SECURING IMAGES THROUGH REVERSIBLE DATA HIDING

ABSTRACT
of
THESIS

SUBMITTED TO

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY

LUCKNOW

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY

LUCKNOW

प्रज्ञा शील करुणा

ESTABLISHED 1996

FOR THE DEGREE OF

Doctor of Philosophy

IN

COMPUTER SCIENCE

Submitted by

Smita Agrawal

(Enrolment no: 607/03)

Supervisor

Dr. Manoj Kumar

Assistant Professor

DEPARTMENT OF COMPUTER SCIENCE

SCHOOL OF INFORMATION SCIENCE & TECHNOLOGY

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY

(A Central University; NAAC-'A' GRADE)

VIDYA VIHAR, RAEBARELI ROAD, LUCKNOW-226 025

2017

Abstract

In the growing world of technology, the revolution of digital information has made access and modification of multimedia content very easy. Due to technological revolution, the digital media such as images, audios, videos etc. are gaining extensive importance and so their security and confidentiality issues are of great concern. Digital watermarking provides a way to secure the digital images in an effective manner. But, there are few issues in digital watermarking such as loss of information, which is not tolerable in some sensitive fields. Reversible data hiding is a technique to embed the secret information in cover image in such a way that at the receiver's end, original cover image is recovered bit by bit after the extraction of the watermark. It is mainly used for content authentication. The main aim of authentication is not only to secure the digital content from illegal modification or tampering but also is to provide a way to maintain the content's integrity and privacy. Reversible watermarking is a type of fragile watermarking in which if any modification is made in watermarked content, watermark would be modified or destroyed and therefore, it would be impossible to recover original image bit by bit. The main challenge in reversible watermarking is to embed the secret information in such a way that visually its effect is negligible while having high embedding capacity and at the receiver's end, original image can also be recovered along with the extraction of the watermark. In this thesis, different reversible data hiding approaches are developed for securing the images while maintaining the integrity of the cover images.

Among all the proposed techniques in literature, algorithms based on histogram modification belong to a simple but effective class of techniques. In this thesis, first work is based on histogram-bin-shifting. Although, the techniques based on this concept are simple and easy in computation, yet there is a limitation that there are many pixel values between zero point and peak point and therefore, a lot of distortion

can be caused due to the shifting of pixels between these two points. In our work, an attempt has been made to improve this shortcoming by reducing the number of pixels to be shifted between zero point and peak point. Instead of using zero point and peak point, the first and second peak points are utilized to create space next to the peak point for data embedding. Due to this, less distortion is caused in watermarked image and quality of watermarked image is improved in terms of perceptibility. The scheme is also extended for RGB (Red, Green, Blue) color images by applying the proposed scheme separately on all the three color planes.

Due to the limited capacity in histogram modification based techniques, our next contribution is focused on increasing embedding capacity in which a concept of prediction error is used. In this, the adjacent pixel's correlation has been utilized to predict the cover image pixel values. For this, odd columns are used to predict the values of even columns and then the watermark is embedded in obtained prediction errors of even columns. To avoid the underflow/ overflow problem during expansion of prediction errors, compressed location map has been used.

Due to better prospects of finding space for data embedding in frequency domain, our next work is focused on developing reversible data hiding technique in frequency domain. Discrete wavelet transform (DWT) is an extensively used transform with multiresolution property which plays a very important role in image processing. Singular Value Decomposition (SVD) is also a very important transform which is frequently used in simple watermarking but has rarely been used for developing reversible watermarking techniques. SVD provides some interesting algebraic and structural properties of an image that can be used in image processing. Use of DWT along with SVD can play a prominent role in developing reversible data hiding techniques, as the combination of salient features of these two can provide more security in reversible data hiding. In the proposed work, unexploited concept of SVD along with DWT are utilized to introduce a novel reversible data hiding technique. The proposed work has provided an added layer of security.

Integer-to-Integer wavelet (IWT) transform is used in next contribution as it has some extra advantages over DWT because it maps integers to integers and therefore there is no chance of any information loss. In this work, cover image is divided into blocks and smooth blocks are chosen using entropy and further, IWT is applied on these selected smooth blocks. Further, watermark embedding is carried out by using histogram bin shifting in subbands of obtained detailed parts.

Due to fast growing area of cloud computing, there is a need to protect the privacy of the digital content and therefore, reversible data hiding techniques for encrypted images can play a very important role in securing and authenticating the multimedia content. Therefore, the focus of our next work is on developing a fully reversible data hiding technique for encrypted images. Due to the maximum entropy of encrypted images, conventional reversible data hiding techniques are not very useful in encrypted domain. Therefore, there is a need of reversible data hiding techniques that can work well for encrypted images. In this work, the simple property of arithmetic mean is used. First the cover image is encrypted using additive modulo 256 and then the mean values of each set of 256 consecutive pixel values are stored at the first position of the corresponding sets. After that, one watermark bit is embedded in each set. Further, these stored mean values are utilized at the receiver's end for extracting the watermark and recovering original image after decryption. Proposed technique is computationally very simple and executes in very less computational time.

The work presented in this thesis has been tested on various standard test images and experimental results have also been compared with recent existing techniques in the field of reversible data hiding. The presented techniques are novel, provide higher embedding capacity along with good visual quality and are also efficient in terms of computational cost as well as security. But still there is a scope of increasing embedding capacity while maintaining visual quality and the work can be extended for encrypted images also.