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A DIGITAL IMAGE WATERMARKING PROCESSING TECHNIQUES USING MULTI-HYBRID WATERMARKING AND COMPRESSION TECHNOLOGY

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ABSTRACT

Digital photos lose quality throughout the compression, transmission, collection, archiving, and retrieval processes. You can't put your faith in digital images because of this, which makes it impossible to trust what you see. Many procedures are involved in the authentication method, such as password, smart card, and biometric identification. These processes include identity, authorization, and authentication. It's also possible to authenticate content by using fragile watermarking (which provides accurate authentication) or semi fragile watermarking (which provides selective authentication). Digital signatures and cryptography with key distribution as a form of symmetry or asymmetry authentication are further options. In order to validate the legitimacy of highly sensitive data without affecting the image's quality, safe processes are necessary. It's possible to spot a fake by counting the number of places in the image that have been digitally altered, in addition to its size. When post-processing is utilized, quality suffers, and computations become more difficult.

(i) *Keywords: Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Image Fidelity (IF), Bit Error Rate (BER), Accuracy Ratio (AR), Entropy, etc.,*

I. INTRODUCTION

DIGITAL IMAGE WATERMARKING PROCESSING TECHNIQUES

The privacy and security of data are two of the most pressing issues facing digital communication technologies, such as the internet. Illegal access to data necessitates the adoption of security methods. As a result, internet technology requires data protection. Various methods including encryption, decryption, cryptography, steganography, and digital watermarking are used to protect digital data (Khalili and Asatryan 2013). An application of digital image processing is watermarking. It's a way to hide information via digital watermarking. Digital items including images, text, music, and video may be used to hide information using a variety of approaches. As previously said, digital watermarking is basically a way for inserting some extra and hidden information in the cover picture that can subsequently be recovered or detected for a variety of objectives such as authentication or owner identification or for protecting content and copyright. It is possible to include a watermark in the cover picture by adjusting the scale factor. In order to safeguard digital information and data from unauthorized usage, digital watermarking is used. It also grants digital data owners' ownership rights. One of the most essential features of digital watermarking is that it is imperceptible and resistant to many sorts of assaults and popular picture modification techniques including rotation, filtering, scaling, cropping, and compression. A digital watermarking algorithm's efficacy depends completely on how well it can withstand different forms of assaults on the embedded watermark. Tamper-proofing and authentication are both done via digital watermarking.

HYBRID WATERMARKING AND COMPRESSION

The rapid development in the multimedia communication sophisticated the users with many advantages. The two critical needs of this multimedia communication are security, privacy and enormous bandwidth requirement (Rajesh *et al.,* **2010**). The issue of security and privacy of the multimedia data such as image/videos is overcome by employing the cryptographic algorithm and watermarking techniques.

Similarly, the bandwidth requirement of the multimedia data is cut down by adopting the compression methods.

II. PERFORMANCE ANALYSIS

Performance analysis is needed to determine the characteristics of the digital image processing technique such as imperceptible, indelible, statistically undetectable and easily decodable. Popular metrics used for evaluating input and output image are PSNR, MSE, Fusion Factor, Fusion Symmetry, Image Fidelity, Bit Error Rate , Accurate ratio and Entropy.

Mean Square Error (MSE)

The MSE is used to calculate the error between the original image and the processed image that is given by

$$MSE = \frac{1}{MN}\sum_{x=1}^{M}[f(x, y) - g(x, y)]^2 \quad (3.8)$$

Where, x and y denote the coordinate values in the image, N is defined as the total number of pixels and f is the original image and g is the reconstructed image.

Peak Signal to Noise Ratio (PSNR)

PSNR provides measurement of signal fidelity metrics and it contains the quality of the images. The PSNR is expressed by

$$PSNR = 10\log_{10}\left[\frac{255^2}{MSE}\right] \quad (3.9)$$

Image Fidelity (IF)

The Image Fidelity (IF) is computed to recognize the similarity between non- watermarked image and watermarked image. The similarity between the two images will be high if the (IF) is high and vice versa.

