A Study of Performance of Above Image Watermarking Approaches with Fuzzy Inference System

Rajeshwar Raju D V[1], Dr. Tryambk Hirwarkar[2]

[1]Research Scholar of Sri Satya Sai University
[2]Research Supervisor of Sri Satya Sai University

Abstract

Digital media has led to extensive threat in terms of piracy of copyrighted material. Protecting integrity, validity and ownership of digital multimedia has become a major issue today. Reliable transmission of data over Internet and verification of originality of this data has become a challenge. The ways and means are required to restrict access to digital media and detect copyright violation. Consequently, digital watermarking has been widely studied as a component of Digital Rights Management (DRM) and protection mechanism in Intellectual Property Rights (IPR). This has encouraged development of digital watermarking and has emerged as effective means to address these problems. Digital watermarking involves embedding a pattern called as watermark in original media to mark ownership. The original media in which watermark is to be inserted is referred to as host media or cover media. The media after embedding watermark should convey same information as original media and is called as watermarked media. This watermark can be extracted from watermarked multimedia whenever required. Digital watermarking is an effective tool for protecting digital multimedia data from copyright infringement. It discourages unauthorized copying of data. The information extracted from watermarked multimedia is used to identify ownership.The digital watermark embedded in host media is a pattern of bits that helps to identify creator's copyright information. It is perceptible or imperceptible identification code embedded in the host image which uniquely identifies its ownership. Invisible digital watermark is used for data hiding in steganography. Media in this research work refers to digital image as the focus is on developing digital image watermarking.

Keywords: *Image Watermarking Approaches, Fuzzy Inference System, Digital media, Digital Rights Management, Intellectual Property Rights*

1. INTRODUCTION

The watermark is inserted in the center recurrence coefficients in DCT area of three DWT levels of the LL band of the first image. In certain papers mix of DWT and SVD are presented as watermarking strategies. Creators of apply SVD to all recurrence groups in DWT of the first image for the watermarking reason. In a quantization based watermarking is proposed. They implant a watermark nibbled by quantizing the points of extensive inclination vectors in various wavelet scales. Creators of have proposed mathematical model for implanting to produce a tradeoff among robustness and straightforwardness. They utilize eight examples of wavelet estimate coefficients from each image block and assembled two-line fragments in a two dimensional space. The proposed strategy for depends on setting demonstrating and fuzzy inference channel which are to decide coefficients with enormous entropy in coarser DWT sub-groups for watermark inserting. The calculation of uses Fuzzy rationale to get a perceptual weighting factor for every wavelet coefficient for inserting at various sizes of an image. A study of DWT base watermarking is clarified in. DWT is broadly utilized in watermarking calculations. The center or high recurrence areas of the coefficients are typically utilized for inserting. Xia et al. present a watermarking technique dependent on DWT. They add pseudo-irregular codes to enormous coefficients at high and center recurrence groups, yet the high recurrence band isn't robust against assaults, for example, JPEG. In a DWT-SVD technique is presented. They install watermark in singular values of the wavelet transform's sub-groups of the first image. Creators of propose wavelet tree grouping for information stowing away. Wavelet trees are delivered by distance vector. These trees are characterized into two groups: one indicates a watermark piece of 1 and different shows 0. Measurable contrast and the distance vector of a wavelet tree are thought about for the extraction of the installed bit. In a blind watermarking strategy is proposed which utilizes quantization of greatest wavelet coefficient. Wavelet

coefficients of the info image are arranged into various squares. The installing is done in various sub-groups. They add different energies to greatest coefficients so that, this consistently stay most extreme in each square. This technique has the disadvantage of having low normalized correlation (NC) against extraordinary JPEG assaults. In and the blend of DCT and DWT spaces is utilized.

Adaptive watermarking

The term adaptive is chiefly used to depict a cycle, conduct as well as a system that can collaborate with its current circumstance and changes its activity as per the climate's factors that are firmly associated with it. With regards to watermarking, transformation is accomplished through various bearings, in order to keep away from watermark inserting in edged zones where changes are more distinguishable or to improve the subtlety of the watermarked image by reproducing models dependent on the Human Visual System (HVS).

