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Image Watermarking by SCHUR Decomposition

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Abstract:

To rely on authenticity of Image we can use Image Watermarking. In this Paper a new robust Image watermarking algorithm is proposed, which is based on Schur decomposition. Schur decomposition gives good result in terms of performance, robustness, imperceptibility and speed etc Schur decomposition technique shows a good performance against the various attacks such as JPEG compression, cropping, filtering, requantization, Resampling. The proposed technique has shown efficient and stable performance against various attacks and it is computationally faster.

Keywords: Image watermarking, Schur decomposition

Introduction

All Image watermarking is one of the research topics. Image watermarking is used for transferring document or image in secured way. Most of the cryptographic algorithms use image for their cryptography [1]. To protect the infringement Image Watermarking concept is invented. Watermarking is nothing but we can embed authentication and extract it. The digital Water marked Image must provide authenticity, imperceptibility, copyright protection and broadcast monitoring. The Meaning of these is given below [2]:-

- *Imperceptibility*: It is the relationship between original image and watermarked image.
- *Payload*: Number of bits embedded in Image per unit time
- *Security*: It is a measure of watermark robustness for the detection against unauthorized persons.
- *Robustness*: Robustness is detection of original image after many attacks. *

- *Speed*: It is measure of time required for embedding and extraction of watermark.

The aim of watermarking algorithm is to achieve above requirements. The scheme is highly secure when knowing the embedding algorithm does not help user to detect the data and infringement [3].

Wu et al [4] represented audio watermarking scheme based on Quantization Index Modeling (QIM). A few years ago, Single Value Decomposition (SVD) was introduced for image watermarking applications [5]. SVD is matrix decomposition technique which is based on least square principal and use of optimal matrix has good result of audio watermarking. Schur decomposition is next popular technique after SVD [6]. schur decomposition has positive advantages on svd which is shown by [7]. It explains that schur decomposition has more speed than that of the single value decomposition because schur decomposition uses upper triangular matrix. The Schur decomposition uses the advantage of QIM and Dither modulation. The proposed algorithm uses schur decomposition and dither modulation.

SCHUR DECOMPOSITION

The Schur decomposition of a A is a matrix decomposition of the form QHAQ=T=D+N. where q is unitary matrix, QH is its conjugate transpose, and T is upper triangular matrix which is sum of a $D = \mathrm{diag}(\lambda_1, \lambda_2, \ldots, \lambda_n)$ (i. e., a diagonal matrix consisting of Eigen values λ_i of A) and a strictly upper triangular matrix.

WATERMARKINGTECHNIQUE:

Embedding Algorithm (refer fig 1)

Take an image I of size M*M which is used for selecting the tree path in Huffman tree and is given by I= {wm (m1, m2): 1<=m1<=M, 1<=m2<=M, I (m1, m2) E {0, 1}}.

- Step 1: Divide the Image in to non overlapping small parts in such a way that it will be U*U samples (a1, a2, a3..... an).
- Step 2: Apply Schur decomposition and compute Euclidean form of Ni=sqrt(ai2)where i =1, 2, 3... n.
- Step 3: Compute as=floor(Ni/d) where d is user defined positive real quantization number.
- Step 4: The bits are embedded using Dither modulation.

  If(W(i, j)==1) then a1=a+m-(a%(2m))
  else
  a1=a+m-(a+m)%2m.
  end

- Now apply inverse Schur decomposition on each block.
- Reform the original Image

Extraction Algorithm

The Decryption is same as that of reverse of encryption. But we require a tree for doing decryption so prepare the tree by using original signal.

- Step 1: Divide the Image in to non overlapping small parts in such a way that it will be U*U samples (a1, a2, a3..... an).
- Step 2: Apply Schur decomposition and compute Euclidean form of Ni=sqrt(ai2)where i =1, 2, 3... n.
- Step 3: Compute as1=floor(Ni/d) where d is user defined positive real quantization number.
- Step 4:if(as1==0) then W(i, j)=1
  Else
  W(i, j)=0;
  End

