Journal of Ambient Intelligence and Humanized Computing (2023) 14:7367–7380
https://doi.org/10.1007/s12652-022-04445-0

ORIGINAL RESEARCH

A robust watermarking scheme for hybrid attacks on heritage images

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Received: 6 May 2022 / Accepted: 3 October 2022 / Published online: 1 November 2022

Abstract
Heritage incorporates images, customs, rituals, beliefs, cultures, knowledge, arts, crafts, music, and artifacts of a region. Apart from conferring the details about the understanding of previous generations, the heritage multimedia also provides details regarding innovative attitudes, ways of living, and heterogeneity of historical and archaeological approaches of a society. Since the availability of the internet in the present scenario makes an illicit user access the data easily, therefore, it is mandatory to protect the Cultural Heritage (CH) media. This paper offers a secure and resilient Discrete Cosine Transform (DCT) based blind watermarking algorithm for copyright security of digital images. We have developed and tested two different approaches of embedding namely Fixed Threshold Reference-based Relative Modulation (FTRRM) and Adaptive Threshold Reference-based Relative Modulation (ATRRM). In either approach, the watermark is embedded in the 'Y' component of the YCbCr color model. In FTRRM, the 'Y' component of the host image is first divided into 8×8 non-overlapping blocks and DCT is applied on each block. The watermark bits are embedded into the transformed coefficients by modulating the relative difference of coefficients depending on the bit to be embedded. A similar embedding strategy is followed in ATRRM, with a change that relative difference is modulated adaptively. Both schemes have been tested on a set of heritage images, besides general test images. We make use of chaotic and Deoxyribo Nucleic acid (DNA) encryption to ensure double-layer security of embedded watermark. The Peak Signal-to-Noise Ratio (PSNR) of the proposed scheme in the case of FTRRM is 40.4984 dB and for ATRRM it is 39.9549 dB, the Structural Similarity Index Matrix (SSIM) values are close to unity, in both cases for various test images that guarantee the imperceptibility of the proposed scheme. The robustness of each scheme is revealed by comparing them with the various state-of-the-art techniques separately.

Keywords Copyright protection · Cultural media · Digital watermarking · Ownership verification

1 Introduction

The term 'Heritage' refers to the inheritance that society obtains from the antecedent generation and is passed around to the following generations. Cultural Heritage (CH) constitutes tangible culture (like museums, buildings, books, monuments, and artifacts), intangible culture (such as oral traditions and expressions, language, rituals, festive events, knowledge), and natural heritage (comprises of culturally remarkable landscapes, and biodiversity). Culture and heritage build human community. Mankind has always relied on its past to create the present and set up its future. Generations have survived before and shaped the world we live in. Therefore, there is a requirement to protect our heritage as it appends character and richness to the place, region, or community and thus provides a perception of identity. Further, CH is an essential resource that boosts the local economy, creates sustainable communities, offers excellent educational

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