As of late, Tsougenis and Papakostas, Papakostas et al. have proposed an adaptive watermarking plan where the most fitting image divide is adaptively chosen, with the end goal that the subtlety and robustness of the watermarked image be improved. Another, course that merits consideration is the adaptive change existing apart from everything else coefficients (adaptive installing strength) subject to certain rules The main endeavor that relates the installing strength (quantization venture) with minutes' requests and redundancies was performed by Xin et al. They proposed an insightful equation that gives the suitable quantization step subject to the pre-owned second's requests and reiterations and an ideal quality as far as PSNR record. Notwithstanding, this methodology doesn't give distinctive quantization step to every second coefficient, yet it relates the choice of the installing strength with the nature of the inferred watermarked image. Following a similar system, Tsougenis et al. alongside the expansion of this methodology to the instance of the Polar Harmonic coefficients demonstrated tentatively the requirement for an adaptive component, with impressive outcomes. Nonetheless, the previously mentioned method that prompts adaptive quantization steps is relevant just for spiral transformations/minutes and, along these lines, it can't be utilized for all second families, for example, the discrete, Tchebichef and Krawtchouk ones.

2. DISCRETE WAVELET TRANSFORM AND FUZZY INFERENCE SYSTEM

Digital multimedia for example, images, writings, music, and recordings are frequently communicated through open channels of the Internet. Without legitimate insurance instrument, digital information can be effectively replicated, adjusted, altered, or produced during mixed media transmission. Securing the uprightness, legitimacy and responsibility for sight and sound has become a significant issue today. Image watermarking is a significant part of image copyright insurance. Different uses of image watermarking incorporate transmission checking, content confirmation, duplicate control, utilization control, fingerprinting and so forth Copyright security of digital images is getting broad consideration as of late as digital images are a lot of powerless to copyright encroachments. Digital image watermarking is a compelling instrument for shielding images from such copyright encroachment. It debilitates unapproved replicating of images. The data extricated from watermarked image is utilized to distinguish legitimate proprietorship. Watermarking an image is a cycle of modifying pixel values of an image in a way so that there is just a slight contrast between unique image and watermarked image.

The distinction might be perceptually obvious or undetectable. The digital watermark is distinguishable or imperceptible recognizable proof code that is implanted into have image; which remarkably recognizes its possession. In copyright security application, digital watermark can be proprietorship identifier, exchange date, chronic number, logo, trademark or copyright data. Imperceptible watermarks change the image in spatial or frequency areas as it were, which no one but machines can identify. One can separate watermark to check proprietorship. Image watermarking can likewise be utilized as an approach to ship data furtively or to secure integrality of cover image itself. Traditionally, the greater part of the watermarking plans installed pseudo-arbitrary succession of autonomously conveyed numbers in the image. Despite the fact that these watermarks can be extricated, it is exceptionally hard for unmistakable character of the equivalent. This prompts impediment on viability and use for copyright insurance of images. Along these lines there is a need to build up a strategy to insert discernible watermark, for example, text or logo in the images that can be handily distinguished upon extraction. In this paper, copyright insurance conspire in wavelet space is created. The epic methodology permits image proprietor to change weight of watermark utilizing FIS and HVS, so impalpability alongside robustness of watermark can be upgraded.

Image Copyright Protection Attributes

Various uses of image watermarking request various credits. Necessities of image watermarking fluctuate contingent upon the image watermarking applications and result in different plan issues. Properties of compelling image watermarking for copyright assurance are as per the following:

- **Robustness**

It is the capacity of watermark to oppose different image preparing and mathematical assaults. Image preparing assaults incorporate JPEG Compression, salt and pepper commotion, Gaussian clamor, sifting and so on Mathematical assaults incorporate turn, scaling, trimming and so forth Mathematical assaults twist the watermark through spatial or transient adjustments of the watermarked image. For copyright assurance application, robustness of watermark is essential necessity. For a large portion of the watermarking strategies, robustness against mathematical assaults is crucial for location of watermark. Mathematical assaults don't cause genuine visual twisting. Yet, they can seriously influence watermark recognition by changing distinguished situation of the installed watermark.

- **Imperceptibility**

It speaks to straightforwardness of watermark with the end goal that it is perceptually undetectable. Alteration of the host image should be unnoticeable after watermarks are inserted. Undetectable watermark is imperceptible copyright data. It is covered up straightforwardly in media content in such a way that can't be taken out by the client. In any case, this data can be separated or perused by the proper party.

- **Blindness**

The capacity to recuperate watermark in the nonattendance or presence of host image demonstrates blindness. Non blind or private image watermarking requires unique image needed to separate the watermark improving security perspective. Then again, blind or public image watermarking doesn't need unique image for discovery lessening stockpiling necessities.

