International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Error Tolerant Digital Watermarking System for the Application of Noisy RGB Images

Bharti Mishra[1], Rashmi Kashyap[2]

[1, 2]Deparment of Electronics and Telecommunication, CV Raman, Kota (C.G), India

Abstract: ***As we witness that present age is information age also known as the digital age, or new media age which is based on internet, hence data transmission is online and happens in real time. With the help of modern digital technology and increasingly powerful image processing tools one can easily manipulate the digital data such as image, voice and videos without leaving obvious visual traces of data having been tampered, hence there is an urgent need to identify and protect the authenticity of the data. In the fields such as forensics, medical imaging, e-commerce, and industrial photography, authenticity and integrity of digital images is essential. Various methods and research issues involving the tampering detection and image authentication have been discussed and Digital Watermarking provides a suitable approach towards addressing this problem. It is also evident that due to online transmission there is a possibility of having noise on input image as well; hence in this paper we present an error tolerant watermarking system which is ideal for the application of noisy RGB images. According to our proposed approach we follow the logic of resizing of the image and use of approximate Gaussian smooth filter. Also the applications and needs of digital watermarking have been discussed here.***

Keywords: Error Tolerant, DWT, Algorithm, FLOW, Communication, Latency, Watermarking

1. Introduction

Digital watermarking is the act of hiding a message related to a digital signal (i.e. an image, song, video) within the signal itself, it tries to hide a message related to the actual content of the digital signal. With the proliferation of digital media such as images, audio, and video, robust digital watermarking and data hiding techniques are needed for copyright protection, copy control, annotation, and authentication. While many techniques have been proposed for digital color and grayscale images, not all of them can be directly applied to binary document images. The difficulty lies in the fact that changing pixel values in a binary document could introduce irregularities and noise that are visually noticeable. In this paper we have taken the noise issues of RGB images into account. Watermarking has been around for several centuries, in the form of watermarks found initially in plain paper and subsequently in paper bills. However, the field of digital watermarking was only developed during the last 15 years and it is now being used for many different applications. The increasing amount of research on watermarking over the past decade has been largely driven by its important applications in digital copyrights management and protection. One of the first applications for watermarking was broadcast monitoring. It is often crucially important that we are able to track when a specific video is being broadcast by a TV station. This is important to advertising agencies that want to ensure that their commercials are getting the air time they paid for. Watermarking can be used for this purpose. Information used to identify individual videos could be embedded in the videos themselves using watermarking, making broadcast monitoring easier. Another very important application is owner identification. Being able to identify the owner of a specific digital work of art, such as a video or image can be quite difficult. Nevertheless, it is a very important task, especially in cases related to copyright infringement. So, instead of including copyright notices with every image or song, we could use watermarking to embed the copyright in the image or the song itself. Transaction tracking is another interesting application of watermarking. In this case the watermark embedded in a digital work can be used to record one or more transactions taking place in the history of a copy of this work. For example, watermarking could be used to record the recipient of every legal copy of a movie by embedding a different watermark in each copy. If the movie is then leaked to the Internet, the movie producers could identify which recipient of the movie was the source of the leak. Finally, copy control is a very promising application for watermarking. In this application, watermarking can be used to prevent the illegal copying of songs, images of movies, by embedding a watermark in them that would instruct a watermarking-compatible DVD or CD writer to not write the song or movie because it is an illegal copy.

Every watermarking system has some very important desirable properties. The first and perhaps most important property is effectiveness. This is the probability that the message in a watermarked image will be correctly detected. Another important property is the image fidelity. Watermarking is a process that alters an original image to add a message to it; therefore it inevitably affects the image's quality. We want to keep this degradation of the image's quality to a minimum, so no obvious difference in the image's fidelity can be noticed. The third property is the payload size. Every watermarked work is used to carry a message. The size of this message is often important as many systems require a relatively big payload to be embedded in a cover work. There are of course applications that only need a single bit to be embedded. The false positive rate is also very important to watermarking systems. This is the number of digital works that are identified to have a watermark embedded when in fact they have no watermark embedded. This should be kept very low for watermarking systems. Lastly, robustness is crucial for most watermarking systems. There are many cases in which a watermarked work is altered during its lifetime, either by transmission over a lossy channel or several malicious attacks that try to remove the watermark or make it undetectable. A robust watermark should be able to withstand additive Gaussian noise,

compression, printing and scanning, rotation, scaling, cropping and many other operations. There are several watermarking techniques broadly categorized as spatial domain watermarking and transform domain watermarking. In transform domain basic transforms used are discrete cosine transform (DCT), discrete wavelet transform (DWT), singular value decomposition (SVD) and their cross relations invisible watermark image is shuffled with some chaotic mapping technique before embedding (here Arnolds cat map is used to transform the binary logo). Although the algorithm scarifies the embedding amount of watermark.

