

Image Watermarking using hybrid approach of DWT-DCT-SVD

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Abstract — With increase the demand of digital media, need to protect digital images are also increased. Such kind of protection is achieved by securing images with the use of image watermarking. Digital image watermarking is the solution of that security problem which provides legal authentication of the transferred image over the internet. Therefore, development of efficient, robust and secure image watermarking techniques has become necessary. In this paper, the hybrid approach of image watermarking using DWT-DCT-SVD is proposed.

Keywords - Image Watermarking, DCT, DWT, SVD, PNSR, MSE, CR, etc.

I. INTRODUCTION

Image is most widely transferring file over the internet than any other, but in most unsecure manner. So that some system must be there to makes they secure from threats and different kind of attacks over the. Digital image watermarking is one such technology that has been developed to protect digital images from illegal manipulations.

The process of embedding the watermark into a digital data is known as Digital Watermarking. It is a process of embedding unremarkable logos or labels or information data or pattern into the digital data.

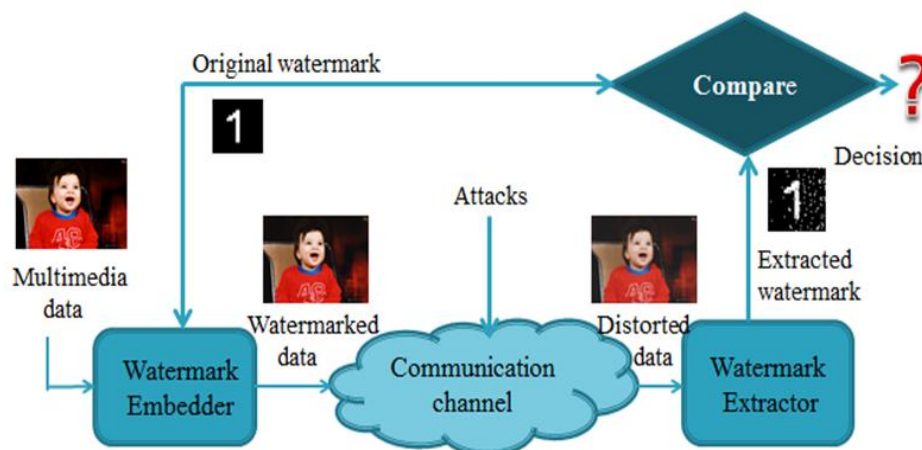


Fig.1 Block diagram of watermark embedding

A typical watermarking system is shown in Figure 2.1 which includes watermark embedder and watermark extractor. The inputs to the embedder are multimedia data and watermark, in our case that is an image, which is to be embedded into the original multimedia data. The output of watermark embedder is watermarked data. The inputs to the watermark extractor are watermarked image. The watermark extraction process involves two steps. In the first step extract a watermark from watermarked image. Then the second step is to determine whether the extracted watermark is same as original watermark by comparing the extracted watermark with the original watermark.

There are mainly two kinds of watermarking based on the working domain:

(1) Spatial domain watermarking

This category of watermarking is very simple and also easier to implement. It hides the watermark directly into original data by pixel modification. It has low complexity and high capacity for embedding more number of bits into host data. But these techniques are less resistant to different types of attacks. The techniques use in spatial domain is LSB (Least Significant Bit), ISB (Intermediate Significant Bits) and many more.

(2) Frequency domain watermarking

This category of watermarking embeds the watermark in frequency values rather than intensity values. DFT (Discrete Fourier Transform), DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Transform) are the main methods for transformation in frequency domain watermarking. These are complex but having good imperceptibility and robustness. Most of the watermarking applications use frequency domain watermarking.

The performance of image watermarking is estimated by some parameters:

1) MSE:

Mean Square Error is distortion rate in watermarked image. It describes the quality of an extracted image.

$$MSE = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N [X(i,j) - X'(i,j)]^2 \quad [1]$$

2) Peak Signal – to – Noise Ratio :

This is widely used quality measurement parameter. High PSNR represents the high quality.

$$PSNR = 10 \log_{10} \frac{255^2}{MSE} \text{ (dB)} \quad [1]$$

3) Correlation :

This parameter is used for checking robustness of the image. It must be nearer to 1.

$$\text{Correlation} = \frac{\sum_{i=1}^N \sum_{j=1}^M w(i,j) * w'(i,j)}{\sum_{i=1}^N \sum_{j=1}^M w^2(i,j)} \quad [1]$$

II. LITERATURE REVIEW

The paper [6] represents the use of DWT and DCT for embedding and extraction of watermark. And then both the DWT and DCT results are compared with respect to PSNR at different thresholds. In this paper, authors use 4 levels DWT. At lower threshold values, performance of DCT is almost similar as DWT. But for higher thresholds, DWT gives better image quality than DCT.

