High Image Quality and Resilience Controlled Reversible Watermarking with Interpolation Error Expansion Technique

Manjumadha T R, Kavitha C, Sakthivel S

Abstract - **Along with the different data hiding schemes, lossless data hiding has attained the improved performance currently identified as reversible watermarking guarantees extraction of the hidden information totally revival the original image. The existing work presented a high capacity reversible watermarking (RW-HPBS) method based on histogram processing and blocks selection. RW-HPBS approach exploits concept of down sampling for effectively increasing capacity and integrity control and authentication related applications. The authentication process is achieved by taking a secondary gain of position map previous to creature compressed and embedded as support information. This process does not concern about the interpolation error expansions. The proposed work presents high image quality and resilience controlled Reversible Watermarking with Interpolation Error Expansion Technique. The image interpolation is the process of estimating the missing pixels. The pixels present in low resolution image are called sample pixels. Using sample pixels of high resolution image are interpolated to construct interpolated image. The difference between interpolated pixel value and original pixel value is called interpolation error. Performance measures in terms of computational complexity, resilience rate, blind data extraction, and extracted image quality.**

***Key Terms*- Reversible Watermarking, Histogram Process, Interpolation Error Expansion Technique.**

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I. INTRODUCTION

The image processing is one of the signal processing for which the input is an image, such as a photographer video frame; the result of image processing may be more ever an image or a collection of characteristics or metrics related to the image. For the most part of image- processing methods concern about delicacy the image as a two - dimensional signal and concerning standard signal-processing methods to it. Reversible watermarking methods are also named: lossless or invertible and were natural to be affected mostly in situations where the validity of a digital image has to be decided and the innovative content is peremptorily needed at the interpreting side. The watermarking is imperative to position out that, originally, a high perceptual value of the watermarked image was not a requisite due to the reality that the unique one was get well and easy issues of outline caused by the watermarking process were not in use into description too. A helpful module in Digital Signal Processing (DSP) systems is the down sampler, which can be used to lesser the efficient sampling velocity at which a signal has been sampled. The oversampling depicts that are accumulating extra information than is necessary and transmitting more information than is required. The bandwidth limited statement system, this effort requires simply sending information which is helpful – hence requiring for down sampling.

II. LITERATURE SURVEY

In reversible watermarking the [1] use of otsu's method to find threshold value and selection of pixel selection as rough pixel and smooth pixel. Hiding details or redundant information is the most preferred way to reduce data complexity. The reversible watermarking is to calculate the threshold value for prediction error expansion is adapted with otsu's method and a levelheaded enhancement in

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performance measures like PSNR can be seen. Capacity parameter directs the embedding of a certain amount of information with digital media formats. Data and information embedding and extraction can be performed by fixing the criterion for calculating threshold with minimum impairment of original contents.

The reversible watermarking [2] technique which involve adaptable predictor and sorting parameter to suit each image and each payload in order to get lowest image distortion. Gaussian weight predictor and expanded variance mean were used as parameters and produce the best result. This method effectiveness is measured by using PSNR. The higher quality image will have a higher PSNR value. The PSNR of this method is higher than both comparing method in every test image and in almost every size of payload. The reversible watermarking method produces less distorted images than Sachnev et al. method. The techniques we use combines adaptive models for both the predictor and sorting parameter as well as optimization techniques to increase predictor efficiency and decreased prediction error.

In this reversible image [3] hiding scheme using linear prediction coding and histogram shifting. In the linear prediction coding, however, the basic value pixel is not used. If a value of the basic pixel value is the largest or the smallest in a block, only one histogram is generated and the hiding capacity is decreased. Tsai et al.'s scheme was solved by the novel linear prediction coding and modified histogram shifting technique that search two peak point in one histogram were proposed to provide the hiding capacity. The hiding capacity is superior to Tsai et al.'s scheme and the image quality is similar. When the extraction and recovery procedure, two peak and zero point fair are required in each block. Although the block size of this scheme is larger than that of Tsai et al.'s scheme, the hiding capacity is similar. It is shown that the communication data, peak and zero points are decreased.

