Blind Watermarking Algorithm Using Complex Block Selection Method

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Abstract. Digital watermarking is the technique, which embeds an invisible signal including owner identification and copy control information into multimedia data such as audio, video, images for copyright protection. A new watermark embedding algorithm is introduced in this paper. In this algorithm, complex 8×8 DCT blocks are selected by calculating the AC coefficients of the DCT blocks, and watermark information is embedded into the selected complex blocks using quantization and modulus calculation. This algorithm uses a blind watermark retrieval technique, which detects the embedded watermark without using the original image. The experimental results show that the proposed watermark technique is robust to JPEG compression with 90% of compression ratio and has an excellent PSNR. With the fast watermark extraction property, this algorithm is suitable for real-time watermark extraction applications such as compressed video watermark.

1 Introduction

With the rapid spread of computer networks and the further progress of multimedia technologies, security and legal issues of copyright protection have become important. Digital watermark is one promising technique for effectively protecting the copyright of digital contents[1]-[6]. The important properties of the embedded watermark are the quality of the contents having embedded watermark data, the robustness of the watermark against modification of the contents, resistance to intentional removal of or tampering with the watermark, and the reliability of extracted watermark data.

The watermarking techniques can be classified into two classes depending on the domain of watermark embedding, i.e. the spatial domain and frequency domain. Among the spatial domain watermark embedding methods, Schyndel *et al*. proposed a watermark embedding technique by changing the least significant bit of some pixels in an image [2]. Bender et al. described a watermarking approach by modifying a statistical property of an image called 'patchwork' [3]. The spatial domain watermarking techniques, however, are not robust to attacks such as compression, clipping, cropping, etc. On the other hand, there are many algorithms for watermark embedding in frequency domain. Cox *et al.* described a method where the watermark

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is embedded into the large discrete cosine transform (DCT) coefficients using ideas borrowed from spread spectrum in communications [4]. Xia *et al.* proposed a frequency domain method of embedding the watermark at all the subbands except LL subband, using discrete wavelet transform (DWT)[5].

In this paper, we introduced new watermark embedding/retrieving algorithm using complex block selection method. An image is divided into 8×8 blocks and the discrete cosine transform (DCT) is performed at each block. A block with largest AC coefficients is defined as a 'complex block.' The watermark is embedded only into the selected complex blocks using quantization and modulus calculation. The watermark information, which is pseudorandom binary sequence ('0' or '1'), is embedded only into the greatest AC component of the complex block. After embedding watermark, the PSNR is calculated to give the index of the image quality, and attacked the watermarked image using JPEG compression to verify the robustness of the algorithm. The watermark retrieving procedure of the embedded watermark doesn't require any prior information such as original image or key, and finds watermark embedded complex blocks to retrieve the hidden watermark information. Such a blind watermark retrieval technique is important for applications in huge image databases. To give an example, for archived movie films, art libraries and Internet image distributors, it may not be convenient to search the original image from a huge database for watermark detection [1]. The results show that the watermarked image has at least 40 dB in PSNR, and the extraction ratio of the watermark more than 100% even if we compress the watermarked image with 90% of compression ratio.

2 Proposed Watermarking Method

Inoue, *et. al.* proposed quantization based watermarking technique using discrete wavelet transform (DWT) for video [6], but with the complex calculation within DWT, this method is not suitable for the real-time watermark extraction. For the real-time processing in video such as MPEG, an efficient and less complex algorithm is required. The algorithm developed in this paper is based on the DCT, which is used in MPEG video decoding, and can reduce computation time. Embedding watermark into all area of an image degrades the picture quality and resulted in lower PSNR. To improve PSNR, special DCT block selection algorithm is needed. In the proposed

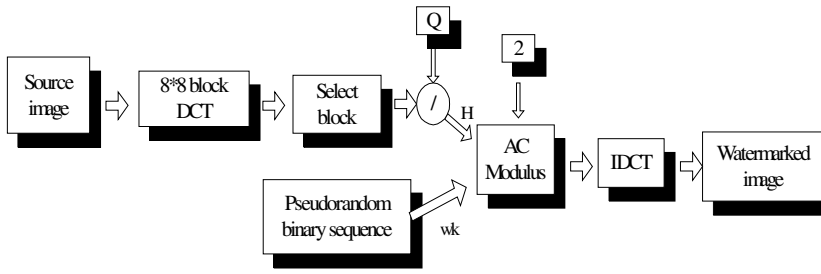

Fig. 1. Watermark embedding procedure