Chapter 13
Geometric Distortions-Invariant Digital Watermarking Using Scale-Invariant Feature Transform and Discrete Orthogonal Image Moments

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ABSTRACT

Many proposed digital image watermarking techniques are sensitive to geometric attacks, such as rotation, scaling, translation, or their composites. Geometric distortions, even by slight amounts, can inevitably damage the watermark and/or disable the capability of the watermark detector to reliably perform its function. In this chapter, the authors exploit the invariant image features to design geometric distortions-invariant watermarking system, and present two watermarking techniques. First technique utilizes the bounding box scale-invariant feature transform and discrete orthogonal Hahn moments to embed the watermark into the selective image patches, and the second technique uses only the Hahn moments to globally embed watermark into the whole image. First technique is non-blind and uses the original image during detection. While exhibiting excellent resistance against different geometric distortions, this technique also has fairly good resistance to image cropping like attacks. However, this technique exhibits a reduced data payload. The second technique is designed to be blind and the watermark is blindly extracted using the independent component analysis. For this technique an improved data payload is achieved but with a little compromise on resistance against cropping like attacks. The implementations are supported with thorough discussions and the experimental results prove and demonstrate the effectiveness of the proposed schemes against several kinds of geometric attacks.

DOI: 10.4018/978-1-4666-2136-7.ch013

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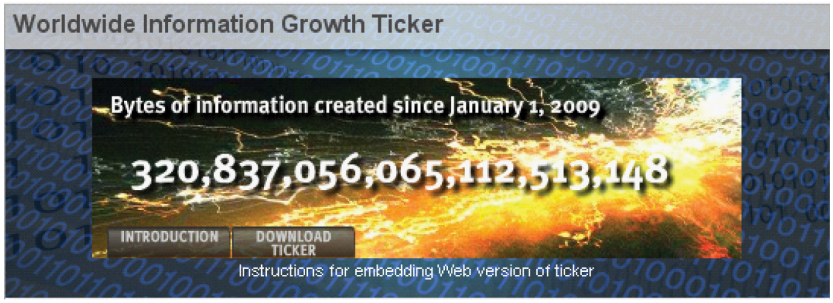
INTRODUCTION

Digital universe is exploding and expanding at an enormous speed, and in year 2008 it was forecasted (Gantz, Chute, Manfrediz, Minton, Reinsel, Schlichting, & Toncheva, 2008) that the amount of information created, captured, or replicated had already exceeded the available storage capacity for the first time in 2007. The digitized information created and replicated during January 10, 2008 to March 12, 2008, 10:27:12 am, alone, was amounted to "80,709,885,774,375, 825,096" bytes of data (Paul 2008), and similarly from January 1, 2009 to June 1, 2009 (11:42:07 am – GMT+08:00 time zone) only the bytes of information created amounted to a total of "320,837,056,065,112,513,148" bytes (EMC, 2009), as shown in Figure 1. While not all the information created and transmitted is stored, it was also estimated that by 2011, almost half of the digital universe will not have a permanent home (Gantz, Chute, Manfrediz, Minton, Reinsel, Schlichting, & Toncheva, 2008). However, the size and explosive growth of the digital universe are only two of its characteristics. The most critical associated issues include: handling, storage, management, and security. It is noted that the visual contents like images and video account for the largest portion of the digital universe (Paul 2008). So if we look at digitized multimedia data (a combination of any of text, image, video, or other types of data), then it turns out to be largest in terms of size of the digital universe. As estimated figures, 30 per cent of information created today is *"security intensive"*, and it may grow to 45 per cent by the end of year 2012 (Gantz & Reinsel, 2009). Evidently, an unlimited set of options, opportunities, and challenges can be realized and perceived in the life cycle of the digital data from birth, creation, replication, manipulation and composite creation (using different types of digital data), to non-stopping and endless distribution and sharing. Hence, this creates more challenging and complex issues regarding data authenticity, security, and protection.

As a matter of fact, and with the advent of digital media, exact replication of multimedia contents and their swift distribution through open networks is no more a problem in this mature digital age. The availability of modern technology and contemporary techniques has not only reduced the time spans involved in the reproduction of digital media data, associated duplication efforts, and quick distribution of contents over the globe by great factors but also eliminated the quality degradation problems as those associated with the analog domain (Ahlzen & Song, 2003). While, without requiring much effort, this fact is

Figure 1. A screenshot of worldwide information growth ticker showing total bytes of information created from January 1, 2009 to June 1, 2009, 11:42:07 am (GMT+08:00 time zone)



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