Reversible data hiding in encrypted [4], since it attains the fantabulous property that the germinal conceal can be lossless recovered after embedded data is extracted while protecting the person proportionality's confidentiality. Reversibly vacating space from the encrypted images, which may be thing to both errors on data extraction and or appearance refurbishment. We declare a method called XOR Ciphering framework which has the benefit of inserting the data without dynamic the icon aggregation, and thus it is gradual for the information hider to reversibly embed accumulation in the encrypted image. A simple and efficient data embedding method based on XOR ciphering technique. The data hider can acquire advantage of all traditional RDH techniques for direct image and succeed superior performance without loss of perfect secrecy. In this method we can attain historical reversibility and the maximum PSNR value is obtained with less MSE

In Reversible data [8] hiding work focuses on both data encryption and image encryption which makes it more secure and free of errors. In previous method embed data without encrypting the data which may subject to errors on the data extraction or image recovery. In this method both the data extraction and image recovery are free of errors. The encryption of image is realized by blowfish encryption algorithm and the secret data is encrypted using Advanced Encryption Standard algorithm. The two main algorithms implemented for data encryption and images encryption are the advanced encryption standard algorithm and blowfish algorithm. Huffman coding method is used for compress the data. The next step is data encryption which is performed using AES algorithm and after this step the image is encrypted using Blowfish algorithm which is highly secure because of its longer key length and strongest and fastest nature in data processing compared to other algorithm.

In this, they are using the reversible watermarking method [8] for authenticating of digital images which exhibits high embedding capacity and high visual quality of marked images. The host image of size n x n is transformed into wavelet coefficients using L level DWT. The embedding is based on parent-child structure. The wavelet tree selection for embedding is random and hence it provides adequate security against unauthorized attempts to extract or remove the watermark. By histogram modification the overflow and underflow are prevented. The lossless recovery of original image is achieved. It is

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quite effective and easy to implement. It is capable of providing better imperceptibility for an image at a given effective payload compared to existing watermarking approaches.

In this paper **[5]** offers a 'Reversible Watermarking method for Image Authentication' (RWIA) handle Integer Wavelet Transform that assures the needed of robustness, imperceptibility and capacity. In this algorithm mask the data and secretarial information in the maximum level of frequency sub bands of CDF integer wavelet coefficients whose extents are preprocess to a definite predefined threshold

In this paper **[6]** represented a watermarking method forceful beside more general geometric and signal processing process, for appliances that need an correct recognition of the holder watermark even if the digital image endures intended and non-intentional attacks. The introduced scheme is based on two modifications in two 2d histograms. The first modification a chooses region of a 2d histogram, send by red and green properties, is changes a according to the watermark bit progression; while in the second modification any 2d histogram, send by blue (B) and filtered red (R) components, is partitioned from different blocks to adapts the watermark data bits

In this paper **[7]** explained about the PEE method is additional examined and a inventive reversible watermarking method is assumed by integrating in PEE two type of original techniques, namely, adaptive embedding and pixel selection. This removed the expanding pixels in large amount of prediction errors also it decreases embedding force by retreating the high level of modification to pixel values.

In this paper [9] represented a modified difference Histogram based reversible data hiding is a technique can retrieve both cover image and hidden data without any distortion from the watermarked image. Difference-pair-mapping is a new embedding and shifting technique, by using this image redundancy can be better exploited by DPM and an improved embedding performance is achieved. The Histogram based methods modify the data by filling the vacant space. This method uses peak and minimum points of the pixel-intensity histogram to embed data.

Interpolation Error Expansion Technique based High Image Quality and Resilience Control

Reversible watermarking is one of the digital watermarks in an interesting feature that when watermarked content has been validated, one can avoid the watermark to recover the inventive, un watermarked content. The original content get back reversibility highly attractive is receptive imagery, such as military data and medical data. A fundamental method of reversible watermarking is to choose an embedding part in an image, and implant equally the payload and the inventive rates in this area into such area.

