Watermarking Using Intelligent Methods: Survey

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INTRODUCTION

Digital watermarking is a technique to embed copy right signature within the digital content (Cox, Miller, & Bloom, 2002). Digital Rights Management (DRM) is a term generally refers to protect the copyrights of digital media files (Hannibal Travis, 2008). The digital watermark applications can be classified based on their perception, robustness, type of insertion, inserted media, processing domain and the authentication requirement (Cox et al., 2002). A robust watermarking method inserts the authentication information such that the watermark is never destroyed from the watermarked content. The intelligent techniques like genetic algorithms (GA) and soft computing are having number of applications in digital watermarking.

BACKGROUND

Genetic algorithms (Holland, 1975; Guo, Yang, & Li, 2003) were developed by Holland over the course of 1960s and 1970s, and finally popularized by Goldberg. These are popular for optimizing non-linear functions with multiple variables. In genetic algorithms, the parameters are represented by an encoded binary string called 'chromosome'. The elements in the binary strings called 'genes' are adjusted to minimize or maximize the fitness value. The fitness function generates its fitness value, which is composed of multiple variables to be optimized by GA. It iteratively searches for an optimal solution based on fitness value using crossover, mutation and selection operators until pre-specified condition is satisfied or maximum number of iteration takes place. Due to its ability to find an optimal solution, genetic algorithms found many applications in digital image watermarking. Soft computing (Zadeh, 1994) is the state-of-art approach to artificial intelligence. Soft computing is the fusion of the fields of fuzzy logic, neural networks, evolutionary computing, and probabilistic computing and chaos theory into one multidisciplinary system. The main goal of soft computing is to develop intelligent machines and to solve nonlinear and mathematically un-modeled system problems. The term 'soft computing' coined by Zadeh (1994) in the early 1990s. Some of the soft computing architectures employed are neuro-fuzzy, fuzzy-neural, neuro-genetic, genetic-fuzzy, neuro-fuzzy-genetic, rough-neuro etc.

The invention of Internet in 1990s and its increased availability along with digital image processing devices made digital image sharing and accessing more simple and convenient. In this paper the review is conducted on applications of genetic algorithms for digital watermarking of

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digital images considering both the gray-scale and color images. The genetic algorithms section subsumes genetic programming(GP) in conducting the review. The review incorporates the papers published in journals/international conferences/ edited volumes in the areas of digital image watermarking and information hiding. The genetic algorithms section subsumes genetic programming in conducting the review. The rest of the paper is organized as follows: Section 2 presents reviews of papers dealing with the application of genetic algorithms. Section 3 discusses insights and section 4 concludes the review with future directions.

MAIN FOCUS

This section describes the literature review of digital watermarking of images by using genetic algorithm techniques.

Genetic Alogorithms (GA)

Liu, Zhang, Sun, and Lagunas (2003) were the first to employ a GA for digital image watermarking. They proposed a fragile watermarking scheme using a simple genetic algorithm. Experimental results showed that the proposed scheme detects any modification made to the image. Shieh, Huang, Wang and Pan (2004) used genetic algorithms to select the best coefficients in transformation domain (DCT coefficients) for watermark embedding to improve robustness and imperceptibility. The proposed algorithm balances the two conflicting requirements, the watermarked image quality measured by PSNR (Peak Signal to Noise Ratio) and robustness of extracted watermarks measured by NC (Normalized correlation). Experimental results showed that the proposed method is superior to the Hsu and Wu (1999) method in terms of better image quality and robustness against different attacks. Kumsawat, Attkitmongcol, Srikaew, and Sujitjorn (2004) presented a technique for optimizing the image watermarking using the genetic algorithm applied to the wavelet transform domain. Experimental results showed that the proposed scheme achieves good imperceptibility and robustness against different attacks when compared to Dugad, Ratakonda, and Ahuja (1998) method. Kumsawat, Attkitmongcol, and Srikaew (2004) proposed a digital image watermarking algorithm using discrete multiwavelet transform. The proposed scheme modifies the watermark embedding and detection procedures proposed by Dugad et al. (1998) by using genetic algorithms. Experimental results showed that the proposed scheme is superior to Dugad et al. (1998) method in terms of imperceptibility and robustness against different attacks.

Wang, Pan, Jain, and Huang (2004) used genetic algorithms to vector quantization index assignment for watermarking. The proposed assignment is called genetic index assignment (GIA). GIA is employed to find better imperceptibility. Experimental results showed that the proposed method is superior to Lu and Sun (2000) scheme; Jo and Kim (2002) scheme; Huang, Wang, and Pan (2002) method in terms of watermark length and robustness against different attacks with good imperceptibility. Khan, Mirza, and Majid (2004) used genetic algorithms to find a optimal perceptual shaping function for DCT based watermarking system. Experimental results showed that the proposed scheme achieves good imperceptibility and robustness against different attacks. Myodo and Tanaka (2004) proposed a watermark-sharing scheme to binary halftone images using genetic algorithms. Experimental results showed that a watermark is shared by generated halftone images keeping high image quality, but clearly decode the embedded watermark by overlapping these images optically. Shih and Wu (2005) proposed a scheme to embed a signature image/ textual data and a fragile watermark into the non-ROI (Region of Interest) part of a medical image using genetic algorithms. Shih and Wu (2005) used genetic algorithms to correct the rounding errors caused when converting images from frequency domain to spatial domain after watermark embedding.