- **Un-ambiguity**

Un-ambiguity alludes to free check from extricated watermark. The separated logo should be sufficiently clear so it can show responsibility for have image precisely.

- **Computational Complexity**

The measure of time watermarking calculation takes to encode and decipher is another thought. More calculations might be expected to guarantee digital watermark security and legitimacy whenever it is gotten.

3. BLIND 3D MODEL WATERMARKING

Digital watermarking has been viewed as a possible proficient answer for copyright security of different multimedia substance. This procedure cautiously conceals some mystery data in the utilitarian piece of the cover content. Contrasted and cryptography, the digital watermarking procedure can ensure digital works (resources) after the transmission stage and the legitimate access. There exist various characterizations of watermarking calculations. We recognize non-blind constantly watermarking plans relying upon whether the first digital work is required at extraction stage resp. Watermark robustness is the capacity to recuperate the watermark regardless of whether the watermarked 3D model has been controlled. Typically, one wants to develop a robust watermark which can experience basic malignant assaults for copyright assurance purposes. Nonetheless, here and there the watermark is deliberately intended to be delicate, even to extremely slight changes, to be utilized in validation applications. Watermarking calculations are isolated into two classes; spatial area based or transform area based, as indicated by the addition space. Spatial space technique implants the watermark by straightforwardly altering the first image information (pixel value), while in the frequency area strategy, a watermark is installed into coefficients by adjusting it subsequent to taking the transform, for example, Discrete Cosine transform (DCT), Fast Fourier transform (FFT) and wavelet transform (WT).

These days, 3D lattices are broadly utilized in augmented experience, clinical imaging, computer games and PC helped plan. A cross section is an assortment of polygonal aspects focusing to comprise a suitable estimate of a genuine 3D article. It has three diverse combinatorial components: vertices, edges, and aspects. From another perspective, a cross section can likewise be totally depicted by two sorts of data: the calculation data portrays the 3D positions (facilitates) of all its vertices, while the network data gives the contiguousness relations between the various components.

The strategy introduced here is a mix of two calculations proposed by Saeed K. Amirgholipour and MukeshMotwani for certain adjustments. Paper spoke to a novel blind watermarking calculation dependent on a joint DWT-DCT for 2D digital image. He abused strength of two normal frequency area strategies; DCT and DWT, to get intangibility and robustness. Inserting watermark in the consolidated transform depended on the way that, the joint transform can take out the downside of one another and afterward, a powerful watermark is installed in the most robust and imperceptible pieces of the image. Watermarking is finished with inserting the watermark in the unique center frequency coefficient sets of 3-levels DWT transformed of a host image, trailed by figuring 4×4 square put together DCT with respect to the chose DWT coefficient sets. Paper has proposed a nonblind watermarking calculation dependent on wavelets and fuzzy rationale, which embeds 8 cycle dark scale image as a watermark into the 3D model. The calculation utilized in this paper implants the watermark by altering the wavelet coefficients of the 3 D model at third level and by utilizing Mamdani's fuzzy inference system, hence improving the robustness and making it more imperceptible as contrasted and other existing calculations. Specific consideration would be paid to guarantee that the implanting calculation safeguards the visual trustworthiness of the models.

Wavelets are utilized in different applications since it has scale and time perspectives. Wavelet investigation can give a windowing strategy changing length zone. A portion of the significant points of interest of wavelet examination are as per the following:

- It permits the utilization of variable size spans (more limited or more) to get high and low frequency data.
- It permits working neighborhood investigation of a sign.
- It can pack or de-commotion a sign without losing its quality.
- It likewise has focal points over different signs like decaying of a sign into different parts and break-in-coherencies for higher subsidiaries.

4. WATERMARKING FOR A 3D MODEL

3d models utilized here comprises of three matrices (x1, x2, x3) of measurement N * (N being the size of matrix) for x, y and z bearing individually. The fundamental strides for inclusion of watermark are clarified in after subsection. Initial 09 stages are applied on X course matrix:

Stage 1: Apply Haar wavelet transform on the 3d model and produce four coefficient sets as estimate coefficients matrix CA and subtleties coefficients matrices as CH, CV and CD.

Stage 2: Apply Haar wavelet transform again on CH and CV of detail coefficient matrices to create level 2 estimate and detail coefficient matrices. Complete 8 matrices are produced in this progression.