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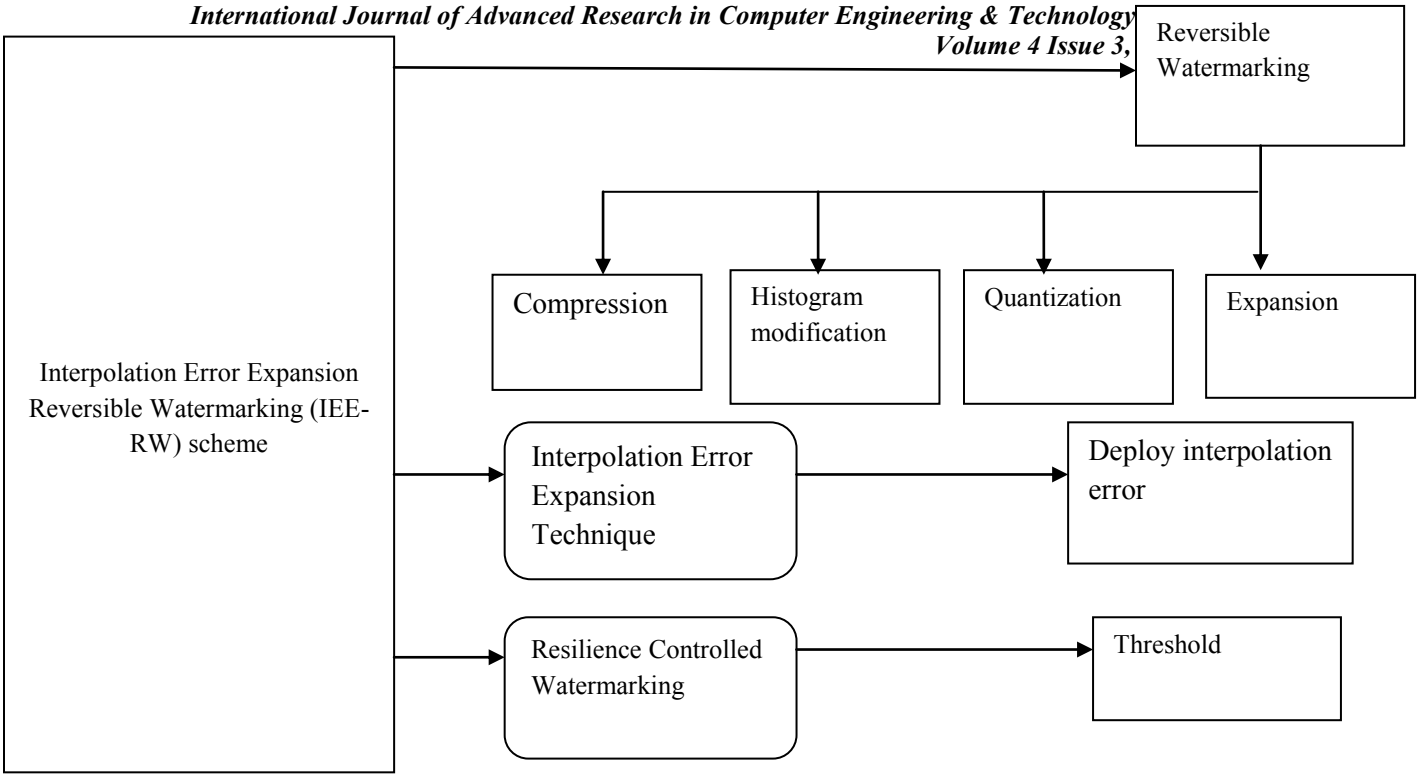

Fig: 3.1. Interpolation Error Expansion Technique based High Image Quality and Resilience Control

The image interpolation issues goes by one or more than names, depending on the appliance. The appliances of image interpolation level into the usual showing of online images to the additional complicated magnification of satellite images. Interpolation is so confidentially connected in its consequent data model that, still when no re sampling operation seems to be involved; it nevertheless contributes under the guise of its data model. The Interpolation Error Expansion Techniques based High Image Quality and Resilience Control is divided into three phases:

a) Reversible Watermarking
b) Interpolation Error Expansion Technique
c) Resilience Controlled Watermarking

a) Reversible Watermarking

Reversible watermarking information to be embedded and watermark are handled interchangeably. Reversible watermarking techniques are Compression, Histogram modification, Quantization and Expansion. Reversible watermarking properties are imperceptibility and embedding capacity. The imperceptibility measure of similarity between the watermarked and cover image. The embedding capacity measure of the maximum number of information bits embedded in the cover image. The performance of reversible watermarking technique is based on imperceptibility and embedding capacity.