Ali Al-Haj, Tuqa Manasrah In 2007 proposed a literature survey on Non-Invertible Copyright Protection of Digital Images Using DWT and SVD and proposed a non-blind imperceptible and robust digital image watermarking algorithm. The algorithm is based on cascading two powerful mathematical transforms; the Discrete Wavelet Transform (DWT) and the Singular Value Decomposition (SVD). Both techniques were combined to exploit their respective attractive features: the spatio-frequency localization of the DWT and compact capturing of semi-global features and the geometric information of images by the significant Components of the SVD. Simulation results demonstrated the effectiveness of the proposed method with regard to the essential watermarking requirements; imperceptibility robustness and non inveritbility

In this paper we have proposed a digital watermarking technique based on DWT, DCT and SVD transform, also the overview of Transforms for watermarking schemes and gives evolution parameters and experimental results has been discussed. The rest of the paper is organized as follows. Necessary background and underlying principle on watermarking is given in Section II whereas Section III describes proposed methodology & Implementation details. Experimental results and its analysis are given in Section V. Finally, Section VI concludes the paper.

2. Literature Review

As we have already discussed the introduction of water marking now here some previous work on the water marking techniques is presented. **Yongjian Hu, Sam Kwong and Jiwu Huang** : In 2004(ICAs) presented a literature survey on watermark protection by using an invisible watermark to protect visible watermarked image to overcome the problem of watermarking removal and unauthorized insertion. To achieve this The Dual watermarking technique is used. The Dual watermarking technique attempts to establish the owner's right to the image and detect the intentional and unintentional tempering of the image. In this the algorithm first used a DCT based visible watermarking algorithm to embed gray level watermarked image and then regarded the resulting image as new image to carry out invisible watermarking which is performed in spatial domain. in this the watermark is chosen in the form of binary image of the embedded watermark so that extracted logos can indicate the owner ship without additional computing and the security of

Ruizhen Liu and Tieniu Tan: In 2002 proposed, An SVD-Based Watermarking Scheme for Protecting Rightful Ownership. As one of the main purposes of a watermark is to protect the owner's copyright. However, for many existing watermarking schemes, an attacker can easily confuse one
By manipulating the watermarked image (or video, audio) and claim that he or she is the legitimate owner. SVD is a numerical technique used to diagonalize matrices in numerical analysis. It is an algorithm developed for a variety of applications. The main properties of SVD from the view point of image processing application are 1)the singular values of an image have very good stability, that is when a small perturbation is added to an image, its SVs do not change significantly; and 2)SVs represent intrinsic algebraic image properties. To demonstrate the robustness of proposed watermarking the resistance of the algorithm to various distortions was studied in a series of experiments on gray scale images and the method is compared with the Spread Spectrum Communication method in order to put the performance investigation of the algorithm in proper context. The results show that the method provides much more robustness under six practical conditions: adding noise, low-pass filtering, JPEG compression, scaling, image cropping, and rotation.

Feng Liu, Yangguang Liu: In 2008(CISP) Proposed A Watermarking Algorithm for Digital Image Based on DCT and SVD. The algorithm can satisfy the transparency and robustness of the watermarking system very well. The SVD transform and the DCT are performed on the watermark and the original image, respectively. Only the SVs of the watermark are embedded into the DCT coefficients of original image. In this study, the cover image size is 512×512 and DCT block size is 8×8. Then the size of approximate image generated with DC values is 64×64 and so the size of watermark. MATLAB and Image Processing Toolbox are used for the experiments and attacks. The experiment based on this algorithm demonstrates that the watermarking is robust to the common signal processing techniques including JEPG compressing, noise, low pass filter, median filter, contrast enhance. Experimental results show that the proposed watermarking scheme is more robust than the SVD methods.

