Robust Image Watermarking using Hessenberg Decomposition and SVD with Integer Wavelet Transform

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***Abstract*— Preventing unauthorized use and distribution has grown more difficult as a result of the extensive usage of the internet and the simplicity of duplicating and distributing digital media. Watermarking has come to be recognized as a successful remedy for this issue. Image watermarking is the process of adding a distinctive identifier to an image so that it is hidden from view but can still be read to establish ownership. This research proposes Hessenberg Decomposition (HD) and Singular Value Decomposition (SVD) in the Integer Wavelet Transform (IWT) domain to achieve high robustness. The proposed method utilizes the HD feature of the image to enhance the robustness of the watermark against attacks, while the SVD technique is used to achieve high invisibility and security. The IWT domain is employed to make the watermarking process more efficient, leading to a faster and more reliable watermarking algorithm. The results of the experiments demonstrate that the proposed scheme provides a high level of robustness for preserving the ownership of multimedia content and resistant to various image processing attacks. The outcomes demonstrate that, in terms of robustness and invisibility, the suggested approach performs better than the existing watermarking schemes.**

Keywords—Robust watermarking, embedding watermark, extracting watermark, Hessenberg Decomposition

I. INTRODUCTION

The advanced development of digital technology has made it simpler to access digital information such as social media and any type of multimedia. As a result, more people are becoming aware of how simple it is to replicate the data. Perfect copies are simple to make, which could result in widespread unauthorised copying especially on images [1]. Nowadays, most of artists has moved their artwork into images which could be view and sold online. It is hard to identify who is making the changes when putting the image online. Numerous solutions are being developed to prevent unauthorised copying as a result of this worry over copyright issues. Digital watermark is one of solutions to embed data that identifies the creator or owner of digital intellectual property [2].

Digital watermarking for copyright protection is a technique that involves inserting copyright information that will difficult to be removed by unauthorized person [3]. Digital watermark can be visible or invisible. By altering the digital data's contents, the information that needs to be inserted, making it possible to locate the original owner or, in the event of unlawful copying. To infer something about the data, this digital watermark can be found or retrieved afterwards. Watermarking is susceptible to various types of attacks. The attacks aim to remove, alter, or otherwise compromise the watermark in the image [4]. Therefore, it is also crucial to always prioritise security in the digital watermarking.

This research aims to utilize Hessenberg Decomposition (HD), SVD and Integer Wavelet Transform (IWT) as the methods of choice. IWT is a wavelet analysis algorithm that converts integers to integers and can be inverted. IWT is better appropriate for lossless data-compression applications and is computationally quicker and memory-efficient than the continuous wavelet transform (CWT). The calculated integer coefficients can be used by the IWT to perfectly reconstruct an integer signal [5]. The integer variants are more easily invertible in finite precision arithmetic than the traditional DWT. Because the cover media requires integers, these transformations are highly helpful in data concealing applications.

Overall, the use of IWT in optimized watermarking allows for more accurate and robust watermarking, as the wavelet coefficients of an image can provide more detailed information about the data compared to other methods. A potential attacker may find it more challenging as a result to remove or change the watermark without affecting the quality of the image. Meanwhile, HD is particularly useful in image watermarking because it transforms the original image into a form that is less sensitive to perturbations caused by attacks such as rotation, scaling, and translation [6]. SVD is a technique used in image processing to break down an image matrix into three separate matrices. These matrices can be used to represent the image in a new coordinate system, which can be useful for image compression and feature extraction. It also can be used to denoise images by removing small singular values considered as noise and reconstruct the image by using the remaining large singular values [7].