Analysis of Digital Watermarking Techniques Using Transform-Based Function

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Abstract**—**Security and protection of digital data is always a challenging job over the internet. For the protection and copyright of digital multimedia data used digital watermarking techniques. The digital watermarking techniques protect the copyright protection of digital multimedia data. Digital watermarking techniques used to transform based function for the processing of watermark embedding. The transform-based function is a texture feature dominated property. The texture feature is the most important part of the digital image. In this paper study and analysis of transform-based digital image watermarking. The transform-based digital image watermarking using the function of DCT, DWT, IWT and SHIFT. In the family of transform, the function used the layered transform function is wavelet transform function, and other is the shift key point transform function. For simulation used MATLAB software and used standard image dataset and symbol for the process of embedding. For the validation of transform function estimate, four well know parameter such as encoding time, decoding time, PSNR, and the value of NC.

Keywords- *Watermarking, Digital Image, copyright, security, transform function.*

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I. INTRODUCTION

The tampering of digital data is an international crime. Robustness and security are two major areas of work in digital watermarking. For the security and robustness used transform-based function for the process of digital watermarking. The transform-based function discrete cosine transforms (DCT) is a block-based operation in the watermarking process[1-3]. The block-based watermarking process faced a problem of searching for the coefficient for the process of embedding to original image and watermark image. The searching and a large number of blocks create more time for embedding in digital watermarking algorithms. Instead of that, the discrete wavelet transform function is easy to embed digital watermarking [4, 10]. The discrete wavelet transforms (DWT) function is a combination of lower frequency and higher frequency[9]. The process of decomposition of wavelet transform function induced the impulsive noise and degraded the quality of digital watermark. The degraded quality of watermark easy for an attacker for the predication. Instead of that used integer wavelet transform function (IWT). The intergern wavelet transform function generates a series of packets for the embedding of watermarking[5-8]. And remove the process of noise and increase the quality of the image. These all transform function directly apply to the watermarking process [11]. Now a day's various authors proposed a method of feature-based watermarking techniques. The features based watermarking techniques used the lower content of features of the image such as color, texture and shape, and size[12-13]. The extraction of features used dominated features extraction process such as for the extraction of color features used DCD features extraction process. The Dominated color descriptor (DCD) extract the color features of the given image. Instead of this for the extraction of texture features used the transform-based function such as DWT, IWT, and sherbet transform function. The texture is the transparent feature of the image. For the extraction of shape and size used the geometrical invariant function for the extraction of these features [14-16]. In all three types of features, the texture features are most dominated features for the process of watermarking. The rest of the paper discusses as section II transform function. In section III, discuss the experimental process and finally discuss conclusion and future work.

II. TRANSFORM BASED FUNCTION

A) DISCRETE WAVELET TRANSFORM

The wavelet transform function plays an important role in digital image watermarking. The major idea of DWT in image process is to multi-isolated crumble the image into sub-image of different spatial space and independent repeat region. By then, change the coefficient of sub-image[18]. After the main image has been DWT transformed, it is rotted into four repeat locales, which is one low-repeat region (LL) and three high-repeat territories (LH, HL, HH)[4,3].In two-dimensional divisible dyadic DWT, each dimension of decay produces four groups of information, one comparing to the low passband (LL), and three others relating to level (HL), vertical (LH), and inclining (HH) high pass groups. The decayed image demonstrates a coarse estimation image in the most reduced goals lowpass band,

and three detail images in higher groups. The low passband can additionally be deteriorated to acquire another dimension of disintegration. This procedure proceeds until the point when the coveted number of levels dictated by the application is come to. The figure indicates two dimensions of decay[17, 20].

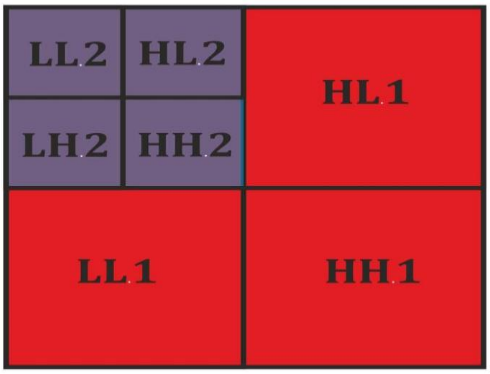

Figure 1: DWT decomposition with two levels.

