

QIS College of Engineering and Technology

(Autonomous)

*Directorate of Project Skilling and Research*

**Literature Survey Summary**

***Papers should be published after 2020, and only those indexed in SCI or Scopus are acceptable. At least three papers should be Journal papers.***

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| --- | --- |
| **Project Title** | **DIGITAL IMAGE WATERMARKING** |
| **Batch Number** | **1** |
| **Domain** | **IMAGE PROCESSING** |
| **Roll No & Name of the student** | **22491A04G6 & M.MURALI KARTHIK** |
| **Mentor Name** | **MANI DEEPIKA** |
| **Mentor Signature** |  |

**Paper 1: "Highly reliable digital watermarking using successive subband quantization and human visual system"**

**Authors:** [Seong-Geun Kwon, Seong-Won Ban, In-Sung Ha, Ki-Ryong Kwon, Kuhn-Il-Lee]  
**Journal/Conference:** [2001, ISIE 2001. 2001 IEEE International Symposium on Industrial Electronics Proceedings (Cat. No.01TH8570)] (SCI/Scopus)  
**Year:** [2001]

**Summary:**

Digital watermarking is a technique used to embed information into digital media such as images, audio, or video to protect intellectual property and ensure content authenticity. The approach discussed, "Highly Reliable Digital Watermarking Using Successive Subband Quantization and Human Visual System," leverages advanced methods to enhance watermarking robustness and imperceptibility.

A wavelet-based digital watermarking algorithm is proposed that uses successive subband quantization (SSQ) and the human visual system (HVS). First, the original image is decomposed into four levels using a discrete wavelet transform (DWT), then a watermark is embedded into the perceptually significant coefficients (PSCs) of the image. The coefficients on the lowest level are excluded in the watermark embedding step as these coefficients can be easily eliminated and modified by lossy compression. The PSCs in the baseband and other high frequency subbands are selected according to the amplitude of the coefficients and by SSQ, respectively The embedding of the watermark follows two different paths based on whether the selected PSCs are located in the baseband or high frequency subbands. As such, a constantly weighted watermark, which has a largest value without the introduction of a visual artifact, is embedded into the PSCs in the baseband. Whereas, for the PSCs in the high frequency subbands, the watermark is embedded based on the HVS so as to provide invisibility and robustness. In computer experiments, the proposed watermark algorithm is found to be superior in invisibility and robustness to the conventional algorithm of Dugad et al. (1998).

**Paper 2: "** **Digital Image Watermarking for Arbitrarily Shaped Objects Based On SA-DWT”**

**Authors:** [A. Essaouabi, E. Ibnelhaj, F. Regragui, Av Allal, Al Fassi-Madinat, Irfane Al, Rabat, Morocco]  
**Journal/Conference:** [2009, arXiv.org]   
**Year:** [2009]

**Summary:**  
SA-DWT (Shape-Adaptive Discrete Wavelet Transform): This transformation technique is an extension of the traditional Discrete Wavelet Transform (DWT) but is tailored to handle objects with arbitrary shapes. Unlike standard DWT, which operates on rectangular regions, SA-DWT adapts to the shape of the object within the image. This allows for more effective watermark embedding and extraction, particularly in images where objects do not conform to a rectangular grid.

**Watermark Embedding**: The watermark is embedded into the image by modifying the wavelet coefficients derived from the SA-DWT. The shape-adaptive nature ensures that the watermark is applied in a manner that respects the contours and structure of the object. This helps maintain the visual quality of the image while embedding the watermark.

**Watermark Extraction**: During extraction, the watermark is retrieved from the transformed image using the same SA-DWT approach. The shape-adaptive method allows for accurate extraction even when the object’s shape or position varies, which can be a challenge with conventional methods.

Many image watermarking schemes have been proposed in recent years, but they usually involve embedding a watermark to the entire image without considering only a particular object in the image, which the image owner may be interested in. This paper proposes a watermarking scheme that can embed a watermark to an arbitrarily shaped object in an image. Before embedding, the image owner specifies an object of arbitrary shape that is of a concern to him. Then the object is transformed into the wavelet domain using in place lifting shape adaptive DWT(SADWT) and a watermark is embedded by modifying the wavelet coefficients. In order to make the watermark robust and transparent, the watermark is embedded in the average of wavelet blocks using the visual model based on the human visual system. Wavelet coefficients n least significant bits (LSBs) are adjusted in concert with the average. Simulation results shows that the proposed watermarking scheme is perceptually invisible and robust against many attacks such as lossy compression (e.g. JPEG, JPEG2000), scaling, adding noise, filtering, etc.

