum degree. On the other hand, the robust watermark is a watermark that able to resist to severe signal processing attacks such as compression and scaling on the image for copyright protection (Ramakrishnan et al., 2011). Robust watermark cannot be easily destroyed after several image manipulations have been performed on the watermarked image. Farquad, (2009) mentioned that the main purpose of using fragile watermark is data authentication and robust watermarks are mainly used for copyright protection.

This research proposed a colour image watermarking technique using Standard Widget Toolkit (SWT) so that the basic issues can be improved. The proposed algorithm is applied to find the best quadrant to hiding information in the cover image. The selected quadrant is the best quadrant to embed the watermark because this quadrant contains less detail. According to HVS, the human eyes are less sensitive to the distortion in that quadrant. The watermark became more imperceptible due to the distortion made is undistinguished by naked eyes. As a result, this can avoid the modifying and removing watermark by intentionally attack. Moreover, DST has been proposed due to the robustness. Four frequency sub-bands are produced after DST process and the Lower Frequency Sub-band (LL) are selected to embed watermark because LL more robust than other sub-bands.

Before extraction stage, there are several attacks are applied on watermarked image to test the quality of watermarked image whether the watermark can be recovered after attacks. The performance of watermarking is based on the imperceptibility and robustness. The Peak Signal-to-Noise Ratio (PSNR) is calculated to measure the quality ratio between the signal of original host image and watermarked image and also the Normalized Cross Correlation (NCC) is measured to verify the robustness of watermarked image (Chin et al., 2007).

## 1.4 Problem Statement

In internet-related life today, it is getting more difficult to prevent the copyright infringement of digital data. Everybody could access them and even use them for their personal purpose. This behaviour is actually violating the copyright and content authentication. Many users abused these contents by forgery and piracy. Therefore, the digital watermarking methods have been identified as a possible solution to the copyright protection, and have become an area of increased research activity over the last decade (Gang Liu, 2010). There are two issues need to be concerned with:

1. How to embed watermark image in the host image without causing any kind of degradation?
2. How to achieve and improve both imperceptibility and robustness of watermarked image before and after attacks?

## 1.5 Aim of Study

The aim of this research is to implement RGB colour watermarking technique using DST for improving both imperceptibility and robustness.

## 1.6 Objectives of Study

The objectives of this research are:

1. To propose a watermarking scheme based on the best selection in RGB channel (Red, Green or Blue) by using DST embedding.
2. To evaluate the quality of watermarked image by determining the imperceptibility value of the watermarked image.

3. To evaluate the robustness of the proposed embedding method against four standard attacks such as Gaussian, Salt and Pepper, Speckle, and Poisson noises.

## 1.7 Scope of Study

For this research, method of watermarking that will be used is DST. The new techniques are used to find the best quadrant. The first image will be standard images which are Lena, Baboon, Pepper, Airplane, Goldhil and Sailboat sit is RGB color image for cover which are (256 x 256) byte as a size. The second one is a watermark image is a grayscale image which is UTM logo (64x64) byte as a size.RGB color scheme was used for cover images. And the gray scale image was used for embedding. The standard image gets from USC-SIPI dataset. 2-level of DST transform will apply for cover image to decompose four frequencies. In addition, this research is conducted to test the imperceptibility and robustness of watermarked image by using different types of attacks such as Gaussian, Salt and Pepper, Speckle, and Poisson noises.

## 1.8 Benefits of Study

It is important to protect the copyrights of multimedia data of the owners and use for ownership identification to discourage unauthorized use and copy of multimedia data. The main benefits of this study work are to come up with a proposed method of scheming color image by using watermarking through Discrete Slantlet Transform (DST). This study benefits further at achieving and developing robustness, imperceptibility and security of cover image for the watermarked image, which can withstand against various attacks.

## 1.9 Research Framework

In the proposed technique have three main stages which are pre-processing, embedding and extraction. The pre-processing stages will illustrate the dividing cover image to three channels Red, Green and Blue. in the embedding stages will embedding the watermark image pieces by embedding formula. While the extracting stage will extract the watermark image pieces from the cover image by extracting formula. Figure 1.1 illustrates the research structure of digital watermarking.

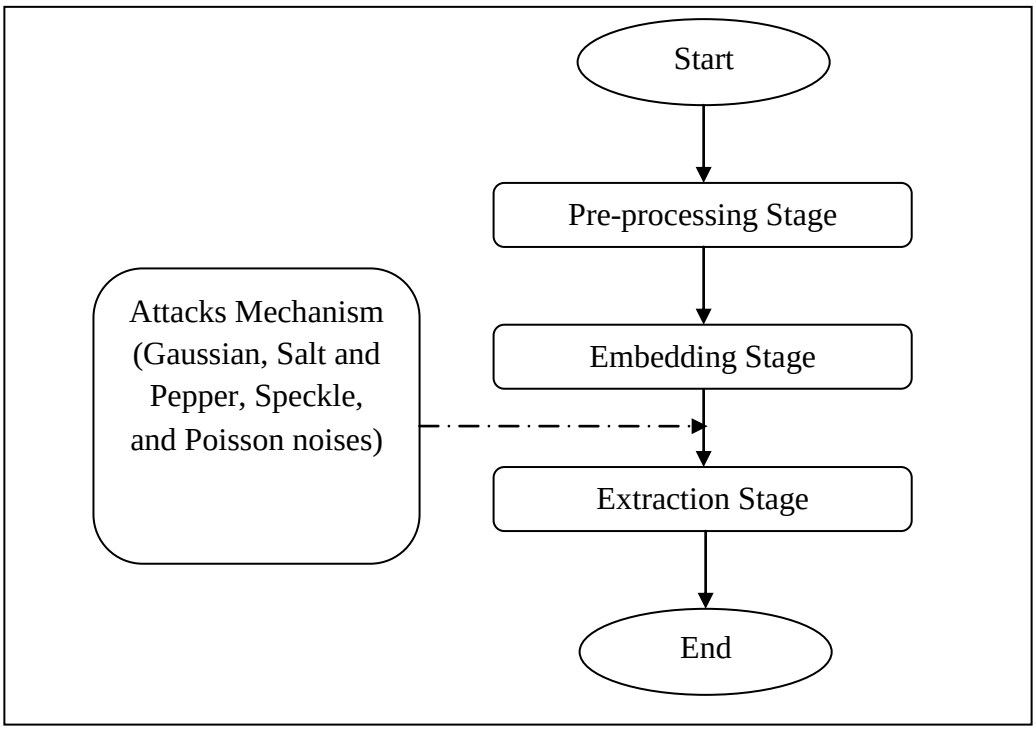


**Figure 1.1** Research framework of digital watermarking

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