B) DISCRETE COSINE TRANSFORM

Discrete Cosine Change is identified with DFT; it could be said that it changes a period space motion into its recurrence parts. The DCT anyway just uses the genuine parts of the DFT coefficients. Regarding property, the DCT has a solid vitality compaction property, and most of the flag data will, in general, be gathered in a couple of low-recurrence segments of the DCT. The JPEG pressure strategy uses this property to separate and evacuate irrelevant high recurrence parts in images[19, 21].

The embedded progression is isolated without falling back on the primary image, so the analyzed methodology addresses an imperative improvement to procedures contingent upon the relationship between the watermarked and one of a kind image[18].

Advantages of DCT[19-24]

1. The semantically meaningful watermark pattern
2. Good perceptual invisibility
3. Acceptable robustness
4. Various user-selected options
5. Reasonable complexity/execution time
6. Fast and Suitable for robustness against JPEG compression.
7. It's a real transform with better computational efficiency than DFT, which is a complex transform.

In this watermarking system to add a code to computerized images is introduced: the technique works in the recurrence space, installing a pseudo-irregular arrangement of genuine numbers in a chosen set of DCT coefficients. Watermark throwing is performed by misusing the veiling qualities of the Human Visual System, to guarantee watermark imperceptibility. The implanted succession is separated without turning to the first image [25].

C) INTEGER WAVELET TRANSFORM

In spite of the fact that in actuality, numerous applications (image pressure and image water-checking) include just number data sources [14]. This transformation from the whole number to floating-point and floating-point to number make them free their ideal recreation property and prompt adjusting off blunder. The lifting plan can be utilized to actualize the number to IWT with the end goal to expel these adjusting off blunders. IWT conations reversibility property; thus, it very well may be utilized for impeccable remaking. With the end goal to give an expedient and efficient execution, IWT can be actualized by the assistance of three essentials ventures of lifting activity split, anticipate, and refresh. The figure is demonstrating the square chart portrayal of lifting activity and utilized advances are clarified as pursues [14-17]:

D) SIFT (SCALE INVARIANT FEATURE TRANSFORM)

The SIFT algorithm was used for the extraction of multimedia information features. The SIFT algorithm was developed by Lowe. SIFT transform function finds the local -invariant features points. The multi-point feature points combined and generate features matrix [26].

Step 1 - Scale-Space Selection:

The scale-space approach is to define a scale parameter into the 2D image data processing model and get 2D image processing data at different scales by regular updating scale parameters[28]. Then, the data is integrated to expand the required properties of 2D-image. The Gaussian convolution kernel is one of the linear kernels to summarize the scale transformation, and the scale-space kernel f_{out} can be expressed mathematically as:

$$f_{out} = K_n * f_{in}$$

Where,

K_n – kernel

f_{in} - input signal

$*$ - convolution operation

Scale-space $S(x, y, \sigma)$ of image $I(x, y)$ is expressed mathematically as:

$$S(x, y, \sigma) = G(x, y, \sigma) * I(x, y)$$

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Where,

$G(x, y, \sigma)$ - scale variable Gaussian function

(x, y) - spatial coordinates

σ - scale-space factor (using image's smoothness)

A large value of σ denotes a smooth image with feature's outline, while a small value of σ introduce an abundant image with feature's described.

To detect the stable points considerable in the $scale - space$, Lowe discussed the DOG

$(difference\ of\ Gaussian)$ scale-space, defined mathematically as:

$$D(x,y,\sigma) = [G(x,y,k\sigma) - G(x,y,\sigma)] * I(x,y) = S(x,y,k\sigma) - S(x,y,\sigma)$$

Where,
$I(x,y)$ - input image
k - multiple of 2 neighboring scale-spaces
$*$ - convolution operation.
To get the local maxima and minima of $D(x,y,\sigma)$, each point is compared with its $8 - neighbors$ in the used image and
$9 - neighbors$ in the scale below and above. Utilizing the DOG scale-space image can be detected as feature points of all extreme points.
Step 2 - feature points:
The goal at orientating the location of feature points precisely. A huge number of extreme points are got in this manner. But not all extreme points are feature points. Afterword's, the desired method is required to calculate some points.
Step 3 - feature point orientation assignment:
The goal is to summarize the SIFT features of rotation invariance. For scaling the smoothed image I_L, the central derivative of I_L at each feature point can be considered. The scale and orientation at feature point (x,y) can be considered by

$$\begin{cases} \theta(x,y) = \tan^{-1} 2\{[I_L(x,y+1) - I_L(x,y-1)]/[I_L(x+1,y) - I_L(x-1,y)]\} \\ g(x,y) = \sqrt{[I_L(x+1,y) - I_L(x-1,y)]^2 + [I_L(x,y+1) - I_L(x,y-1)]^2} \end{cases}$$