Navas k a, Ajay mathews cheriyan and Lekshmi.m:- In 2008 presented a literature survey in which they proposed a method of non-blind transform domain watermarking based on DWT-DCT-SVD. The DCT coefficients of the DWT coefficients are used to embed the watermarking information. This method utilizes the wavelet coefficients of the cover image to embed the watermark in which any of the four sets of wavelet coefficients can be used to watermark the image. The DCT coefficients of the wavelet coefficients are calculated and singular values are decomposed. The same procedure is applied to the watermark also. The singular values of the cover image and watermark are added to form the modified singular values of the watermarked image. The modified DCT coefficients form the singular value decompositions triangular matrices. Then the inverse DCT transform is applied followed by the inverse DWT. This is the algorithm that clubs the properties of SVD, DCT and DWT. This is a technique that has never been used before. Watermark embedded using this algorithm is highly imperceptible. This scheme is robust against all sorts of attacks. It has very high data hiding capacity.

One advantage of using SVD-based watermarking is that there is no need to embed all the singular values of a visual watermark. Depending on the magnitudes of the largest singular values, it would be sufficient to embed only a small set. This SVD property can be exploited to develop algorithms for lossy image compression. This method of watermarking is found to be robust and the visual watermark is recoverable without only reasonable amount of distortion even in the case of attacks. Thus the method can be used to embed copyright information in the form of a visual watermark or simple text.

Zhenwei Shang, Honge Ren and Jian Zhang:- In 2008 presented a comparative study about a block location scrambling algorithm of digital image based on Arnold transformation. Image scrambling is a commonly used digital image encryption method, it directly performs to set a given digital image into a chaotic image, and image scrambling includes location scrambling and gray scrambling. Location scrambling from the name can infer that it achieves the objective of image encryption by changing the position of pixels and Gray scrambling is carried out through changing the gray of each pixels to achieve encryption.

This paper presents a location scrambling algorithm of digital image by using improved Arnold transformation combined with Logistic chaotic map, and carry out the location scrambling on the block digital image. This algorithm achieves very good scrambling effect; it can be used as a method of encryption and also can be used as to be the pre treatment process of further information hiding.

CAI Yong-mei, GUO Wen-qiang and DING Hai-yang: - In 2013 presented literature survey on An Audio Blind Watermarking Scheme Based on DWT-SVD algorithm. In order to protect the digital audio and video products copyright in the network, an improved audio blind watermarking algorithm scheme based on discrete wavelet transform (DWT) and singular value decomposition (SVD) is proposed. In the algorithm, first, the audio signal is divided into sections. Each section audio is decomposed on discrete wavelet transform for two degree. Then each approximate component is singular value decomposed. Last the watermark image is embedded into the relative singular values chosen. In this method original audio is split as blocks and each block is decomposed on discrete wavelet transform for two degree, then first quarter audio approximate sub-band coefficients are decomposed on SVD transform to obtain a diagonal matrix. The watermarking information is embedded into this diagonal matrix. The transparency of the proposed algorithm is better, and robustness is strong against the popular audio signal attack such as resampling, Low-pass filtering, requantization, gaussian white noise, MP3 compression and other popular audio signal attacks. This method has stronger robustness and transparency and average normalized correlation coefficient NC > 0.950, average BER<0.048.

Satyanarayana Murty P. and Rajesh Kumar P.:- In 2013 presented an approach towards a robust reference image watermarking scheme in Discrete Wavelet Transform (DWT) using Singular Value Decomposition (SVD) and edge detection. Here the cover image has scrambled and then segmented into number of blocks. Based on number of edges in each block a reference image is formed. Then the singular values of DWT applied to reference image and the watermark image is modified. The proposed algorithm provides good robustness against various attacks. In this algorithm the Eigen matrix in the singular value decomposition is explored for data embedding. The perceptibility of the watermarked image is enhanced by embedding the watermark image in some selected and most complex blocks of the host image. A block is said to be a complex block, if the number of edges in the block is more than a predefined threshold. In the frequency based watermarking technique based on DWT, the watermark is added to the low and high frequency values of the DWT coefficients. In some schemes only the LL band is modified while in others the watermark is added to the all bands. A robust and semi-blind watermarking scheme using DWT and SVD is proposed. The host and watermark images are gray scale images of size N × N and m × m respectively Also the proposed method results were compared with other existing algorithms, which have been used DWT-SVD.