In the research paper [1], authors put emphasis on frequency domain techniques than spatial domain techniques due to robustness. They proposed DWT-SVD based watermarking system which is robust and blind. They choose DWT for its property of multi scale representation of function and SVD for its good noise immunity property. Proposed approach has high degree of robustness against major attacks. Thus it is clearly proved that transform domain is more robust than spatial domain.

In the paper [2], authors embed multiple watermarks having different sizes in single cover image using SVD. Thus capacity of the system was increased but complexity of SVD is very high as well as due to large number of watermarks, imperceptibility also not maintained.

Sr. No.	Name Of techniques	Features
1	DWT	✓ Good robustness ✓ Capacity level may be degrade ✓ Average impercaptibility
2	DCT	✓ Good impercaptibility ✓ Average robustness
3	SVD	✓ High complexity ✓ Good capacity

Table 1: Comparisons between various techniques of watermarking.

III. PROPOSED APPROACH

The section describes the proposed method of this paper. The proposed method is hybridization of DWT-DCT-SVD. The fig. 2 show watermark embedding process of proposed system and fig. 3 shows the watermark extraction process of proposed system.

□ Watermark Embedding:

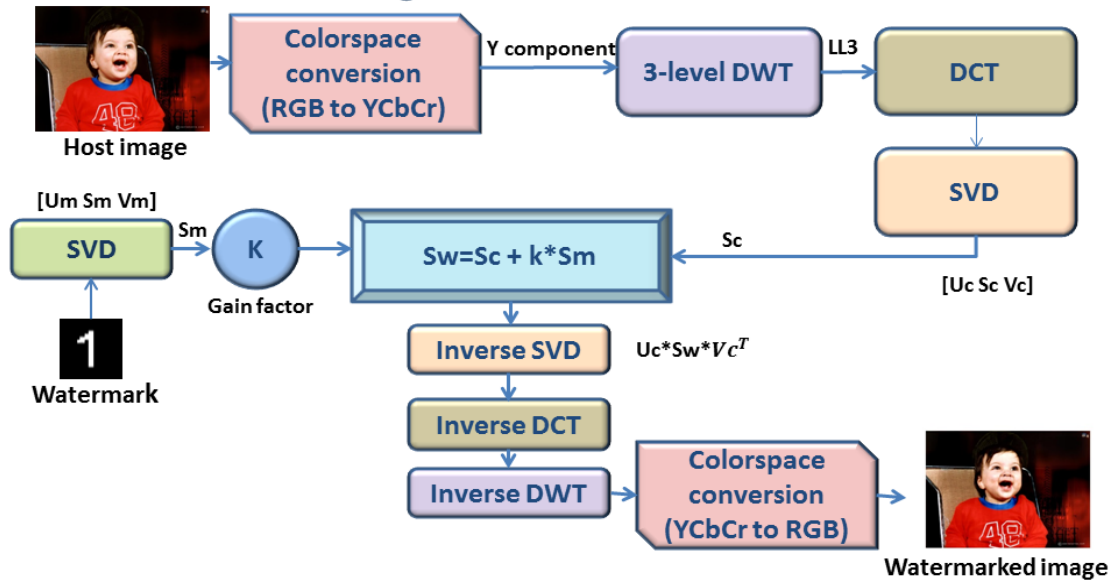


Fig.2 Watermark embedding process.

In the watermark embedding procedure, first of all color space of host image is converted from RGB to YCbCr. Then apply 3-level DWT on the y-component of resultant image. Now, apply DCT on LL3 band and then apply SVD on it. Other side, on the watermark applies only SVD. After that embeds the Singular value of watermark in the resultant SVD of host image with the gain factor K. Then inverse SVD, DCT and DWT applied to get the original size of image back. At last, YCbCr is also converted into RGB, which is finally watermarked image.

