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Image Watermarking Using Adaptive Quantization and Singular Value Decomposition

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Abstract – Nowadays, we all have seen that use of internet has become very important to all the generations. So, large amount of data has been shared through internet. So, important information that has been travelling through internet can be copied by an unauthorized user. To avoid this type of problem Digital Watermarking Technique has been used. In this paper watermarked image has been developed using Adaptive Quantization and Singular Value Decomposition Technique (SVD). In this quantization step has been used and after that PSNR value is calculated and compare with the PSNR values of watermarked image designed by using Singular Value Decomposition technique.

Keyword – SVD, DWT, PSNR, Adaptive Quantization, Quantization Step.

I. INTRODUCTION

In recent era, internet has become a very useful for all people in each and every generation. As, we can say due to increase in the digital data like images, audio and videos. Use of internet has been expanded all over the world. As data or message is exchanged from sender to receiver there is a big risk of duplication or privacy by an unauthorized user. To handle this type of problem Digital Watermarking [1] is used for ending the message in form of images, audios and videos.

Digital watermarking is defined as important information has been hidden into digital media such as image, audio or video. Digital image watermarking is comprised of a watermark image or secret message and cover image in which watermark image has been embedded. Two types of digital watermarking are there: one is visible watermark; the message is visible in original image. It can be easily identified by owner and second is invisible watermark; message is not visible in original image. In this encoding and decoding process is done for embedding and extracting a watermark image into the cover image. Watermarks are embedded into original image with the help of key and send it to destination. Then at receiver side, message is decrypted with the help of actual key only. Different techniques have been used for doing this process like DCT, DWT [2] and SVD [3]

In this paper watermarked image has been developed by using adaptive quantization with SVD [4] and calculate the peak signal noise ratio (PSNR) value of watermarked image. In this Quantization step is used and it act as a secret key to access the watermark In result the comparison is done of the PSNR values of watermarked using SVD and Adaptive Quantization with SVD .

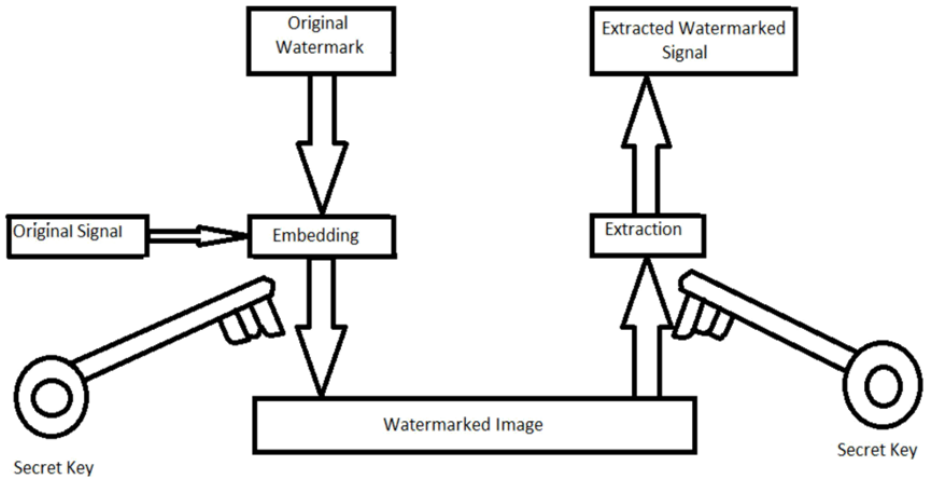


Fig1: watermarking block diagram

This paper is organized as follows: section II comprise of parameters of image watermarking, section III comprised of approach using SVD, section IV defines the experimental result and Section V defines conclusion drawn from analysis.

II. PARAMETERS OF IMAGE WATERMARKING

A. Robustness –

Watermarking should be robust if it has enough power to request all kinds of attacks or unauthorized access. Robustness against attack is a requirement for watermarking and success of this technology for copyright protection depend on this.

B. Security –

The information that is watermarked should be only accessible to the authorized parties. Only authorized user should have the permission to alter the watermark content. To provide security, encryption of watermark is done to cover image.

C. Effect on Bandwidth –

Watermarking is done so that it does not increase the bandwidth that is required for the transmission.

D. Imperceptibility –

Watermarked image is called imperceptible if the original image and watermark image are indistinguishable. It means if presence of watermark image is not noticeable in original image.

