Colour Image Watermarking using Efficient Multi-Channel Singular Value Decomposition

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Abstract - Images make up a major component of digital multimedia in modern age. Digital data can be put away proficiently and with a high caliber, and it can be controlled effortlessly utilizing computers. Besides, digital information can be transmitted in a fast and modest route through information communication networks without losing quality. Editing is simple since one can get to the correct discrete areas that should be changed. A duplicate of a digital media is indistinguishable to the original. The basic transmission and control of digital data constitutes a real hazard for information sources, and copyright proprietors need to be compensated each time their work is utilized. Encryption does not give general protection. Once the encoded information are decrypted, they can be freely distributed or manipulated. "Watermarking" concept may be used in multimedia digital contents for checking the authenticity of the original content. There are numerous image watermarking algorithms have been developed so far which are based either on spatial domain or on transform domain. The transform domain based watermarking algorithms are more popular because of its higher robustness than spatial domain. In this work colour image watermarking using efficient multi-channel singular value decomposition has been proposed. The proposed algorithm has been implemented and simulated on MATLAB. The productivity of proposed work has been evaluated based on PSNR value.

Keywords- Watermarking, Colour Image, Image Processing, Singular Value Decomposition, Spatial domain, Transfer domain.

I. INTRODUCTION

The explosion of the digital multimedia is one of the greatest technology events of the last two decades. Unlike the analog media, digital media can be stored efficiently and transmitted in a fast and inexpensive way through communication networks. Furthermore, digital data can be manipulated easily using computers. With the rapid development of multimedia and the widespread distribution of digital data over the internet networks, it has become easy to obtain the intellectual properties. Consequently, the multimedia owners need more than ever before to protect their data and to prevent the unauthorized use of their data. The design of new techniques for protecting the ownership of digital information is key to future development of data services.

Digital Watermarking incorporates means of securing the rights of the owner of the digital data, providing authentication of the source or originality of the digital data. The hidden message (watermark) signifies information that can be detected and retrieved by authorized personnel or systems designed for that purpose. Methods of Digital Watermarking can be applied to many types of content such as text, audio, images, software programs and network packets.

In spite of a great variety of digital watermarking methods, characteristics of robustness and transparency are the most universal and important for any of them. A degree of robustness of the watermark data defines how immune it is against modifications and/or malicious attacks. Another important characteristic is the perceptual transparency of the watermark. Artifacts introduced through a watermarking process may reduce the commercial value of the watermarked data.

Watermarking algorithms can be classified based on the domain used for watermark embedding. Studies have shown that two popular techniques; spatial and transform watermarking techniques exist. Spatial domain watermarking techniques are useful for higher data embedding applications. Transform domain watermarking techniques are suitable in applications where robustness is of prime concern. These techniques as proposed include, Discrete Cosine Transform (Chandramouli et al., 2001); Discrete Fourier Transform (Premaratne, P., 1999); Discrete Wavelet Transform (Kundur, D. and Hatzinakos, D.,1998); Discrete Hadamard Transform (Anthony, T.S.; Shen, J.; Tan, S.H. and Kot, A.C., 2002); Contourlet Transform (Jayalakshmi, M. ; Merchant, S.N. and Desai, U.B.,2006); and Singular Value Decomposition (Mohan , B.C. and Kumar, S.S.,2008) are some of the useful transformations for image processing applications.

With the introduction of the JPEG2000 standard digital image, watermarking schemes that are derived from Discrete Wavelet Transform (DWT) are becoming a robust area attracting lots of attention. Nearly all watermarking schemes consider Discrete Cosine Transform known as DCT method of preference.

The fundamental objective of this work is to come up with a proposed method of scheming color image by using watermarking using efficient multi-channel singular value

decomposition. To improve watermarking technique on RGB color image through the use of multi-channel singular value decomposition for cover image.