Where,
$\theta(x,y)$ - orientation of the gradient
$g(x,y)$ - magnitude
With the use of gradient direction histogram graph, getting the gradient amplitude and direction, that direction of feature points can be determined. The highest peak visualizes the direction. In the gradient direction histogram, when another peak value equals 80% of the main peak's value, this direction should be set as the auxiliary direction of this feature point. The direction matching has been finished with the parameter, position, situation and recent step is to find the local image descriptor of the feature points.

III. EXPERIMENTAL ANALYSIS

In this section discuss the experimental analysis of digital image watermarking based on these transform-based function such as DCT, DWT, IWT and SHIFT. For the process of simulation used MATLAB software. MATLAB is well known computational analysis software for the processing of image processing. For the processing of watermark used different symbol image and host image. For the validation of function used standard parameters such as PSNR (Peak to signal noise ratio), NC, ET and DT[27-30].

A) IMPLEMENTATION PROCESS

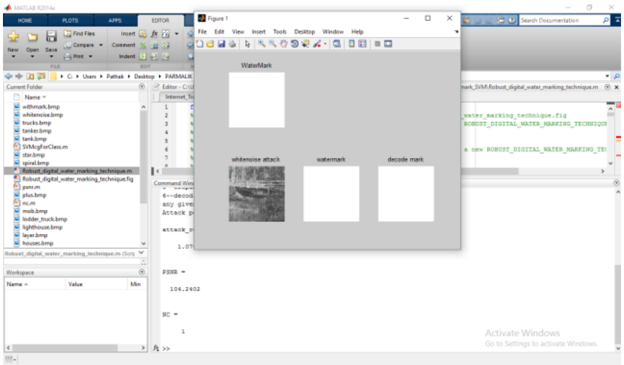

Figure 2: window show that the output figure 1 using DCT method and here host image bridge and watermark image is getmark. In this window, we can see the command window that has all parameters numeric result of Encoding Time, Decoding Time, PSNR, NC using the MATLAB platform for execution of our simulation model of watermarking.

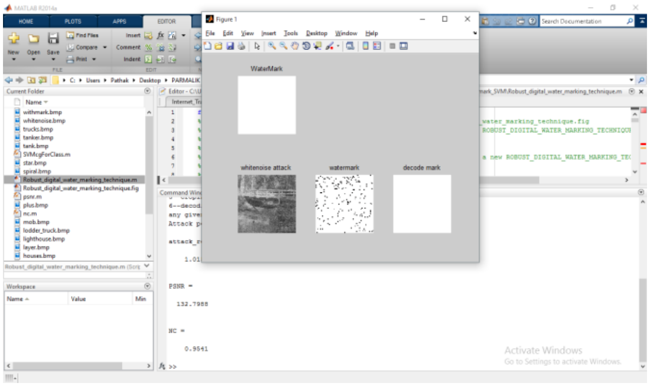

Figure 3: window show that the output figure 1 using DWT method and here host image bridge and watermark image is getmark. In this window, we can see the command window that has all parameters numeric result of Encoding Time, Decoding Time, PSNR, NC using the MATLAB platform for execution of our simulation model of watermarking.

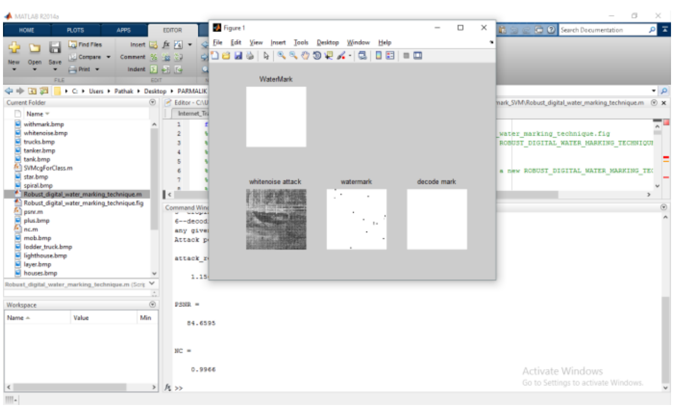

Figure 4: window shows that the output figure 1 using IWT method and here host image Clown and watermark image is

getmark. In this window, we can see the command window that has all parameters numeric result of Encoding Time, Decoding Time, PSNR, NC using the MATLAB platform for execution of our simulation model of watermarking.