**Paper 3: "** **Content Adaptive Watermarking Based on Regions Segmentation"**

**Authors:** [B.J. Saoussen, E. Zagrouba, S. Guezguez]  
**Journal/Conference:** [2006 2nd International Conference on Information & Communication Technologies]   
**Year:** [2006]

**Summary:**  
This paper describes a new method of watermarking based on visual contents and using four spaces insertion of insertion to take advantage of properties of each of them. This is realized initially by segmenting image in unrefined regions and then adapting every space of insertion to these regions in order to maximize the invisibility of the marked image. Experimental results show that the watermark is robust to several distortions including geometric alterations, JPEG coding at different qualities, STIRMARK attack, filtering and cropping.

Content adaptive watermarking based on regions segmentation is a technique used in digital watermarking where the watermark is applied in a way that adapts to different regions of the content based on their importance or characteristics.

Region Segmentation: The content (such as an image or video) is divided into different regions based on certain criteria. This could be based on features like texture, color, or importance of different areas in the content. For example, in an image, regions with more detail might be segmented separately from regions with less detail.

Content Adaptation: The watermarking process is adapted according to the characteristics of each segmented region. For example, in regions where there is high detail or important content, the watermark might be applied more robustly to ensure it remains detectable even if the content is modified. Conversely, in less important or less detailed regions, the watermark might be applied more subtly to reduce visual impact.

Watermark Embedding: The watermark, which could be text, a logo, or some form of digital signature, is embedded into the content. The embedding process takes into account the specific characteristics of each region to balance between robustness and imperceptibility. The goal is to ensure that the watermark remains detectable under various conditions while minimally impacting the quality of the content.

Extraction and Detection: When the watermarked content is accessed or processed, the watermark can be extracted and detected based on the same region-based adaptation approach. This ensures that the watermarking remains effective even if the content has been modified or if the watermark is subjected to various attacks.

**Paper 4: "** **Wavelet-based Digital watermarking Using Multiple threshold"**

**Authors:** [Jae-Won Kim, J. Nam]  
**Journal/Conference:** [2003, The Kips Transactions:partb]   
**Year:** [2003]

**Summary:**  
Recently, digital watermarking has been proposed as a viable solution to the need of copyright protection and authentication of multimedia data. A robuwavelet-based watermark casting scheme and a watermark retrieval technique are suggested in this paper. We present a method which can add the watermark to the significant coefficients in the DWT domain, and does not require the original image in the detection process. In adaptive watermark casting method is developed to select perceptually significant coefficients for each subband using multiple threshold. In the proposed method, an adaptive multiple threshold scheme is used to reflect characteristics of each subband and complexity of image. The watermark is adaptively weighted in different subbands to achieve robustness as well as high perceptual quality. The watermark, Gaussian random sequence is added to the large coefficients but not in the lowest subband in the DWT domain. Experimental results show that the proposed algorithm produced visually very good watermarked image which has good invisibility to human eyes and very robust against various image processing and compression attacks.

**Paper 5: "** **Digital image watermarking for joint ownership"**

**Authors:** [Huiping Guo, N. Georganas]  
**Journal/Conference:** [2002, MULTIMEDIA '02]  
**Year:** [2002]

**Summary:**  
Though many image watermarking schemes have been proposed, none of them can resolve the problem of joint ownership. This paper proposes two novel algorithms that make use of a secret sharing scheme in cryptography to address this problem. The first one applies Shamir's (2, 2) threshold scheme to the watermarking algorithm. A watermark, which is a gaussian distributed random vector determined by two keys, is embedded to selected coefficients in all middle bands in the wavelet domain of an image, so that only when the two keys are put together can the ownership be verified. The second algorithm is a modification of the first one. Three random watermarks are embedded to middle bands in the wavelet domain of an image. For the watermark detection, two thresholds are set, so the watermark detector can verify partial ownership as well as full ownership. Experimental results show that both algorithms have the desired properties such as invisibility, reliable detection and robustness against a wide range of imaging processing operations.

Digital image watermarking for joint ownership involves embedding watermarks into images to signify and protect the shared ownership of digital content. This technique is particularly useful for scenarios where multiple parties contribute to the creation of an image or where collaborative works need to establish and manage ownership rights.

**Joint Ownership Watermarking**

* **Purpose**: Joint ownership watermarking is designed to acknowledge and protect the contributions of multiple parties to a digital image. Each party's rights and contributions are represented through a unique watermark or by combining multiple watermarks.
* **Embedding Strategy**: The watermarking strategy for joint ownership must ensure that each contributor’s rights are clearly represented and that the watermark is robust enough to withstand common image processing operations while remaining imperceptible.
* **Robustness**: The watermark needs to be resilient to various types of attacks and modifications (such as resizing, cropping, or compression) to ensure that ownership claims remain intact.

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