II. GENERAL WATERMARKING SCHEME

One of the distinctive and most beneficial features of watermarking is that protective information is mixed with the original media content. As a result, the watermark is usually unnoticeable and inseparable from the content which means that the watermarked media can be used legally with very little functional limitations in many practical applications while still witnessing an owner. In contrast to that, for instance, media cryptographically encrypted by owner can not be used in any way by a third party if not being decrypted. Additionally, in case of cryptographic protection the fact of encryption is always observable and obvious which might encourage an attacker to break the channel.

Digital watermarking is a process of embedding an identification code or some other information called watermark into digital multimedia without affecting the visual quality of the host multimedia. A block diagram for the general scheme of watermarking is shown in Figure 2.1 [2]. It consists of the following modules.

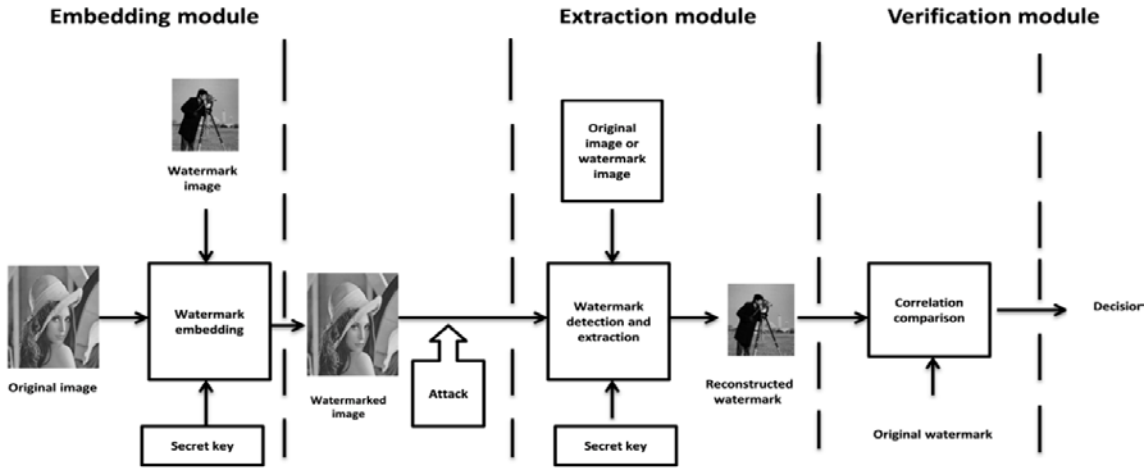

Figure 2.1 A general block diagram of image watermarking.

(a) Watermark embedding module

Inputs to a watermark embedding process are original data, watermark data, and a secret key. The output for the embedding module is watermarked data.

(b) Watermark detection and extraction module

Inputs to a watermark detection process are the watermarked data, the secret key, and depending on the watermarking algorithm, the original data, the original watermark or both. If the detection process needs a copy of the original cover image and a secret key, the watermarking scheme is called private watermarking [5]. However, if a scheme requires only a secret key, it is called public watermarking. On the other hand, if the detection process needs a copy of the watermark along with a secret key the scheme is called semi- privet watermarking.

(c) Verification module

In this module, the extracted watermark is checked whether or not it matches the original watermark. Usually this step is performed by comparing the original watermark with the extracted one using the correlation coefficient and the result gives a clear evidence whether or not the original watermark was embedded in the data.

III. PROPOSED METHODOLOGY

A Colour Image watermarking using efficient multi-channel singular Value Decomposition SVD has been proposed in this work. The implementation and simulation of proposed work has done on Matlab and Simulink. Singular value decomposition (SVD) can be seen as a method for data reduction. SVD is a powerful mathematical tool and also popularly used in watermarking. Figure 3.1 shows the block representation of proposed work.