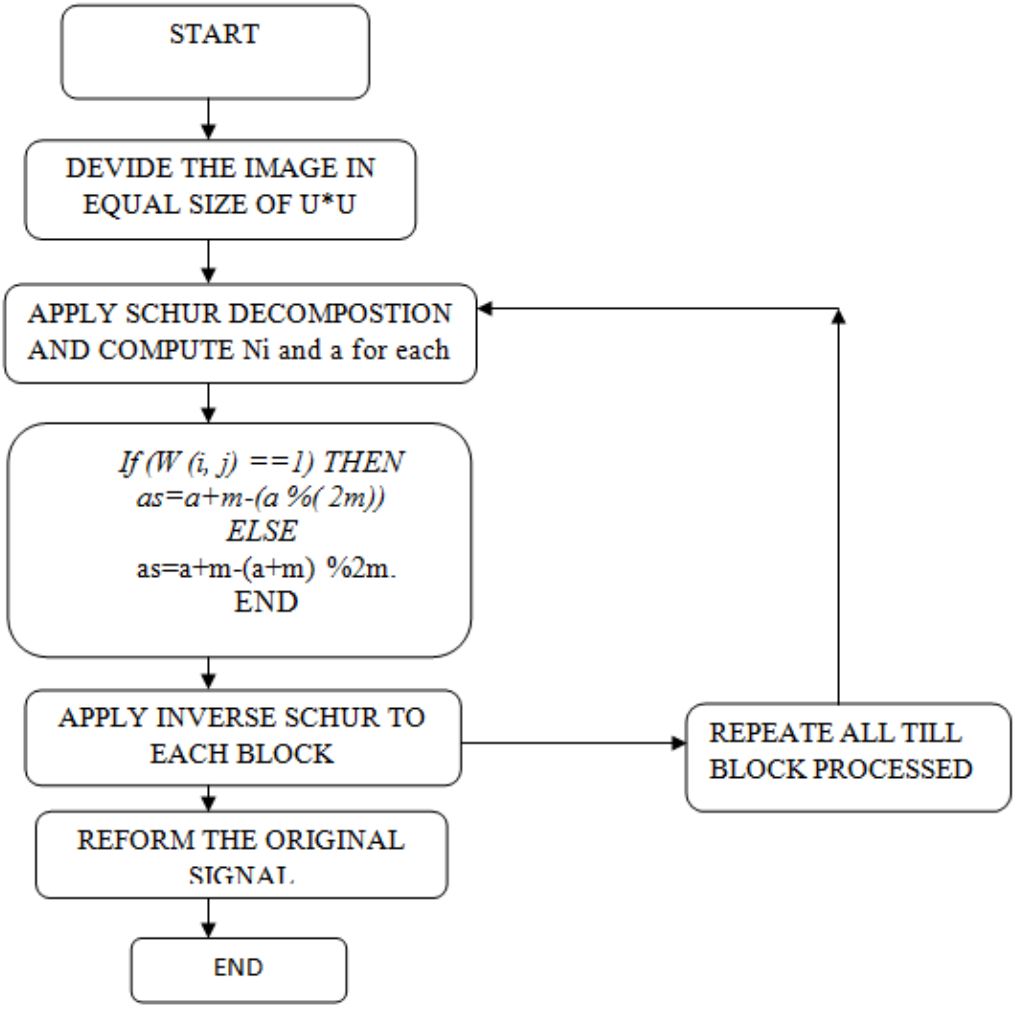

Fig. 1: Embedding Algorithm.

We have executed this algorithm in MATLAB 12 in Image and having JPEG format. A plot of a host Image and its watermarked Image is shown in below figure. The embedded watermark with the help of binary logo image of size M × M = 45 × 45 = 2025 bits. In our experiment, the QIM and Dither modulation algorithm strengthens the water mark and increases robustness. After executing the program the we got the embedded watermark.

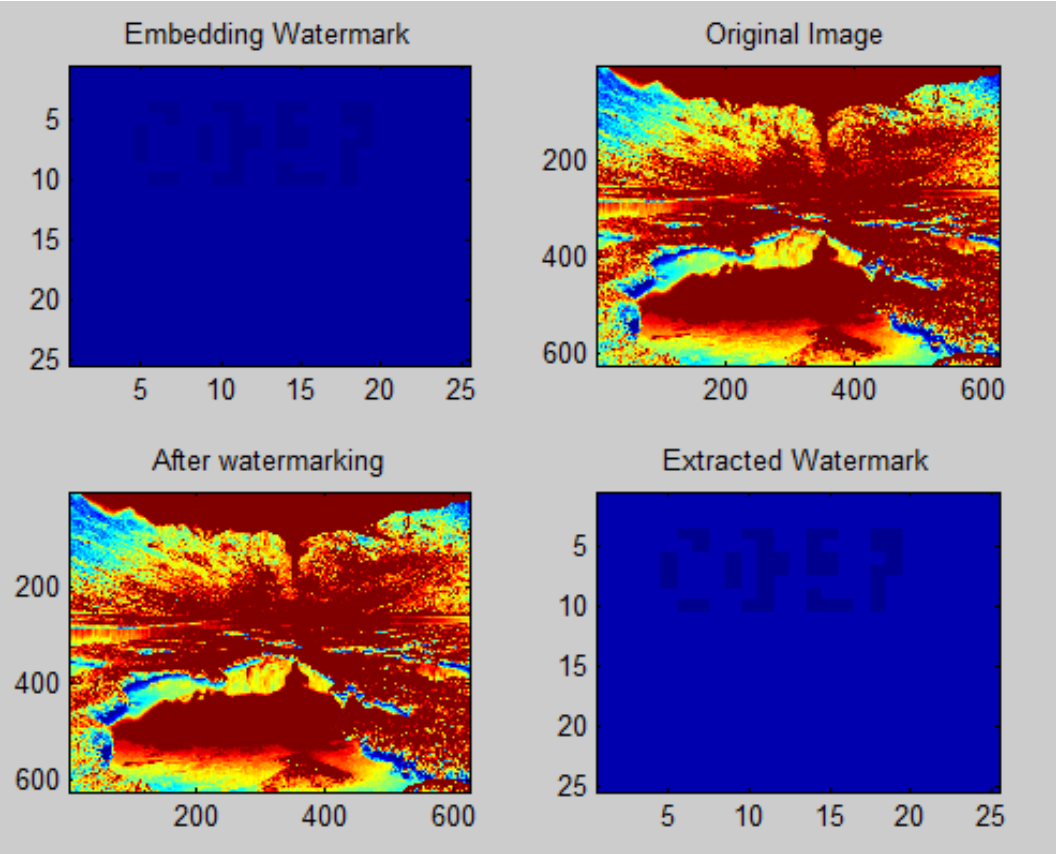

Fig. 2. MATLAB Results

ROBUSTNESS TESTS:

In the robustness experiments, we apply a variety of attacks on watermarked image. The attacks introduced in watermarked sample are as follows.

- filtering: Filter watermarked Image is altered.
- Requantization: The Image is re quantize down to 8bits/sample and then back to 16 bits/sample.
- Cropping: Removing few samples from the watermarked Image from few positions.
- Embedding and Extraction time: Time required for Embedding and extracting watermark from the original image.

RESULT:

The watermarking algorithm is robust on various attacks like JPEG compression, cropping, filtering, requantization, Resampling. This algorithm has the strong capabilities of detection and location and it also can keep the original image quality well.

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