Chapter 3.12
Digital Watermarking for Multimedia Transaction Tracking

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ABSTRACT

This chapter focuses on the issue of transaction tracking in multimedia distribution applications through digital watermarking terminology. The existing watermarking schemes are summarized and their assumptions as well as the limitations for tracking are analyzed. In particular, an Independent Component Analysis (ICA)-based watermarking scheme is proposed, which can overcome the problems of the existing watermarking schemes. Multiple watermarking technique is exploited—one watermark to identify the rightful owner of the work and the other one to identify the legal user of a copy of the work. In the absence of original data, watermark, embedding locations and strengths, the ICA-based watermarking scheme is introduced for efficient watermark extraction with some side information. The robustness of the proposed scheme against some common signal-processing attacks as well as the related future work are also presented. Finally, some challenging issues in multimedia transaction tracking through digital watermarking are discussed.

INTRODUCTION

We are now in a digital information age. Digital information technology has changed our society as well as our lives. The information revolution takes place in the following two forms

- Data/information retrieval/representation
- Data/information dissemination/communication

Digital presentation of data allows information recorded in a digital format, and thus, it brings easy access to generate and replicate the information. It is such an easy access that provides the novelty

in the current phase of the information revolution. Digital technology allows primarily use with the new physical communications media, such as satellite and fiber-optic transmission. Therefore, PCs, e-mail, MPCs, LANs, WANs, MANs, intranets, and the Internet have been evolving rapidly since the 1980s. The Internet has a worldwide broadcasting capability, a mechanism for information distribution, and a medium for collaboration and interaction between individuals and their computers regardless of geographic location. This allows researchers and professionals to share relevant data and information with each other.

As image, audio, video, and other works become available in digital form, perfect copies can be easily made. The widespread use of computer networks and the global reach of the World Wide Web have added substantially an astonishing abundance of information in digital form, as well as offering unprecedented ease of access to it. Creating, publishing, distributing, using, and reusing information have become many times easier and faster in the past decade. The good news is the enrichment that this explosive growth in information brings to society as a whole. The bad news is that it can also bring to those who take advantage of the properties of digital information and the Web to copy, distribute, and use information illegally. The Web is an information resource of extraordinary size and depth, yet it is also an information reproduction and dissemination facility of great demand and capability. Therefore, there is currently a significant amount of research in intellectual property protection issues involving multimedia content distribution via the Internet.

Thus the objective of this chapter is to present multimedia transaction tracking through digital watermarking terminology. The Independent Component Analysis (ICA) technique is employed efficiently for watermark extraction in order to verify the recipient of the distributed content, and hence, to trace illegal transaction of the work to be protected.

MULTIMEDIA DISTRIBUTION FRAMEWORK THROUGH DIGITAL WATERMARKING

The rapid growth of networked multimedia systems has increased the need for the protection and enforcement of intellectual property (IP) rights of digital media. IP protection is becoming increasingly important nowadays. The tasks to achieve IP protection for multimedia distribution on the Internet can be classified as follows:

- **Ownership identification**: The owner of the original work must be able to provide the trustful proof that he/she is the rightful owner of the content.
- **Transaction tracking**: The owner must be able to track the distributions of the work, so that he/she is able to find the person who is responsible for the illegal replication and redistribution.
- **Content authentication**: The owner should be able to detect any illegal attempts to alter the work.

This chapter concentrates on the task of transaction tracking for multimedia distribution applications. Let us consider the scenario when an owner wants to sell or distribute the work to registered users only. To enforce IP rights, two primary problems have to be solved. First of all, the owner must be able to prove that he/she is the legal owner of the distributed content. Second, if the data have been subsequently copied and redistributed illegally, the owner must be able to find the person who is responsible for the illegal copying and redistribution of the data (see Figure 1).

The first technology adopted to enforce protection of IP rights is cryptography. Cryptographic technology (Schneier, 1995) provides an effective tool to secure the distribution process and control the legal uses of the contents that have been received by a user. The contents to be delivered

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