The (IF) between two images is computed by

$$I_F = 1 - \frac{\sum_{i,j}(I(i, j) - I_w(i, j))^2}{\sum_{i,i}(I(i, j))^2} \quad (3.10)$$

Bit Error Rate (BER)

In watermarking method the Bit Error Rate (BER) is computed by

$$BER = \frac{DB}{NB} \quad (3.11)$$

The sum of original bit is denoted by NB and the sum of erroneous decoded bit is denoted by DB.

Accuracy Ratio (AR)

The similarity between the watermarked image and the host image (i.e. obtained after extraction) is computed by Accuracy Ratio (AR) which is expressed below

$$AR = \frac{DB}{NB} \quad (3.12)$$

In equation 2.5 the sum of original bit is denoted by NB and the sum of correct bit is denoted by CB.

Entropy

Image entropy is a quantity which is used to describe the `business' of an image, i.e. the amount of information which must be coded for by a compression algorithm.

Low entropy images, such as those containing a lot of black sky, have very little contrast and large runs of pixels with the same values.

$$\text{Entropy} = -\sum P_i Log_2 P_i \quad (3.13)$$

In the above expression, P_i is the probability that the difference between 2 adjacent pixels is equal to i, and Log_2 is the base 2 logarithm.

II. CONCEPT AND METHODOLOGY

A spatial domain approach and a transformation domain method are combined in a Multi-Hybrid watermarking technology. 512512 host pictures such as Lena, Foster City, Splash, Earth, Oakland, and Baboon were used to create the algorithm in Matlab. Besides that, the approach has been assessed in terms of PSNR and MSE and evaluated in terms of IF, BER, and AR for each of these variables.

It's possible to combine watermarking with compression in an innovative way. In order to effectively communicate, this study makes use of the Multi-Hybrid watermarking approach and SVD-based picture compression. In addition to employing a Xilinx Platform Studio EDK 11.1 FPGA Spartan-6 for the method's implementation, Matlab was used to calculate the bandwidth.

Echocardiography has a long history relative to other imaging modalities, yet it is still evolving and growing at a rapid pace, as we saw in the introduction. Recent years have seen a rise in the use of three-dimensional echocardiography in therapeutic settings. Three-dimensional (3D) echocardiography with contrast enhancement assigned left ventricular volumes that were found to be the same as cardiac 'Magnetic Resonance Imaging' values Furthermore, it may be used to check the health of the valves as well as for a variety of other medical purposes. To yet, the general cardiology community is unaware of the benefits of 3D echocardiography. Most academic institutions still use it primarily as an investigative tool, but community hospitals seldom do. Software advancements, benefits over two-dimensional echocardiography, and improved community awareness will all contribute to the technology's adoption and widespread usage in the clinical context in the future.. Contrast perfusion imaging is another promising field of echocardiography with the potential to transform clinical practise. Due to the upcoming FDA clearance of novel perfusion-specific contrast agents, this opens up a whole new world of potential applications for echocardiography.

III. CONCLUSION

During the embedding process, the hardware design for morphological operations consumes the greatest operating frequency (9.56 ns), and this is visible from the findings. Handel-C outperforms VHDL and Verilog implementations for dilation and erosion at the synthesis level, according to the findings of this study.

Because of this, it is ideal for low-power applications such as low-power picture fusion, since it decreases the amount of hardware resources required. The merged image's PSNR, MSE, and Entropy are all higher on the combined version. The fusion technique compares well to other approaches in terms of performance. When the embedding process is complete, the highest operational frequency (50 MHZ) is used by the hardware design, and this results in a combined path delay of 10.223 ns.

It's clear that lossy compression is a superior method even at high compression ratios, as shown by the findings of this study. For the high PSNR value increase, it's because SVD compression boosts the picture without much loss of quality, and this results in a low MSE number.

Comparing the performance of the Multi Hybrid watermarking technique to other traditional watermarking methods like LSB, MSB, DCT, and DWT, a significant improvement can be seen.

When using image compression, the maximum frequency is 173.89 MHz, while using watermarking, the maximum frequency is 182.34 MHz, while using a power rate of 221.35 W. When comparing the standard approach to diverse photos, the bandwidth required is significantly reduced. It's clear that the system we've put in place makes good use of available resources. The system's time to market, cost, and bandwidth requirements are all reduced.

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