Stage 3: Apply Haar wavelet transform again on CH and CV coefficients of level 2 matrices to create level 3 approximations and detail coefficients. Complete 16 matrices are created in this progression.

Stage 4: Convert the watermark image into double arrangement.

Stage 5: Scramble the watermark with Arnold transform for key occasions.

Stage 6: Compute Inputs (like Curvature, Area and Bumpiness) of 3d model

Stage 7: Apply contributions to Fuzzy Inference system (FIS) and choose weight contingent on standards gave in the FIS to each info values. The fuzzy output has 7 enrollment capacities (like Lowest, Lower, Low, Medium, High,

Higher, Highest), just High and HIGHER fuzzy output sets are utilized for inclusion of watermark in the 3D model. This is to make the watermark imperceptible and more robust.

An aggregate of 15 fuzzy standards are created, one of the principles is as per the following:

Rule: IF Curvature == MEDIUM and

Bumpiness == MEDIUM and Area == LOW

THEN Weighting factor = LOW.

Step 8: Stage 8: Modify coefficients to implant the watermark into the model where the comparing weighting factor has the values either high or higher. The watermark is embedded by changing the rest of wavelet coefficient vector more prominent than I if watermark bit is 1 or not as much as j if watermark bit is 0 so that it ought not upset the visibility(or nature) of the model, where I and j are a few constants and i>j.

Stage 9: Apply converse DWT on the altered coefficients set up to level 3.

Stage 10: Repeat stages 1, 2, 3, 8 and 9 for Y course matrices to create watermarked 3d model. We can likewise embed watermark information in z bearing matrix to expand the watermark inclusion limit.

5. ROBUST 3D WATERMARKING

The primary point of robust watermarking is to show possession and to permit the watermarks recognizable even after various watermark assaults. Robust 3D watermarking is again arranged into blind and non-blind methods. Examined beneath is a portion of the current robust 3D watermarking methods. A large portion of the watermarking procedures are of blind strategies. A tale non-blind 3D watermarking strategy is proposed dependent on Geometry Image and robust against relative transformations, commotion expansion, smoothing, resampling, editing. This technique utilizes DCT transform in a shading image for inserting. Cai et.al proposed a blind robust watermarking plan in which three novel blind spatial watermarking techniques viz. OTP-W, OTC-W and Zero-W) for subjective 3D cross sections dependent on Octree are proposed. OTP-W and OTC-W have a huge installing space to implant a twofold image and a RGB image, a strategy which is robust against interpretation, pivot, uniform scaling and vertex reordering assaults with blind recognition. Utilizing Octree in Zero-W, Zero watermarks is built to oppose assaults of rearrangements, clamor and remeshing.

Chen et.al proposed a blind and robust watermarking plan for 3D Triangular Mesh Models utilizing the idea of 3D Edge Vertex Detection where the watermark is covered up inside the 3D graphical item changing a subset of deliberately chose edge vertices to oppose against different assaults, for example, commotion, 3D pivot, editing and other consolidated assaults. A blind watermarking calculation of 3D models and items is proposed in which a series of pieces is created dependent on a key and is inserted in the mathematical structure of the graphical article adjusting the areas of certain vertices. An insignificant perceivability of the bends in the watermarked object is guaranteed by a spot encoding of 1 position a vertex inside a volume demonstrated by the calculation of its area while a touch encoding 0 positions the vertex outside such a volume. A blind 3D watermarking technique dependent on a wavelet transform, a fuzzy inference system and multiresolution portrayal (MRR) of the 3D model is created in which the watermark to be covered up is mixed by Arnold transform and inserted in the wavelet coefficient at the third goal level of the MRR and the intangibility of the watermark is cultivated by the fuzzy rationale. A blind robust 3D cross section model watermarking applications is proposed in which a pseudo-arbitrary watermark is inserted in the 3D lattice model disfiguring mathematically its vertices, without charming the vertex geography. Preceding implanting and recognition a bunch of straightforward transforms is applied to the 3D cross section model and the watermark arrangement is inserted in a bunch of vertices for network rearrangements.