The expansion based reversible watermarking utilizing prediction error based on correlation among neighboring pixels for gray scale images. The correlation is modeled using predictor computes current pixel intensity.

b) Interpolation Error Expansion Technique

Interpolation Error Expansion Technique (IEET) deploys the interpolation error for data embedding instead of adjacent pixels difference or prediction error. This problem expands the error by addition ration than bit shifting. Image interpolation estimates the missing pixels. The pixels in low resolution image are considered as candidate or

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sample pixels. The candidate/sample pixels evaluate the missing pixels of high resolution image. Non candidate pixels and candidate pixels are interpolated to construct interpolation images. The interpolation error is calculated by difference between interpolation pixel value and original pixel value. On embedding of watermarked images increases in interpolation error result in overflow / underflow. Expandable pixel locations are selected for embedding to discard overflow and underflow. The locations undergo interpolation error expansion are referred as expandable locations. Expandable location arises in certain location of cover image.

c) Resilience Controlled Watermarking

Resilience control is done on reversible watermarking by evaluating a threshold for interpolation error and expandable location. This problem identified the expandable locations based on interpolation error and pixel intensity. The subsets of expandable locations are selected by applying a threshold value. Location Map (LM) is created to indentify selected expandable locations and then compressed to a bit stream for its embedding in the LSBs of watermarked image. Threshold value depends on size of the watermark to be embedded and auxiliary data comprising LMc and LSBs of the corresponding pixels. Watermarked interpolation error is added in interpolated pixel intensity. On decoding of reversible watermarking for resilience control location map region is extracted and decompressed. Watermarked bits are extracted along with recovery of the cover image to maintain better resilience rate.

1. Performance Metrics

This work quantifies the performance of interpolation error expansion techniques (IEET) by identify the expandable locations based on the interpolation error and pixel intensity. It evaluates the performance of the methods by evaluating the image size, PSNR, extracted image quality, interpolation error, resilience control rate and computational overhead when compared to the existing system. This system performs and analyzed the metrics in matlab environment by:

- Extracted Image quality
- Interpolation Error
- Computational Overhead

1.1. Extracted Image quality

Extract the image quality is an imperative factor in the performance of automatic identification system. Comparing the terms in the frequency domain and the spatial domain is a classification problem, which must be resolved to choose suitable preprocessing and improvement parameters.

Table 4.1: Image size Vs Extract image quality (%)

Image Size	Extract Image Quality (%)	
	RWA (Existing)	IEET (Proposed)
5	55	61
10	60	64
15	65	69
20	72	79

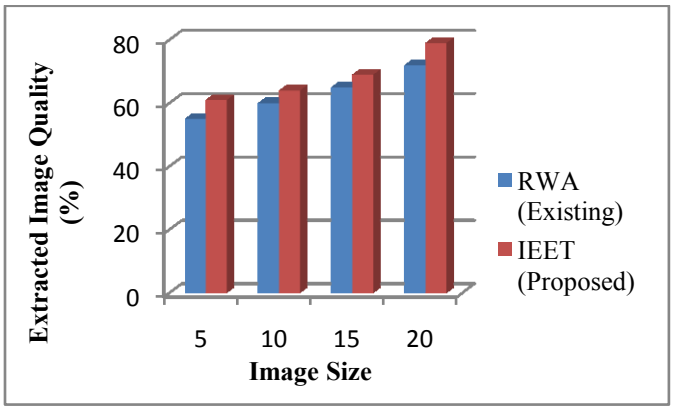

Figure 4.1: Image size Vs Extract image quality

Figure 4.1 demonstrates Extracted image quality. X axis represents the image size values whereas Y axis denotes extract image quality using both the concept of improve the image quality and capacity resilience and control. When image size increased, clarity of image quality gets increases accordingly. The Interpolation Error Expansion Technique (IEET) achieves the high performance of 10 to 15 % when compared to the existing system (RWA).