Mei Jiansheng, Li Sukang and Tan Xiaomei:- In 2009 presented a journal on A Digital Watermarking Algorithm Based On DCT and DWT. In this journal they introduced an algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). In this DCT-DWT algorithm, the information of digital watermarking which has been discrete Cosine transformed, is put into the high frequency band of the image which has been wavelet transformed. Then distils the digital watermarking with the help of the original image and the watermarking image. The watermarking image will be discrete Cosine transformed at first, because these DCT modulus contain the low frequency information of watermarking image.

Error Tolerant [13]: As we already know that nowadays every application needs fast processing system. We also know that in current era everyone uses mobile phone and laptop for multimedia applications. But these devices work on battery and due to high latency they require large amount of energy and consume a lot of power at the hardware level. Hence with the use of error tolerant approach we can resolve the above mentioned issues. Also detection is very critical for most of the multimedia applications. Basically there are following three main challenges being faced by the currently available Watermarking technique which have been addressed in this work:

1) Time Complexity
2) Quality Complexity
3) Watermarking Level

3. Proposed Methodology & Implementation Details

In this section the proposed algorithm has been presented and also comparative analysis between previous existing approaches has been performed. In previous approaches DWT based watermarking by using DCT, SVD and Arnold transformation has been used. In addition to this our proposed approach also covers most important part which is

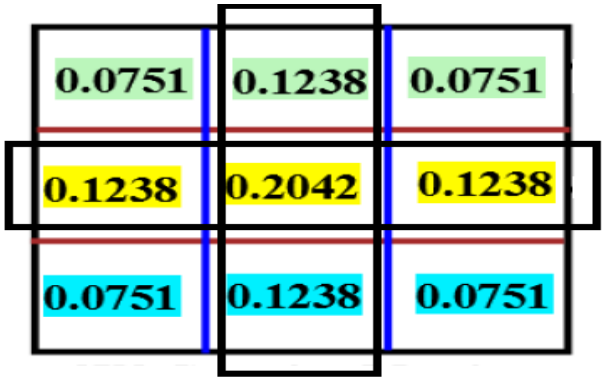
noise. So here we have focused on noise of input image as well.

Fig. 2 below shows a block diagram of our proposed system. Here we can see that a noisy image is applied to the input. On the input image we will apply resize image logic and with the application of this logic our time complexity will reduce. Now after that while considering RGB image we follow the logic of RGB to YCbCr, using this logic we take only Y part and apply DWT, Arnold, inverse Arnold and SVD process respectively.

Similarly we also take one watermarked image and apply similar logic which has been applied for input image. After this we apply combination of our input image with watermarked image, which inturn results into output watermarked image but before that we apply the logic of approximate 2D Gaussian smooth filter, which is as follows:

Error Acceptable 3X3 Gaussian Smooth Filter

Original Gaussian 3X3 kernal have a total of 9 coeffiecient and these coefficient make convolution operation with 3X3 input image matrix and generate a smooth output image. They are not capable of making justice with the output image quality.In this paper we are focucing on quality hence we are using plus mask of 3X3 gauusian where we are using total 5 coeffient. As shown in the figure below.



Here we select total five coefficient and convert those original coefficient's value into fixed points as shown below.

Gaussian Kernal for 3X3 [14]:

First Row: 1/4 =0.25

Second Row: 1/8=0.125, 3/16=0.1875, 1/4= 0.25

Third Row: 1/4 = 0.25

As this is our proposed approach which is different from the existing approaches and also provides ample improvement in image quality and also reduces time complexity.

The input image and watermarked image are shown in figure below:

Figure 1: Input image and Watermark image

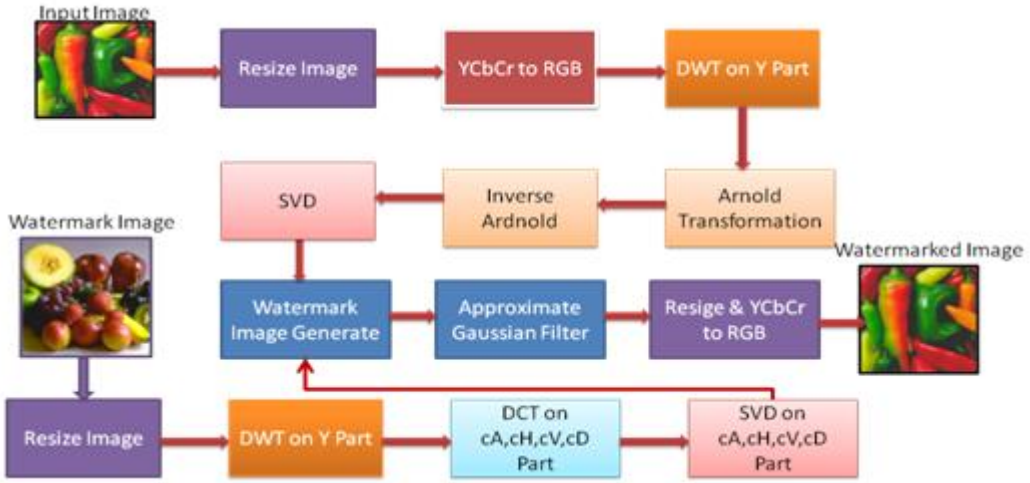


Figure 2: Proposed Block Diagram

Table 1: Comparative HOST Image Analysis with previous approach and proposed approach for different parameters

PARAMETER	DWT	DWT_SVD	DWT_SVD_DCT	LSB	DWT_ARNOLD	PROPOSED
PSNR	15.91	16.84	19.34	20.13	21.03	26.13
SSIM	0.5442	0.568	0.6426	0.6213	0.5937	0.7132
FSIM	0.8595	0.878	0.9201	0.9036	0.8956	0.9285
RFSIM	0.0715	0.3534	0.6158	0.4668	0.4691	0.4778
Correlation	0.9361	0.9578	0.9422	0.9603	0.9601	0.991
Similarity (%)	69.58	91.79	96.71	97.48	97.96	97.34
TIME(Sec.)	0.955	1.18	0.493	0.5242	1.308	0.4015

4. Result and Analysis

In this section we present the comparative study about our proposed approach with all different type of existing approaches. Here we will use some existing scientific parameters for proper justification of our proposed approach. Those parameters are:

1) PSNR [15]
2) SSIM [16]
3) FSIM [17]
4) RFSIM [18]
5) Correlation
6) Similarity (%)
7) Time Complexity

According to table 4.1 we can see the comparative analysis between all those parameters. It is clearly visible that our proposed approach is far better than all previous existing approaches. Our proposed approach justifies the image quality and also reduces the time complexity. Here we have presented graphs for all different parameters to show the comparative analysis between proposed approach and previous existing approaches. According to fig. 4.1 shows the comparative analysis in terms of time complexity as we know that for any application time complexity is very critical, our proposed approach have approximately 200% improvement as compared to Arnold transform based watermarking technique. Similarly our proposed approach also shows an improvement over LSB techniques as well.

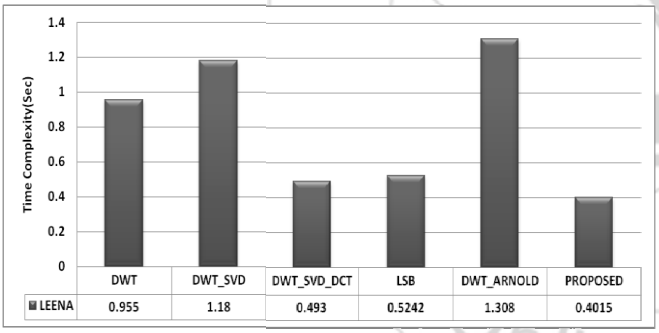


Figure 3: Comparative Analysis of Time Complexity (Sec.)