□ Watermark Extracting:

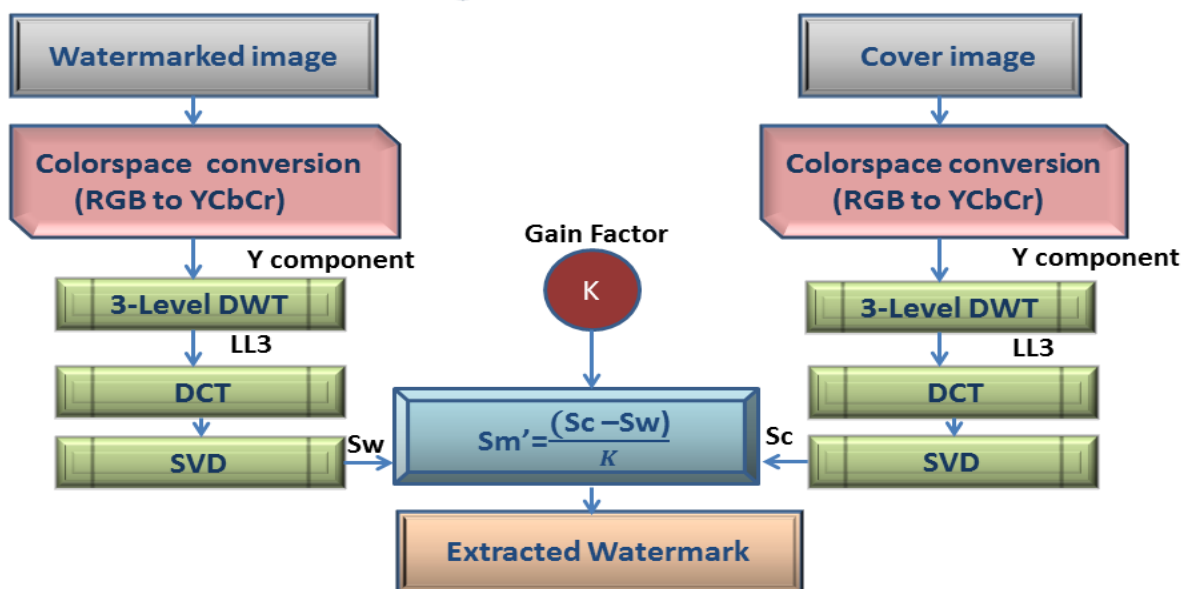


Fig.3 Watermark extracting process.

At the other side, in the watermark extraction process, the reverse procedure has to follow to extract the watermark back from the watermarked image as shown in above figure.

IV. RESULT AND ANALYSIS

The proposed method is implemented in MATLAB 7.10.0. The various images are tested by the proposed system. The result of the proposed system is compared with the other existing methods. Fig.4 shows original lady image with the watermarked image using DCT, DWT, SVD, DWT-SVD and proposed method. Fig. 5 shows the original watermark image with the extracted watermark using DCT, DWT, SVD, DWT-SVD and proposed method. Fig. 6 and Fig. 7 shows the same for chili image.