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1.2. Interpolation Error

The interpolation errors enforce the restraint. In this section, a separation of the pixels in wants to be decided and the interpolation problem becomes a description of the in painting problem. It provided an error image which characterizes the regions in the check image that are visually various into the original image.

Table 4.2: Image size Vs Interpolation Error (%)

Image Size	Interpolation Error (%)	
	RWA (Existing)	IEET (Proposed)
5	16	11
10	21	17
15	24	19
20	25	21

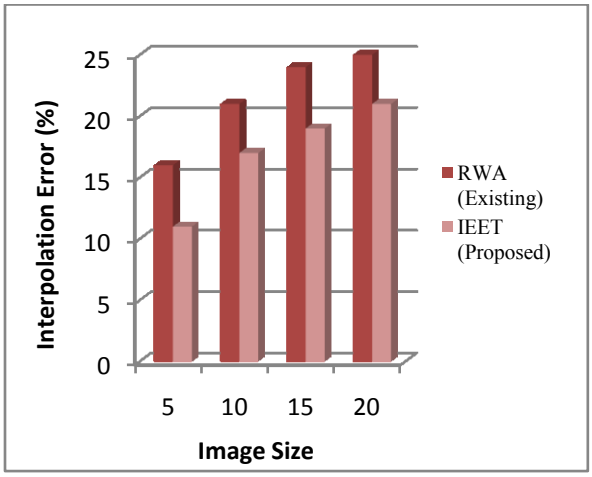

Figure: 4.2. Image size Vs Interpolation Error (%)

Figure 4.1 demonstrates Interpolation Error. X axis represents the image size values whereas Y axis denotes Interpolation Error using both the concept of improve the image quality and capacity resilience and control. When image size increased, the complex of Interpolation Error gets decreases accordingly. The Interpolation Error Expansion Technique (IEET) achieves the high performance of 5to 10 % when compared to the existing system (RWA).

1.3. Computational Overhead

The extraction process is easily the reversed of the embedding process. For every histogram of the totality coefficient sets, the locations of the computationally peak point and zero point which are occupied in alteration must be recorded as overhead information wanted through the extraction process.

Table 4.3: Image size Vs Computational Overhead (%)

Image Size	Computational Overhead (%)	
	RWA (Existing)	IEET (Proposed)
5	28	25
10	39	36
15	51	48
20	62	59

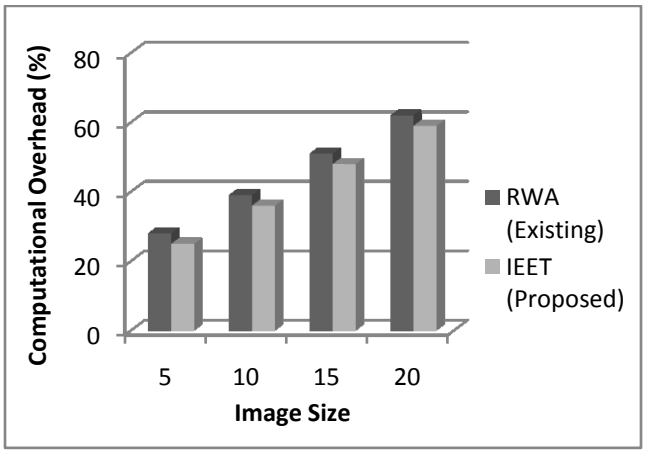

Figure: 4.3. Image size Vs Computational Overhead (%)

Figure 4.3 demonstrates Computational Overhead. X axis represents the image size values whereas Y axis denotes Computational Overhead using both the concept of improve the image quality, capacity resilience and control. When image size increased, the complex of Computational Overhead gets decreases accordingly. The Interpolation Error Expansion Technique (IEET) achieves the high performance of 15 to 20 % when compared to the existing system (RWA).

2. Conclusion

In this paper described a high image quality and resilience controlled reversible watermarking with interpolation error expansion techniques. Interpolation Error Expansion Technique is to deal with image interpolation process and estimating the

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missing pixels. The important work of resilience control is done on reversible watermarking by evaluating a threshold for interpolation error and expandable location.
This system performs and analyzed the metrics in Mat lab environment. In future works, to extend the different type of technique apply and show effective image quality and resilience controlled reversible watermarking.

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