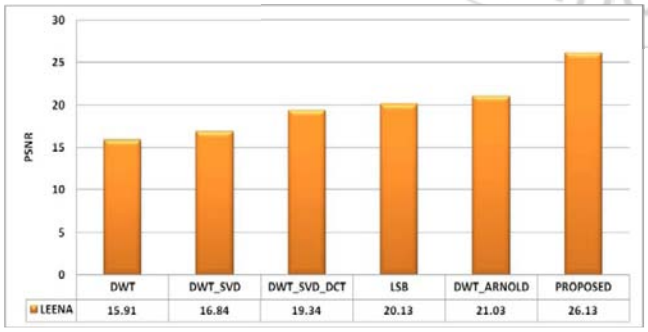


Figure 4: Comparative Analysis of PNSR

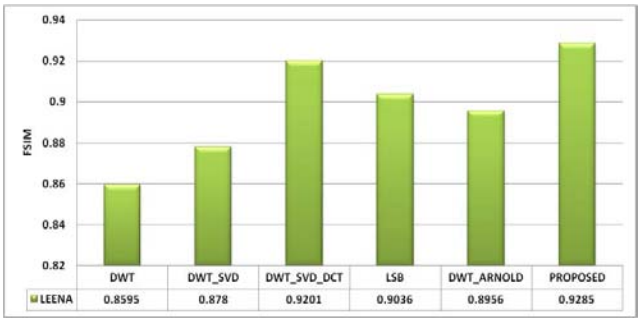


Figure 5: Comparative Analysis of FSIM

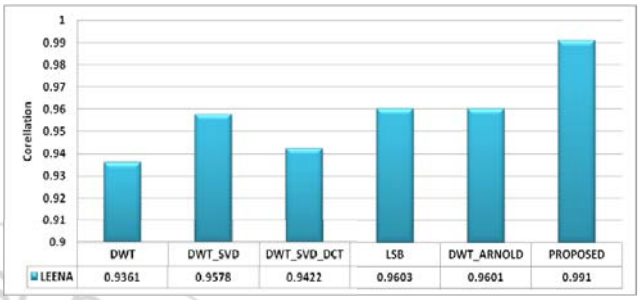


Figure 6: Comparative Analysis of Correlation

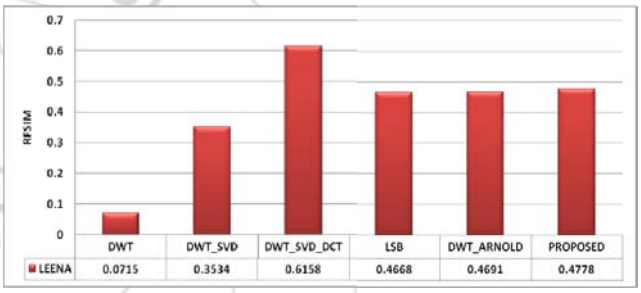


Figure 7: Comparative Analysis of RSIM

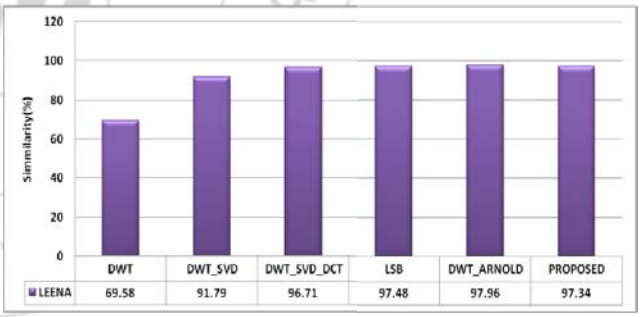


Figure 8: Comparative Analysis of Similarity (%)

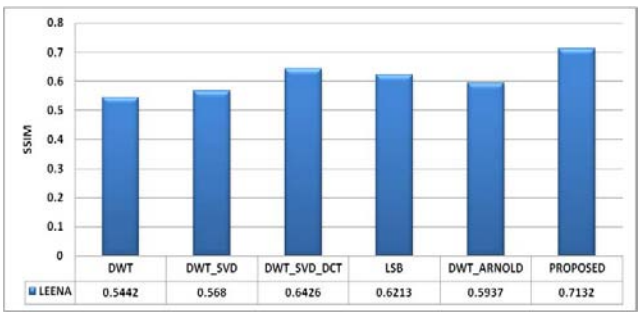


Figure 9: Comparative Analysis of SSIM

5. Conclusion

Watermarking is a very active research field with a lot of applications. Although it is a relatively new field, it has

produced important algorithms for hiding messages into digital signals. Digital watermarking can be utilized for authentication of data, copyright protection and communication process. It is the most common technique for the security of digital information. It has been issued in security tools, security features and other security parameter. As per the current scenario we can envisage that the future will be entirely based on online applications, which states the need of extensive communitarian system, networking, Internet of things etc. and all these systems mainly utilize mathematical functions. In this work we have presented a new algorithm which is based on the concept of approximation. Also we have used the concept of SVD, DCT and DWT with addition of resize, RGB to YCBCR and approximate 2D Gaussian smooth filter. Also the noise issue of RGB image has been addressed. The Experimental result proves that the quality of the watermarked image is better. Furthermore, the extracted watermark can be easily identified. It is evident from the result that the proposed system is far better than previous existing techniques. And proposed algorithm has wide range of scope in terms of implementation at architecture level.