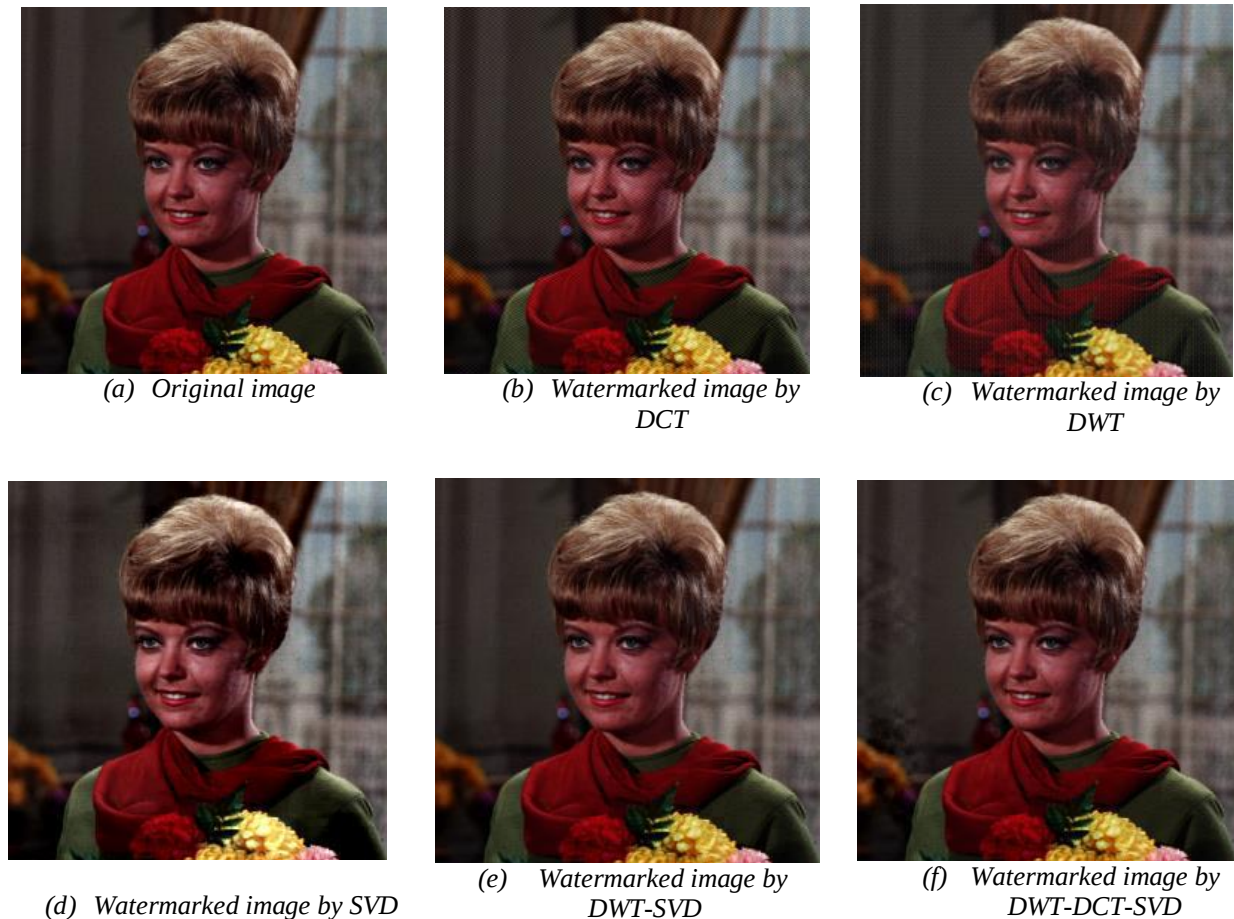


Fig.4 shows the results of Lady image using other existing methods and proposed method.

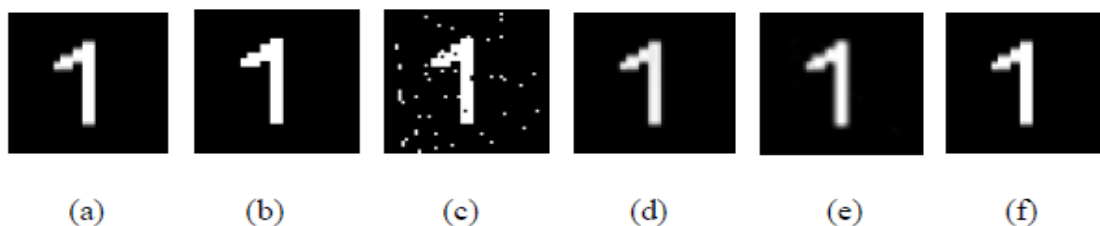


Fig.5 shows the extracted watermark of lady image
 (a)original watermark (b) using DCT (c) using DWT (d) using SVD (e) using DWT-SVD (f) using proposed approach

