

ABSTRACT

Copyright infringement in digital music distribution is a serious problem that threatens the creative industry. One solution to protect audio works is to insert a watermark as the owner's identity. This study proposes an audio watermarking method using Echo Hiding combined with noise reduction to improve signal quality before insertion. The three noise reduction methods used are Gaussian Filter, Spectral Subtraction, and Wavelet Transform. This study uses Pop-punk genre songs with a duration of 2 to 5 minutes in WAV and MP3 formats, and inserts a secret message of 128 to 1024 bits. The system stages include the noise reduction process, converting text to binary, insertion using echo delay, and evaluating signal quality using SNR (Signal to Noise Ratio) and PSNR (Peak Signal to Noise Ratio). In addition, the success of message extraction is also tested to assess the accuracy of the system. The test results show that the WAV format provides the best performance with an SNR reaching 12.48 dB and a PSNR of up to 22.28 dB, while the MP3 format experiences a decrease in performance with a maximum SNR of 11.10 dB and a PSNR of around 20.77 dB. The Spectral Subtraction method shows the most consistent results in maintaining audio quality and message accuracy, even being able to extract messages up to 512 bits intact in most scenarios. In contrast, the Gaussian Filter and Wavelet Transform begin to experience interference in messages of 512 and 1024 bits. From all tests, the optimal configuration for the watermarking system is on WAV audio with a duration of 2 - 3 minutes, a message length of 128 - 256 bits, and the use of Spectral Subtraction. This study shows that the combination of Echo Hiding and noise reduction can form a robust watermarking system while maintaining audio quality.

Keywords: Audio Watermarking, Echo hiding, Noise reduction, SNR, PSNR, Pop-Punk