References

[1] Yongjian Hu, Sam Kwong, Jiwu Huang.using invisible watermarks to protect visibly watermarked IMAGES. *Proceedings of the 2004 International Symposium on Circuits and Systems, 2004.* ISCAS '04

[2] Ali Al-Haj, Tuqa Manasrah. Non-Invertible Copyright Protection of Digital Images Using DWT and SVD. *2nd International Conference on Digital Information Management, 2007.* ICDIM '07

[3] LIU Rui-zhen, Tan Tie-niu. SVD Based Digital Watermarking Method. *acta electronica sinica,* Vol.29, No.2, Feb. 2001.

[4] Feng Liu, Yangguang Liu. A Watermarking Algorithm for Digital Image Based on DCT and SVD. *Congress on Image and Signal Processing, 2008.* CISP '08.

[5] Navas K. A., Ajay M. C., Lekshmi. M.,Archana Tampy.S, Sasikumar M.. DWTDCT- SVD Based Watermarking. *3rd International Conference on Communication Systems Software and Middleware and Workshops, 2008. TELECOMMUNICATIONS.* Vol.12, No.5, Sep. 2007.

[6] Zhenwei Shang, Honge Ren, Jian Zhang. A Block Location Scrambling Algorithm of Digital Image Based on Arnold. The 9th International Conference for Young Computer Scientists, 2008. ICYCS 2008.

[7] CAI Yong-mei, GUO Wen-qiang and DING Hai-yang "An Audio Blind Watermarking Scheme Based on DWT-SVD". JOURNAL OF SOFTWARE, VOL. 8, NO. 7, JULY 2013

[8] Satyanarayana Murty P. and Rajesh Kumar P "TOWARDS ROBUST REFERENCE IMAGE WATERMARKING USING DWT- SVD AND EDGE DETECTION" *International Journal of Computer Applications (0975 – 8887) Volume 68– No.9, April 2013*

[9] Mei Jiansheng, Li Sukang and Tan Xiaomei presented a journal on" A DIGITAL WATERMARKING ALGORITHM BASED ON DCT AND DWT" In 2009 ISBN Proceedings of the 2009 International Symposium on Web Information Systems and Applications (WISA'09) *Nanchang*, *P. R. China*, *May 22-24*, *2009*, *pp. 104-107*

[10] Preeti Sharma and Tapan Jain Presented a literature survey on "ROBUST DIGITAL WATERMARKING FOR COLOURED IMAGES USING SVD AND DWT TECHNIQUE".

[11] J. R. Hernandez and F. Perez-Gonzalez, "Statistical analysis of watermarking schemes for copyright protection of images," *Proc. IEEE*, vol. 87, pp. 1142–1166, July 1999.

[12] D. Kundur and D. Hatzinakos, "Digital watermarking using multiresolution wavelet decomposition," in *Proc. IEEE Conf. Acoust., Speech, Signal Processing*, vol. 5, 1998, pp. 2969–2972.

[13] Lee, Kyoungwoo, et al. "Error-exploiting video encoder to extend energy/qos tradeoffs for mobile embedded systems." *Distributed Embedded Systems: Design, Middleware and Resources*. Springer US, 2008. 23-34.

[14] Khorbotly, Sami, and Firas Hassan. "A modified approximation of 2D Gaussian smoothing filters for fixed-point platforms." *System Theory (SSST), 2011 IEEE 43rd Southeastern Symposium on*. IEEE, 2011.

[15] www.ni.com/white-paper/13306/en/

[16] Wang, Zhou, et al. "Image quality assessment: from error visibility to structural similarity." *Image Processing, IEEE Transactions on* 13.4 (2004): 600-612.

[17] Zhang, Lin, et al. "FSIM: a feature similarity index for image quality assessment." *Image Processing, IEEE Transactions on* 20.8 (2011): 2378-2386.

[18] Zhang, Lin, Lei Zhang, and Xuanqin Mou. "RFSIM: A feature based image quality assessment metric using Riesz transforms." *Image Processing (ICIP), 2010 17th IEEE International Conference on*. IEEE, 2010.