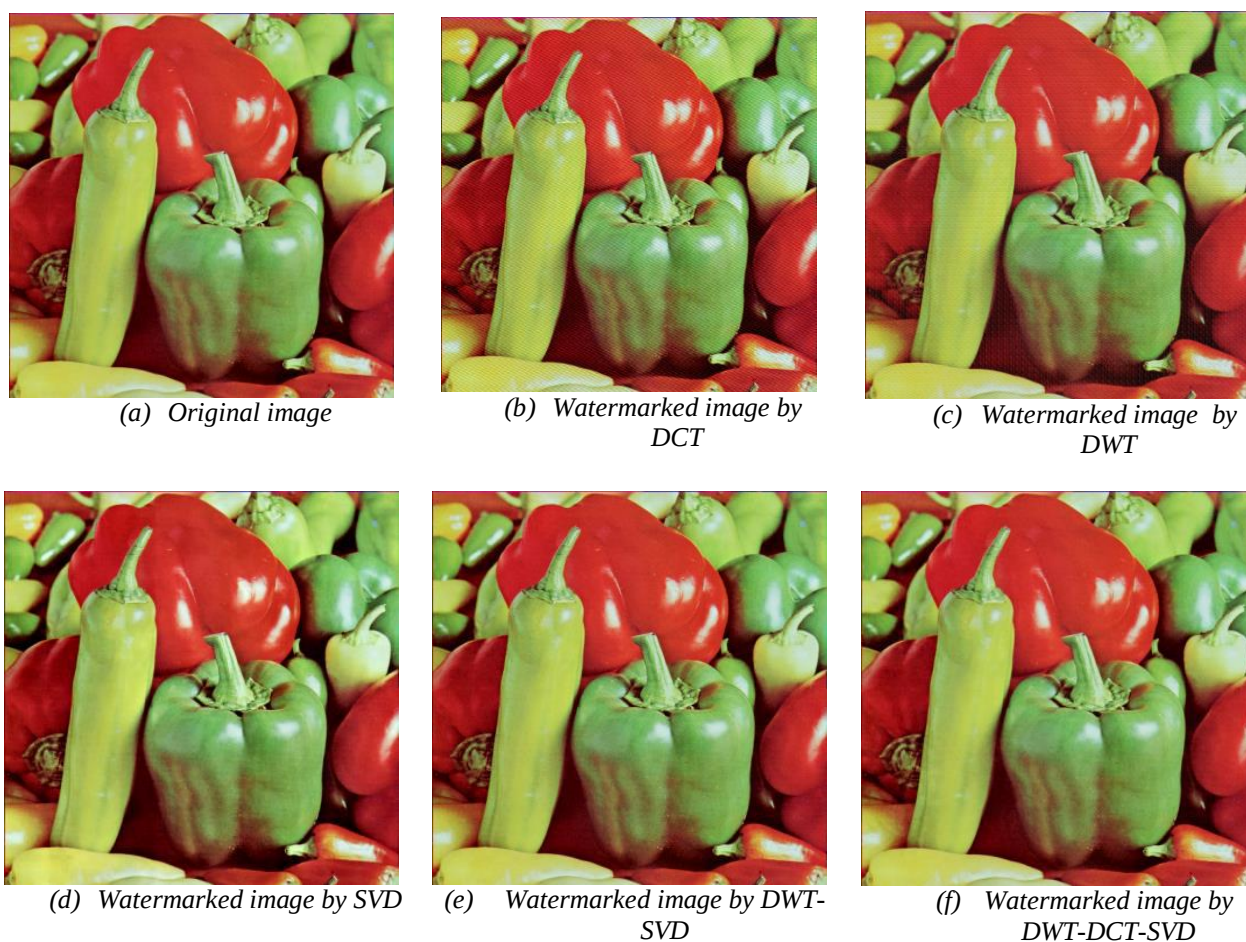


Fig.6 shows the results of chili image using other existing methods and proposed method.

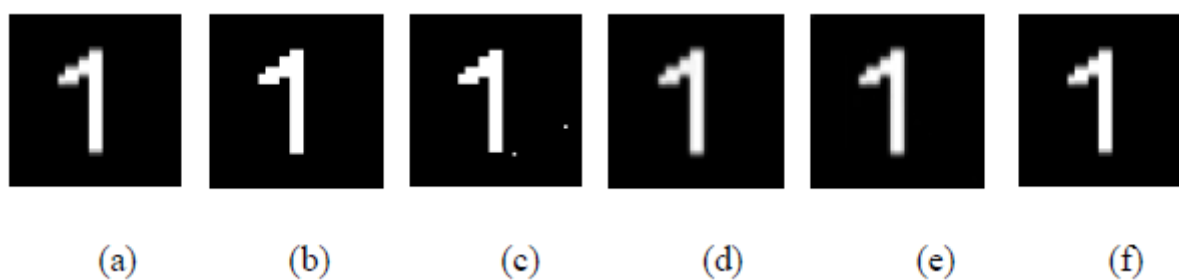


Fig.7 shows the extracted watermark of chili image

(a)original watermark (b) using DCT (c) using DWT (d) using SVD (e) using DWT-SVD (f) using proposed approach

The Result of images is evaluated by MSE, PSNR, CR and Time parameters. The Fig. 8, Fig.9, Fig.10 and Fig.11 are shows the comparison of proposed method with the other existing methods for various image.

