An Improved Fully Convolutional Neural Network (FCNN)- Based Digital Image Watermarking by Using DWT, DCT, and Particle Swarm Optimization Algorithms

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Abstract

Digital Content Protection is one of the most significant research area that lies at the intersection of cyber-security and multimedia processing. Digital Image Watermarking is utilized to preserve the copyright of different digital images from forgery. Protect multimedia content from copyright violation, unauthorized use, replication, and online content theft is needed. Various techniques had been developed in this regard with two main issues, the method robustness and the resistance against various types of attacks like, Salt and Pepper noise, filtering and blurring.

. Current Digital watermarking techniques may reduce the quality of the original digital media content if it is not robust. The purpose of this research is to create a robust image watermarking technique against different attack types such as salt and pepper noise and Gaussian noise, ensuring the image content is protected.

Specifically, this study proposed a new mechanism for Image watermarking based on combining Discrete Wavelet Transform (DWT), and Discrete Cosine Transform (DCT). Additionally Particle Swarm Optimization (PSO) was applied to perform the optimization for both the embedding and extraction processes. At the final stage we assess the proposed approach against some types of attacks such as Additive White Gaussian Noise (AWGN). The Denoising Network, DnCNN based on Convolutional Neural Networks was used to evaluate the mechanism against AWGN. DnCNN consists

of 59 layers including input and output layers (with a mix of convolutional layers, Batch Normalization layers, and RELU layers) and the last layer is a regression layer. Peak Signal-to-Noise Ratio (PSNR) and Normalized Correlation Coefficient (NC) measures were used for testing.

The Experimental findings of applying the proposed mechanism for embedding and extraction of watermarks into different host images sizes were promising with 0.998 PSNR ratio and 1 NC without attack. Also, this assessment shows that such type of denoising attack not only destroyed the watermark (not completely). But also, enhances the image quality (illumination and resolution…etc.). Furthermore, it's significant to mention that we outperformed the literature results and the PSNR and NC values proved that. Future recommendation including taking into consideration more types of attacks to test the robustness and fidelity of the proposed approach more deeply. Moreover, we plan to perform some pre analysis for the images before the DCT hiding process to enhance the efficiency of the watermarking embedding and reconstruction.

Keywords: Particle Swarm Optimization, Discrete Wavelet Transform, Discrete Cosine Transform, Denosing Network, DnCNN, Additive White Gaussian Noise, Peak Signal-to-Noise Ratio, Normalized Correlation Coefficient.