Fist the color image is loaded into Matlab environment. Image is segmented into different components of Red Green Blue (RGB). Further the singular decomposition coefficient of segmented image has been calculated. W_1, W_2,and W_3 are watermark added in each individual segment of cover image. Now each RGB segments are combined to embed water mark securely in cover image. Finally the cover image has obtained. Process flow of proposed work has shown in figure 3.2.

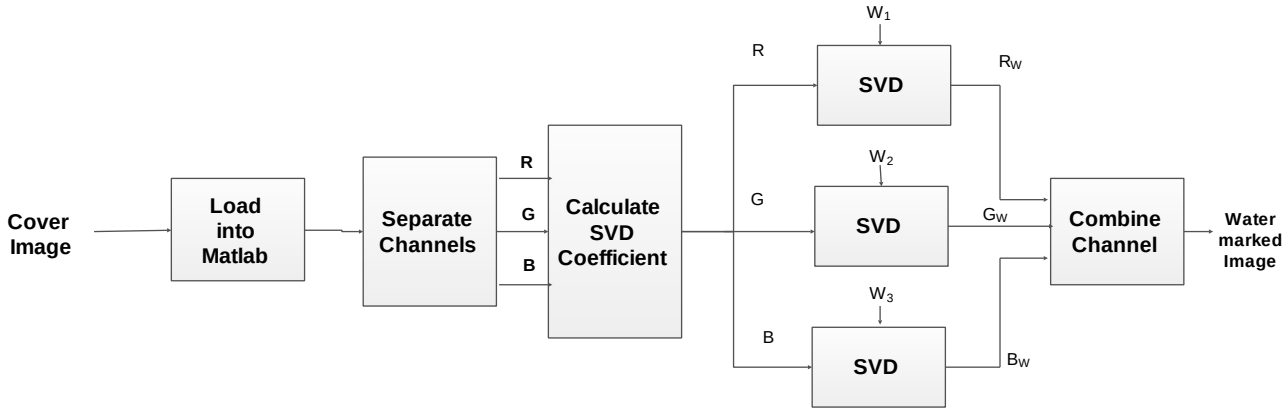

Figure 3.1 Block Diagram of proposed work.

Steps of Simulation:

1. Start simulation with MATLAB Simulation environment.

2. Define system parameters and select cover image.

3. Load a cover image (Test image) in to MATLAB.

4. Decompose image into basic color segments i.e. RGB channel.

5. Embed watermark with respective channel.

6. Calculate SVD coefficients for respective channel of cover image.

7. Calculate SVD coefficient of watermarked image.

8. Repeat the above three steps for subsequent channels

9. Save output watermarked image.

10. Calculate PSNR & Display results.

11. End Process.

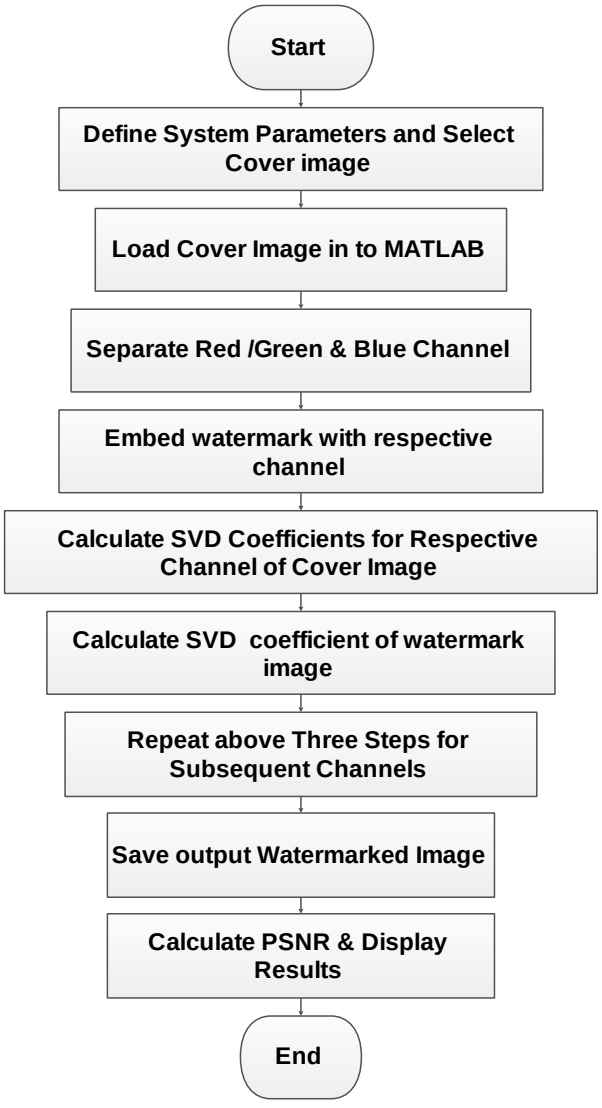

Figure 3.2 Process Flow chart.

IV. SIMULATION RESULTS

The implementation and simulation of proposed work has done on MATLAB Simulink. The results obtained from the proposed scheme and its comparison with other previous base work image watermarking schemes has done. For the analysis of the proposed scheme, the greyscale image of girl has taken of size 256 × 256 as a cover/original image as shown in figure 4.1(a) at top left hand side image and its multichannel watermarked outcome image has shown beside it at right hand side. Experiments are done separately by taking a gray scale ' Baboon ',‘cameraman’ and ' Barbara ' image as watermark as shown in figure 4.1 Watermark1 Watermark2 Watermark3.

Also the proposed scheme is being experimented by taking some other greyscale images of Zebra Image as cover as shown in Figure 4.2 by taking a gray scale ' Baboon ',‘cameraman’ and ' Barbara ' image as watermark as shown in figure 4.2 Watermark1 Watermark2 Watermark3

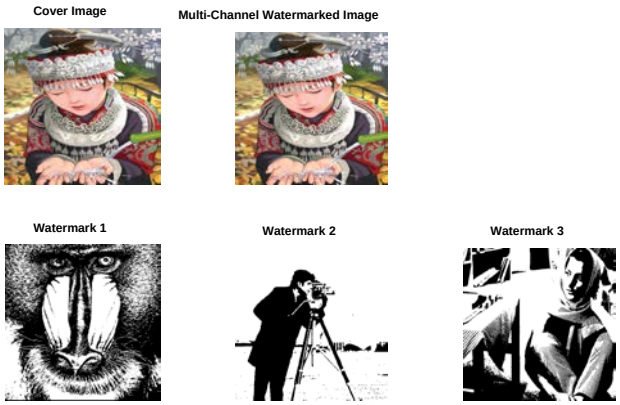

Figure 4.1 Proposed Watermarking Results with Multi-Channel SVD using Comic Image as Cover and Baboon, Cameraman and Barbara as Watermark Images.

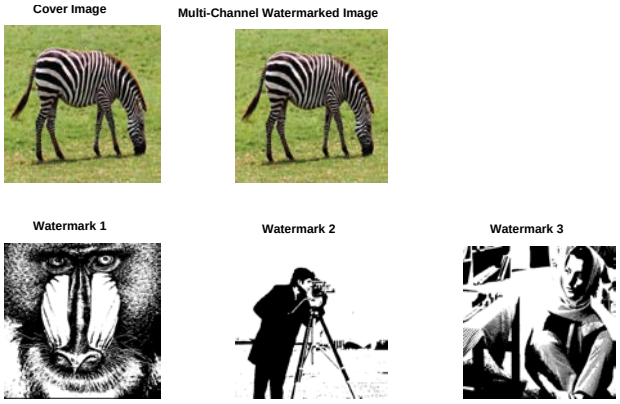

Figure 4.2 Proposed Watermarking Results with Multi-Channel SVD using Zebra Image as Cover and Baboon, Cameraman and Barbara as Watermark Images.