6. CONCLUSION

Human visual system boundaries are set up to guarantee impalpability of watermarked image using impediments of human vision successfully for image watermarking. The strength of watermark embedded is fluctuated in various locales of the host image according to HVS boundaries. The robustness and impalpability boundaries are determined in this stage for target analysis. Digital image watermarking dependent on DWT, HVS and FIS is planned and

created. The strength of watermark embedded is diverse in unmistakable areas of host image contingent on weight controlled by FIS. Impalpability and robustness analysis is completed on comparative foundation as in prior stages. Different attacks are planned and numerical model is worked for each attack. Watermarked image is exposed to weakening for various levels of solidarity to debase watermarked image up to most extreme conceivable degree. The process included enhanced and broad assortment of attacks going from different signal processing attacks, geometric attacks and blend of the two as novel kind of attacks named as consolidated attack. The watermarked image is exposed to these attacks bringing about corruption of image quality followed by intangibility analysis and robustness evaluation.The technique is robust when contrasted with DWT based watermarking and DWT and HVS based image watermarking. The technique is tried with all the images and for all the watermarks used to assess attacks. The proposed strategy is robust to a wide scope of expanded attacks giving excellent outcomes. The watermarked image is presented to a systematic corruption through an enormous number of forceful image processing tasks, for example, expansion of noise to pressure, filtering to trimming and so forth Visual just as mathematical outcomes have been introduced. Separated watermarks in all cases are unmistakable to various degrees and the relating CRC value is sufficiently high to show the presence of watermark in attacked watermarked images.

7. REFERENCES

1. Y. J. Zhang, T. Chen, and J. Li, "Embedding watermarks into both DC and AC components of DCT," SPIE Security and Watermarking of Multimedia Contents III, Jan. 2001, pp. 424-435.
2. Mohanty, S. P., Ramakrishnan, K. R., AndKankanhalli, M. S., "A DCT Domain Visible Watermarking Technique for Images," IEEE International Conference on Multimedia and Expo. 2000, pp. 1029–1032.
3. Yang Qianli and CaiYanhong, "A digital image watermarking algorithm based on discrete wavelet transform and Discrete Cosine Transform," IEEE International Symposium on Information Technology in Medical and Education, 2012.
4. DongyangTeng, Renghui, Xiaokun Zhao, "DCT image watermarking technique based on the mix of time-domain," IEEE International Conference on Information Theory and Information Security, 2010.
5. Anil N. Bhure and Vaishali S. Jabade, "A Modified Approach of Image Steganography based on Block DCT and Huffman Encoding without Embedding Dictionary into StegoImage", IJCA, Volume 94 - Number 8, May-2014, pp. 24-27.
6. Barni M, Bartolini F, Piva, "An Improved Wavelet-based Watermarking through Pixelwise Masking", IEEE transactions on image processing, Vol. 10, 2001 pp.783-791.
7. Victor V., Guzman, Meana, "Analysis of a Wavelet-based Watermarking Algorithm", IEEE Proceedings of the International Conference on Electronics, Communications and Computer, 2004, pp. 283-287.
8. Zhao Dawei, Chen Guanrong, Liu Wenbo, "A Chaos-based Robust Wavelet-domain Watermarking Algorithm", IEEE International Conference on Multimedia and Expo (ICME), 2004.
9. N. Kaewkamnerd and K. R. Rao, "Wavelet based Image Adaptive Watermarking Scheme", IEEE Electronic Letters, Vol. 36, February 2000, pp. 312-313.
10. D. Kundur and D. Hatzinakos, "Digital Watermarking using Multiresolution Wavelet Decomposition", Proceedings, IEEE International Conference Acoustic, Speech, Signal Processing, Vol. 5,1998, pp. 2969-2972.
11. D. Kundur and D. Hatzinakos, "A Robust Digital Image Watermarking method using Wavelet based Fusion", Proceedings, Fourth IEEE International Conference Image Processing, 1997, pp. 544-547.
12. Bo Chen, Hong Shen, "A New Robust-Fragile Double Image Watermarking Algorithm", Third International Conference on Multimedia and Ubiquitous Engineering, 2009, pp. 153- 157.
13. Ming-Xiang Zang, Na Zang, Jian-guo Jiang, "An Adaptive Digital Watermarking Algorithm based on Balanced Multi-wavelet", Fifth International Conference on Information Assurance and Security, 2009, pp. 243-246.
14. Hey Jiang and Liu Jianjun, "A Digital Watermarking Algorithm for DEM Image based on Stationary Wavelet Transform", Fifth IEEE International Conference on Information Assurance and Security, 2009, pp. 221-224.
15. Peng Liu, Zhizhong Ding, "A Blind Image Watermarking Scheme Based on Wavelet Tree Quantization", Second IEEE International Symposium on Electronic Commerce and Security, 2009, pp. 218-222.