

# Chapter 9

## Secure and Robust Digital Image Watermarking Technique to Secure Medical Images: A Comprehensive Approach

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### ABSTRACT

*This paper presents a novel watermarking method that utilizes the combined power of the Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT), and Set Partitioning in Hierarchical Trees (SPIHT) algorithm. Our method embeds two distinct watermarks, into different sub-bands of host image. Initially, the cover image and Watermark1 undergo optimization using hybrid optimization techniques (Particle Swarm Optimization and the Butterfly Optimization). Subsequently, Watermark1 is encrypted using the Arnold transform, while Watermark 2 is encoded using a Hamming encoder. Both encrypted watermarks are then embedded into their respective sub-bands. To compress the watermarked image, while retaining the embedded watermarks, we apply the SPIHT compression algorithm. The performance of our proposed method is evaluated against various attacks. Results demonstrate the robustness of the proposed method across these attacks. Notably, the proposed method achieves a maximum PSNR value of 48.50 dB and a maximum NC value of 0.9999, underscoring similarity between the original and watermarked images.*

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## 1. INTRODUCTION

Digital watermarking techniques have become increasingly essential in safeguarding multimedia content, especially concerning intellectual property rights and copyright protection. In today's digital landscape, where content replication and unauthorized distribution are rampant, the need for effective protection mechanisms has grown exponentially. Digital watermarking provides a solution by embedding hidden identifiers within digital media, thus establishing ownership and deterring unauthorized usage. Recent years have seen a surge in the development of robust and secure watermarking methods capable of withstanding various attacks while preserving the integrity of the host image(Kumar,218).In this study, we proposed a resilient watermarking method that integrates the Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT), and Set Partitioning in Hierarchical Trees (SPIHT) techniques. Our approach involves decomposing the host image into distinct sub-bands, where two secure watermarks are embedded. Initially, both the cover image and Watermark 1 undergo optimization using a Hybrid optimization technique, which combines the whale optimization and cuckoo search algorithms. Subsequently, Watermark 1 and Watermark 2 are encrypted using the Arnold Transform and Hamming Encoder, respectively, before being embedded into the cover image. Finally, SPIHT compression is applied to minimize distortion while maintaining the watermark's integrity(Singh,2023)

The proposed watermarking technique's performance is rigorously evaluated against a spectrum of watermarking attacks, including JPEG compression, Gaussian noise, and salt and pepper noise. Our findings demonstrate the method's robustness in preserving the embedded watermarks under various adversarial scenarios while ensuring minimal distortion to the cover image.

Key contributions of our research include:

1. **Robust Watermarking Method:** Our method exhibits high resilience against diverse watermarking attacks, owing to the synergistic combination of DWT, DCT, SPIHT techniques, and the hybrid optimization approach.
2. **Minimal Distortion:** Despite the watermark embedding process, our method maintains the visual quality and integrity of the cover image, ensuring a seamless viewing experience.
3. **Enhanced Security Measures:** Additional security measures, such as watermark encryption and encoding, fortify the embedded watermarks against unauthorized access and tampering, bolstering authenticity verification.
4. **Novel Hybrid Optimization Technique:** The introduction of a hybrid optimization technique streamlines the optimization process, leading to improved robustness and efficiency.

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