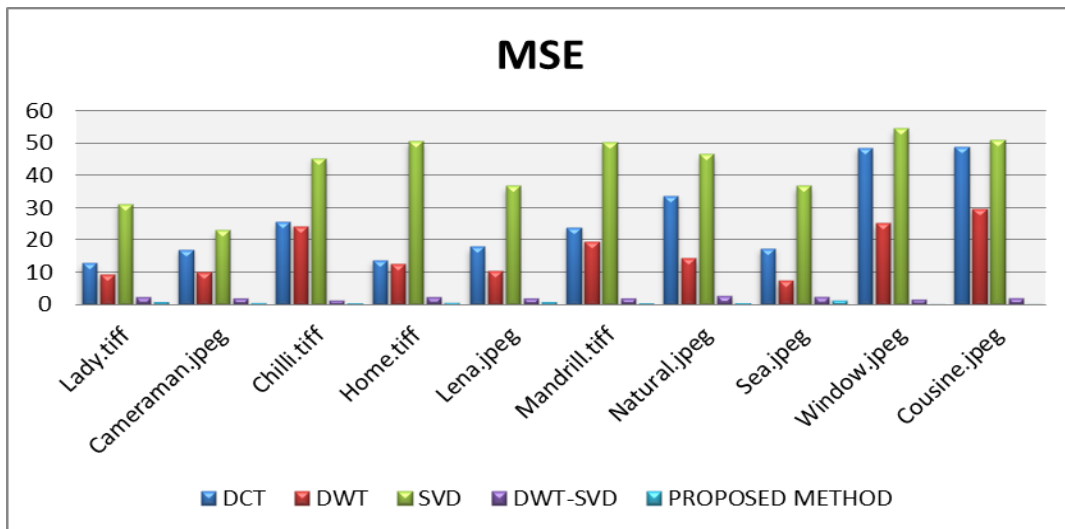


Fig.8 Comparison of MSE for various methods

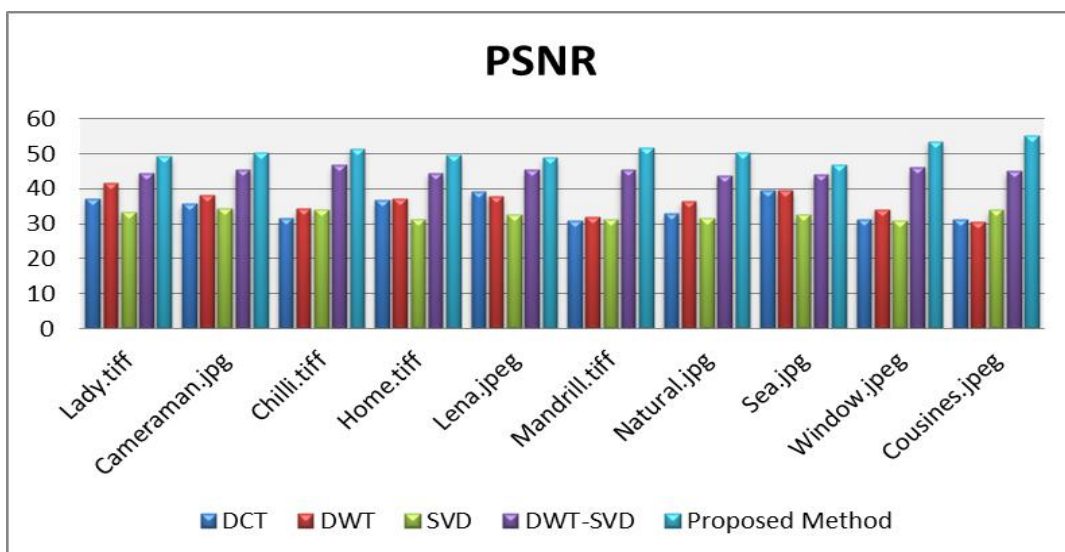


Fig.9 Comparison of PSNR for various methods

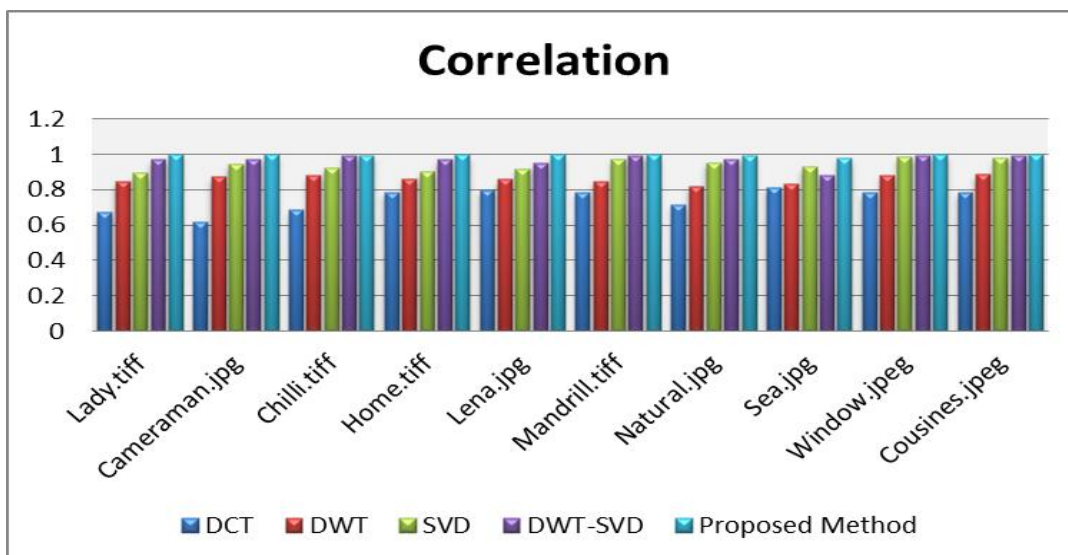


Fig.10 Comparison of Correlation for various methods

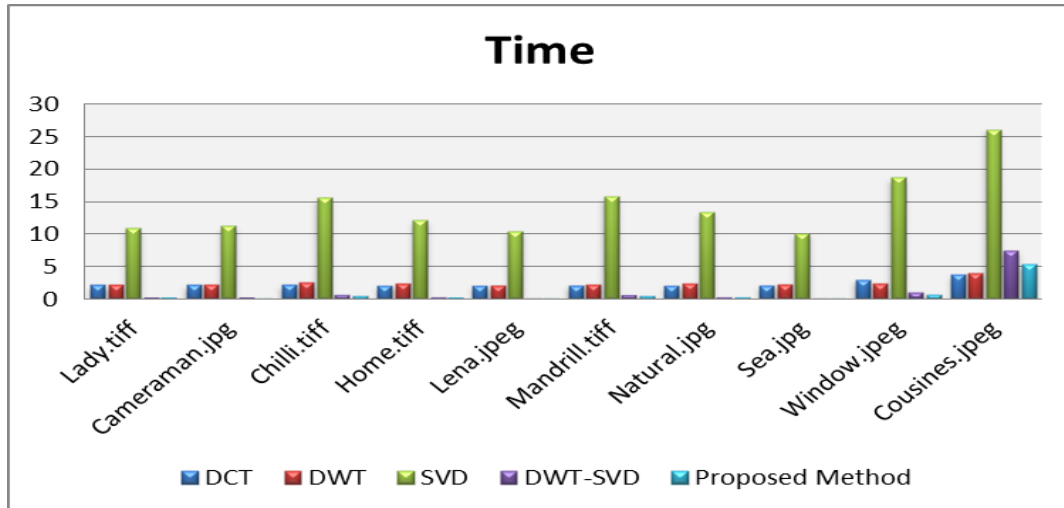


Fig.11 Comparison of time for various methods

V. CONCLUSION

Digital image watermarking must be needed in today's digitized world where digital image is most widely transferred file over the internet. In previous work, there are so many techniques in spatial and frequency domain for image watermarking from which DCT, DWT and SVD are most widely used techniques. SVD provides better noise immunity but the main drawback is that it cannot be used alone because of its large computations requirements. DWT provides good robustness but the visibility is average. In case of DCT, we can attempt acceptable visibility and average robustness. So, Hybridization of DCT and DWT gives much better result than independent DCT or DWT because it overcomes the drawbacks of each other. Thus, here we used hybridize concept of DCT, DWT & SVD to overcome the problems faced at earlier stage of research. By implementing proposed system in matlab, we say that the proposed system is more robust than earlier system with full proof of implementation results. The time taken by the proposed method is less than any earlier method and also having the good image quality in terms of PSNR. In future, this technique can be further improved by reducing processing time as well we can also hybridize other techniques than these three to make more robust system. We can also use semantic key encryption algorithm to make the system more secure.

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