III. APPROACH USING SVD AND ADAPTIVE QUANTIZATION

A. Singular Value Decomposition -

Singular Value Decomposition (SVD) is a method that is used to evaluate matrices. This technique is used as it is a best factorization of matrix. Matrix (A) is given of size m * n. The representation of matrix A in SVD form is –

$$A = UDV^T$$

In this U and V is orthogonal matrix and D is diagonal matrix. If a matrix is multiplied by an orthogonal matrix, then error value should be less. Rotation and Scaling technique have been used in SVD.

Embedding algorithm using SVD –

1. Read original image and watermark image.
2. Check image is RGB then,
   Convert to gray scale and go to step
   Otherwise,
   Go to step 3.
3. Segment image into blocks of size w * w.
4. Compute i1 = || v || + 1, where
   $v = (\lambda_1^k, \lambda_2^k, \ldots, \lambda_w^k)$, k = 1, 2……N
5. Compute integer number s = floor (i1 / d_k).
6. Convert watermark image into black and White image.
   Embedding one bit of watermark image
   If b=1 then
   If s is odd number, then s=s+1
   Else s remain unchanged
   If b=0 then
   If s is even number, then s=s+1
   Else s remain unchanged
7. Calculate nvd = d_k * s + d_k / 2
8. Compute matrix
   $$\widetilde{B}_k = \sum_{i=1}^{w} \gamma_i^k U_i(k) V_i^T(k).$$
9. Calculate PSNR value of watermarked image in comparison to original image
   PSNR = 10 * $\log_{10}$ (255 * 255 / MSE)

Here, v is known as the vector of singular values. nvd is used to calculate modified singular values. d_k is quantization step for i1 corresponding to block. MSE is mean square error.

The extracting algorithm is describes as follows:

1. Segment the watermarked image into block Of size w * w.
2. Compute nv= || u || + 1, Where
   u is formed by singular values of each block that has been divided of watermarked image.
3. Compute S1 = floor (nv / d_k)
4. If S1 is even
   Then embedded bit is 1
   Otherwise,
   Embedded bit is 0

B. Adaptive Quantization –

To compress the maximum value into minimum or we can say in single value, defined as Quantization. In quantization precision is reduced. It is lossy compression. Adaptive Quantization is a linear quantization. In this step size is not fixed it varies so as to analyze the variance.

Adaptive quantization [5] combine with SVD has been used to improve the quality of an image. With this scheme, high transparent and more robust watermarked image has been formed.

Algorithm is as follow using Adaptive Quantization:-

1. Standard deviation (σ_{Bk}) is calculated for each block (B_k).
2. Maximum value (σ_M) and minimum value (σ_m) for all σ_{Bk}.
3. Quantization step (d_k) is calculated for different blocks.

$$d_k = d_m + (d_M - d_m) \times \frac{\sigma_k - \sigma_m}{\sigma_M - \sigma_m}.$$

k= 1, 2 ……. N

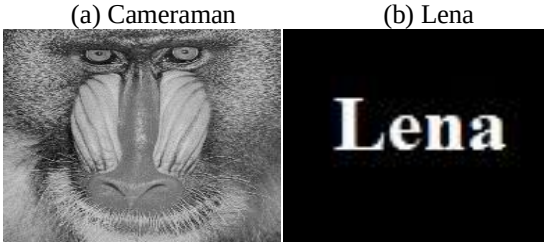
N is number of blocks, d_m and d_M are minimum and maximum quantization step.

In our calculation, d_m and d_M is taken as 9 and 54.

IV. EXPERIMENTAL RESULT

By using the SVD with adaptive quantization technique and PSNR values have been calculated of different images at different quantization step. If the PSNR values of a watermarked image are highest then we can say that hidden message or image cannot be seen in the cover image and it fulfills security parameter.

(a) Cameraman (b) Lena



(c) Baboon (d)

Fig 2: (a)-(c) Original Images (d) Watermark image

Table 1: PSNR Values for different images using SVD and Adaptive Quantization

IMAGES	PSNR		
	$d_k = 27$	$d_k = 54$	Adaptive quantization
Cameraman	**34.0087**	**28.4308**	**38.9887**
Lena	**34.1596**	**28.3588**	**38.8821**
Baboon	**34.0587**	**29.1219**	**36.6784**

V. CONCLUSION AND FUTURE SCOPE

According to the work done in this paper result has been concluded that PSNR values of watermarked image using SVD with Adaptive Quantization technique is better than the SVD technique. By using this technique image quality has become better. As we compare that if we use SVD with Adaptive Quantization the PSNR value is more while using only SVD with Quantization Step 27 and 54.

In future Block Truncation Coding [10] method will be used for the compression of the image and different attacks have been applied on watermarked image like cropping, blurring etc and then PSNR value is calculated of watermarked image.[7][8] From that we can conclude that which technique is better after applying different attacks on watermarked image and.

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