Chapter VII
Digital Rights Management of Images and Videos Using Robust Replica Detection Techniques

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ABSTRACT

Intellectual property rights protection and management of multimedia data is essential for the deployment of e-commerce systems involving transactions on such data. Lately, replica detection or fingerprinting has emerged as a promising approach for the rights management of multimedia data. In this chapter, a review of 2 replica detection techniques is presented. The first technique utilizes color-based descriptors, an R-tree indexing structure, and Linear Discriminant Analysis (LDA) to achieve image replica detection. The second technique is a video fingerprinting method that utilizes information about the appearances of individuals in videos along with an efficient search and matching strategy.

INTRODUCTION

E-commerce systems have become an almost integral part of everyday life, introducing new distribution channels and bringing up a radical change to the way transactions are being conducted. This change is, without doubt, more evident in multimedia content, whose distribution is constantly shifting towards electronic means (online music stores and commercial image databases, video on demand services,
etc). However, the successful deployment of e-commerce systems for multimedia data requires the
resolution of the critical issues of intellectual property rights protection and management since their
digital nature allows for arbitrary reproduction and distribution, without any control by the copyright
holders. Replica detection or fingerprinting is an emerging technology that can be used as an alternative
to watermarking for the efficient Digital Rights Management (DRM) of multimedia data. Two replica
detection approaches are reviewed in this chapter. The first is an image fingerprinting technique that
makes use of color-based descriptors, R-trees and Linear Discriminant Analysis (LDA). The second is
a video fingerprinting method that utilizes information about the appearances of actors in videos along
with an efficient search strategy. Experimental performance evaluation is provided for both methods.

BACKGROUND

Numerous systems addressing the issue of copyright protection and DRM in general can be found in
the literature, the vast majority of them being based on watermarking. Watermarking is the technique of
imperceptibly embedding information within a medium (Tefas et al. 2005). Although watermarking has
been the subject of intensive research in both the industry and the academia, it has certain disadvantages.
Embedding information inside a multimedia item before it becomes available to the public, implies that
the data will be distorted up to a certain extent and that watermarking methods are not applicable to
data that are already in the public domain and need to be protected. Moreover, watermarking is unable
to cope with leakage of unprotected content, i.e., cases where a copy of the original item that bears no
watermark is stolen and distributed.

Recently, the scientific community started to investigate digital rights management in multimedia
data from an alternative point of view i.e. as a problem of similarity of such data, the similarity being
defined in a robust way. These approaches, which come under different names, such as multimedia
fingerprinting (Oostveen et al. 2002), robust or perceptual hashing (Michak & Venkatesan 2001), repli-
ca or near-replica recognition/detection (Ke et al. 2004) and copy detection (Kim & Vasudev 2005)
aim at extracting from the data a feature vector, called perceptual hash, fingerprint or signature, that
characterizes them in a unique, robust and discriminative way. This feature vector can be combined
with a database of multimedia documents that need to be managed with respect to their digital rights,
an appropriate similarity metric and an efficient database search strategy in order to devise a DRM
system. More specifically, such a system can decide if a query digital item resembles a reference item
in the database. If this is indeed the case, the query item is identified as being a copy (replica) of the
corresponding item in the database and legal action can be pursued against its owner/distributor if he is
not legally possessing/distributing it. In order to be of practical use, the feature vectors and the match-
ing procedure involved in a fingerprinting system should be robust to manipulations that multimedia
data might undergo, either due to their distribution and use or due to an intentional attempt to make
them unrecognizable by the fingerprinting system. Unlike watermarking, no information needs to be
embedded within the multimedia content in a fingerprinting system, thus ensuring perfect quality for
the data to be protected and furthermore making the system applicable to data that are already in the
public domain. It should be mentioned here that the term fingerprinting as used in this chapter and in
other papers, should not be confused with the fingerprinting watermarking which is essentially a vari-
ant of watermarking.
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