Also the proposed scheme is being experimented by taking other greyscale images of PPT3 Image as cover as shown in Figure 4.3 by taking a gray scale 'Baboon','cameraman' and 'Barbara' image as watermark as shown in figure 4.3 Watermark1, Watermark2, and Watermark3

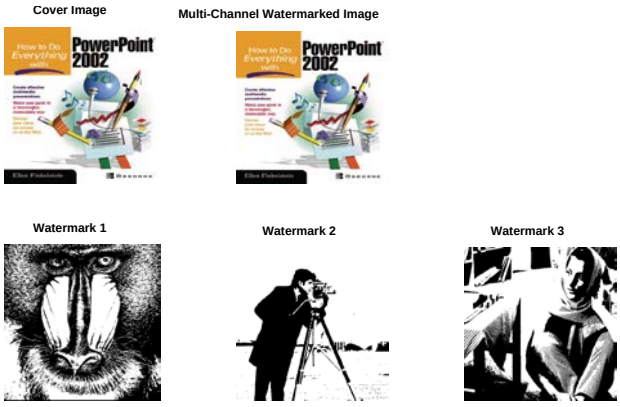

Figure 4.3 Proposed Watermarking Results with Multi-Channel SVD using PPT3 Image as Cover and Baboon, Cameraman and Barbara as Watermark Images.

For checking the performance of proposed work the parameter used is PSNR values in dB. The PSNR values for the original image along with other images are depicted in Table 1. The proposed scheme is simulated in MATLAB environment. Here while embedding the watermark into the cover image.

Table 1: Performance Comparison of Peak Signal to Noise Ratio (PSNR) in dB with Multi-Channel SVD

Methodology	***Watermark Image***	***Cover Image***		
		Comic	***Zebra***	***PPT3***
Previous Method *(Wavelet + QR-Decomposition)*	*Baboon*	88.56	88.25	86.99
	Cameraman	87.40	87.81	85.75
	Barbara	87.78	88.45	86.89
Proposed Method *(Single-Channel Singular Value Decomposition)*	*Baboon*	96.83	96.76	99.06
	Cameraman	95.02	94.18	96.58
	Barbara	96.57	96.34	98.67
Proposed Method *(Multi-Channel Singular Value Decomposition)*	*Ch1: Baboon Ch2: Cameraman Ch3: Barbara*	91.32	91.06	93.16

The graphical representation of performance parameter of proposed work has shown in Fig 4.4 Performance Comparison of PSNR with Baboon Watermark Image. Fig 4.5 Performance Comparison of PSNR with Cameraman Watermark Image. Fig 4.6 Performance Comparison of PSNR with Barbara Watermark Image.

