Faculty of Information and Communication Technology

DIGITAL IMAGE STEGANOGRAPHY BASED ON INTEGER HAAR WAVELET TRANSFORM AND COEFFICIENT DIFFERENCE

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DIGITAL IMAGE STEGANOGRAPHY BASED ON INTEGER HAAR WAVELET TRANSFORM AND COEFFICIENT DIFFERENCE

PRAJANTO WAHYU ADI

A thesis submitted
in fulfillment of the requirements for the degree of
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I declare that this master project entitled "*Digital Image Steganography Based on Integer Haar Wavelet Transform and Coefficient Difference*" is the result of my own research except as cited in the references. This master project has not been accepted for any degree and is not currently submitted in candidature of any other degree.

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I hereby declare that I have read through this project report and in my opinion this project report is sufficient in term of scope and quality for the awarded of the degree of Master of Computer Science (Software Engineering and Intelligence).

Signature : ……

Name : Dr. Nor Azman bin Abu

Date : January 2014

DEDICATION

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ABSTRACT

The development of digital information led to the demand for information security technology that protects the confidentiality of information. Digital steganography is one of such technology that able to protect the information from illegal interception due to its capability to hide the existence of the information without attracting the eavesdropper‟s attention. Among digital media, digital image is the most widely used media for steganography. Discrete Cosine Transform (DCT) is a well-known technique in digital image steganography, but the block calculation of DCT may pose artifact on the images. The disadvantages of DCT can be eliminating by the Discrete Wavelet Transform (DWT) which is more compatible with the Human Visual System (HVS). However the floating point of DWT can causes loss of information. On the other hand, Integer Wavelet Transform (IWT) is represented in finite precision numbers, which can avoid the problem of floating point precision of DWT. In this study, the messages are embedded on the wavelet coefficients of 1-level Integer Haar Wavelet Transform (IHWT) using Coefficient Difference scheme that adopted from Pixel Value Differencing (PVD). The messages are embedded on the difference value of two adjacent wavelet coefficients. Peak Signal to Noise Ration (PSNR) and Structural Similarity (SSIM) are used to measure the quality of stego image. The result shows that the proposed method has outperformed the existing method that employ IHWT and Pixel Mapping Method (PMM) in term of capacity vs. imperceptibility, as well as the maximum capacity. This is due to the high degree of Coefficient Difference that can tolerate larger modification of wavelet coefficients. Moreover, the Coefficient Difference can be applied on all coefficients instead of either significant or insignificant coefficient. These lead to the both high capacity and imperceptibility of digital image steganography system.

ABSTRAK

Pembangunan maklumat digital membawa kepada permintaan untuk keselamatan teknologi maklumat yang melindungi kerahsiaan maklumat . Steganografi Digital adalah salah satu teknologi itu yang dapat melindungi maklumat daripada pemintasan haram kerana keupayaan untuk menyembunyikan kewujudan maklumat tanpa menarik perhatian yang mencuri password ini itu. Antara media digital, imej digital adalah media yang paling banyak digunakan untuk steganografi. *Discrete Cosine Transform* (DCT) adalah teknik terkenal dalam imej steganografi digital, tetapi pengiraan blok DCT boleh menimbulkan artifak pada imej-imej . Kelemahan DCT boleh menghapuskan oleh *Discrete Wavelet Transform* (DWT) yang lebih sesuai dengan *Human Visual System* (HVS), bagaimanapun titik terapung DWT boleh menyebabkan kehilangan maklumat. Sebaliknya, *Integer Wavelet Transform* (IWT) diwakili dalam jumlah ketepatan yang terbatas , yang boleh mengelakkan masalah terapung titik ketepatan DWT. Dalam kajian ini , mesej yang sudah ada pada pekali wavelet 1-tahap *Integer Wavelet Transform* (IHWT) menggunakan skim *Coefficient Difference* yang diambil daripada *Pixel Value Differencing* (PVD). Mesej yang sudah ada pada nilai perbezaan dua pekali wavelet bersebelahan. *Peak Signal to Noise Ratio* (PSNR) dan *Structural Similarity* (SSIM) digunakan untuk mengukur kualiti stego imej. Hasilnya menunjukkan bahawa kaedah yang dicadangkan telah mengatasi kaedah yang menggaji IHWT dan *Pixel Mapping Method* (PMM) dari segi keupayaan vs imperceptibility , dan juga kapasiti maksimum. Ini adalah kerana tahap yang tinggi Pekali Perbezaan yang boleh bertolak ansur dengan pengubahsuaian yang lebih besar daripada pekali ombak kecil . Lebih-lebih lagi, *Coefficient Difference* yang boleh digunakan ke atas semua pekali bukannya pekali sama ada penting atau tidak penting. Ini membawa kepada keupayaan kedua-dua tinggi dan imperceptibility imej digital sistem steganografi.

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DCT	-	Discrete Cosine Transform
DWT	-	Discrete Wavelet Transform
HVS	-	Human Visual System
HWT	-	Haar Wavelet Transform
IHWT	-	Integer Haar Wavelet Transform
IIHWT	-	Inverse Integer Haar Wavelet Transform
IWT	-	Integer Wavelet Transform
LSB	-	Least Significant Bit
MSE	-	Mean Squared Error
PSNR	-	Peak Signal to Noise Ratio
PMM	-	Pixel Mapping Method
PVD	-	Pixel Value Differencing
RMSE	-	Root Mean Squared Error
SSIM	-	Structure Similarity
SSIS	-	Spread Spectrum Image Steganography

CHAPTER 1

INTRODUCTION

1.1 Introduction

Along with the existence of internet technology and rapid growth in consumption of digital information in past decade cause attention in security issue such as digital right management, authenticity, and content security (Mali et al., 2012). Various cyber crimes such as forgery, modification, duplication, and interception have reached alarming level (Tsai et al., 2009).

To solve the problem of illicit interception, several techniques such as cryptography, and information hiding had been proposed (Yu et al., 2005). Cryptography is a known method for protecting the information by encrypt the message to become unreadable (Highland, 1997), but the unreadable message may attract the eavesdroppers‟ attention (Yu et al., 2005; Liao et al., 2011; Yang et al., 2011).

Information hiding has been widely used to protect the digital media contents (Lee et al., 2010), it plays an important role in information security (Luo et al., 2011). One of the branch of information hiding which aimed for secret communication is steganography (Petitcolas et al., 1999). Steganography conceal the existence of the message which prevent the attention of eavesdroppers (Artz, 2001; Wang and Wang, 2004). This makes steganography a good manner to communicate secret information (Yang et al., 2011).

Originally, steganography is the art and science of writing secret message inside the media, and transferring the media to the addressee in such way that only the intended