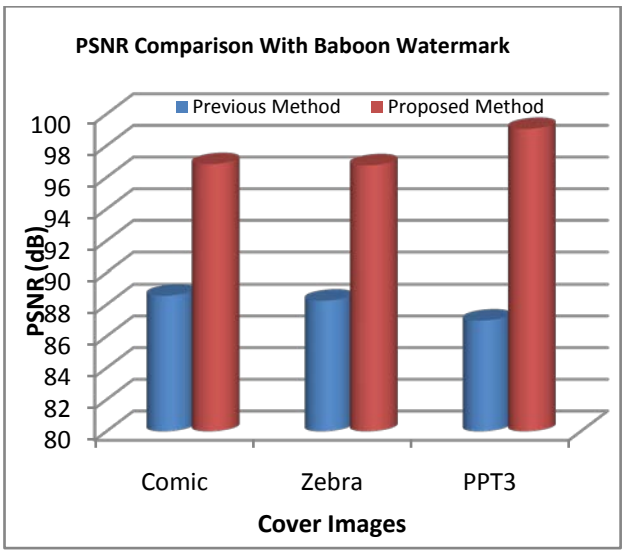

Figure 4.4 Performance Comparison of PSNR with Baboon Watermark Image

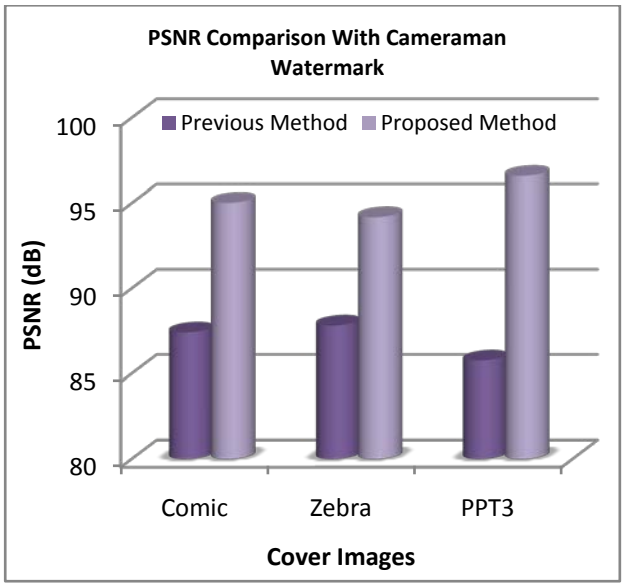

Fig 4.5 Performance Comparison of PSNR with Cameraman Watermark Image

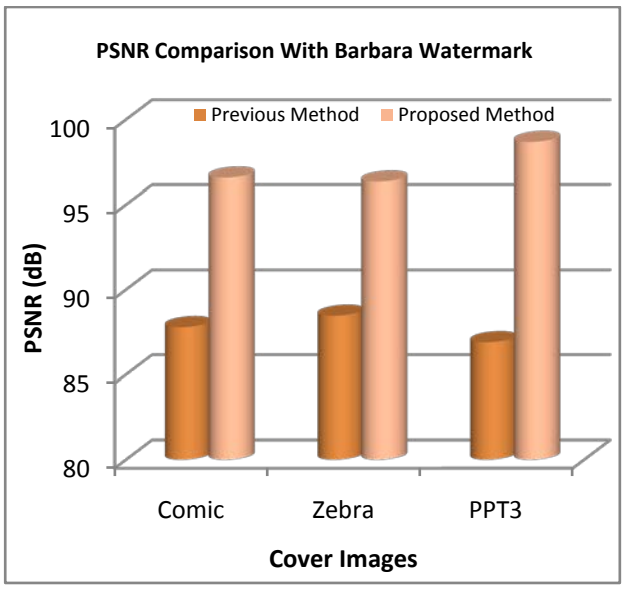

Figure 4.6 Performance Comparison of PSNR with Barbara Watermark Image

V. CONCLUSION AND FUTURE WORK

With the expanded utilization of web, the general thought of hiding some data in digital content has a more extensive class of uses that go past copyright protection and validation. The procedures engaged with such applications are all in all alluded to as data hiding. Many digital watermarking methods have been developed and according to the domain where the watermark is embedded, the watermarking methods can be of spatial domain or of transform domain. Each domain watermarking schemes have their own advantages and disadvantages. Transform domain based image watermarking schemes are popular than spatial domain based watermarking because of higher robustness. DCT, DWT are the popular transform domain methods. For some years another transform domain method i.e. Singular Value Decomposition has been popularly used in watermarking. The imperceptibility along with robustness are important in every watermarking scheme. Here the scheme has been experimented by taking a greyscale watermark and a binary watermark separately. The simulated result shows that the outstanding performance of proposed work. That means the scheme yields higher PSNR value, also yields better NCC values and because of Singular Values, more watermark information bits can be embedded into the image. Future work on proposed scheme can be done to resist against Steganalysis. Steganalysis is a method to detect whether content is being hidden with some information or not i.e. it is a steganography one or not. As watermarking is similar to steganography and also some algorithms have been developed to resist against steganalysis.

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