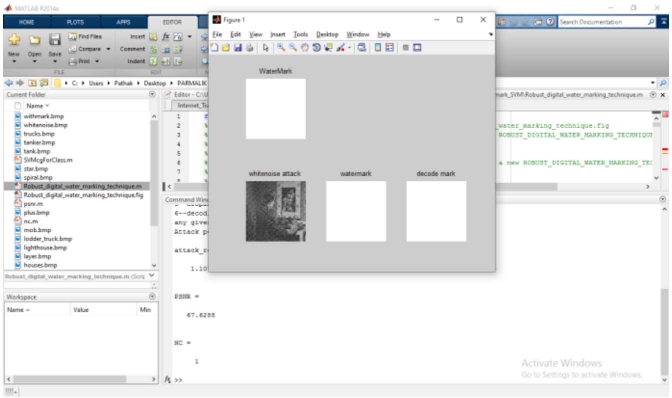

Figure 5: window shows that the output figure 1 using SHIFT method and here host image Clown and watermark image is freemaster. In this window we can see the command window that has all parameters numeric result of Encoding Time, Decoding Time, PSNR, NC using the MATLAB platform for execution of our simulation model of watermarking.

Table 1: Show that the comparative result of DCT, DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC using Bridge host image and freemaster watermark image.

Parameter	DCT	DWT	IWT	SHIFT
Encoding Time	0.5478	0.6856	0.5811	0.5315
Decoding Time	1.0781	1.0156	1.1563	1.0101
PSNR	84.2402	84.7988	87.6595	89.2451
NC	1	0.9541	0.9966	0.8827

Table 2: Show that the comparative result evolution on behalf of simulation in MATLAB of DCT, DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using Clown host image and Layer watermark image.

Parameter	DCT	DWT	IWT	SHIFT
Encoding Time	0.8798	0.8695	0.8785	0.8356
Decoding Time	1.1094	1.4063	1.5976	1.0871
PSNR	67.6288	72.4290	85.4934	86.5895
NC	1	0.9988	0.9731	0.9596

Table 3: Show that the comparative result evolution on behalf of simulation in MATLAB of DCT, DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using Crane host image and plus watermark image.

Parameter	DCT	DWT	IWT	SHIFT
Encoding Time	0.6849	0.7928	0.7211	0.6947
Decoding Time	1	1.0156	1.0106	0.8852
PSNR	72.1096	82.6266	86.6305	87.0018
NC	0.9926	0.9797	0.9295	0.8928

Table 4: Show that the comparative result evolution on behalf of simulation in MATLAB of DCT, DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using House host image and spiral watermark image.

Parameter	DCT	DWT	IWT	SHIFT
Encoding Time	0.8726	0.8164	0.7441	0.6319
Decoding Time	1.1406	1.3281	1.0156	0.9879
PSNR	77.3205	86.2909	78.1979	86.8921
NC	1	0.9993	0.9951	0.9685

Table 5: Show that the comparative result evolution on behalf of simulation in MATLAB of DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using lighthouse host image and star watermark image.

Parameter	DWT	IWT	SHIFT
Encoding Time	0.9584	0.8798	0.82597
Decoding Time	1.2417	1.2101	1.3047
PSNR	82.6985	86.5252	89.2186
NC	0.8924	0.86991	0.84793

Table 6: Show that the comparative result evolution on behalf of simulation in MATLAB of DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using Lodder-truck host image and freemaster watermark image.

Parameter	DWT	IWT	SHIFT
Encoding Time	0.6985	0.5827	0.5784
Decoding Time	1.5824	1.2412	1.0259
PSNR	77.5983	76.6989	80.0124
NC	0.9837	0.9524	0.9563

Table 7: Show that the comparative result evolution on behalf of simulation in MATLAB of DWT, IWT, SHIFT Techniques for Encoding Time, Decoding Time, PSNR, NC parameters using mob host image and getmark watermark image.

Parameter	DWT	IWT	SHIFT
Encoding Time	0.6959	0.6536	0.6244
Decoding Time	1.2541	1.3148	1.0248
PSNR	67.6985	69.2123	70.6951
NC	0.9896	0.9432	0.9308

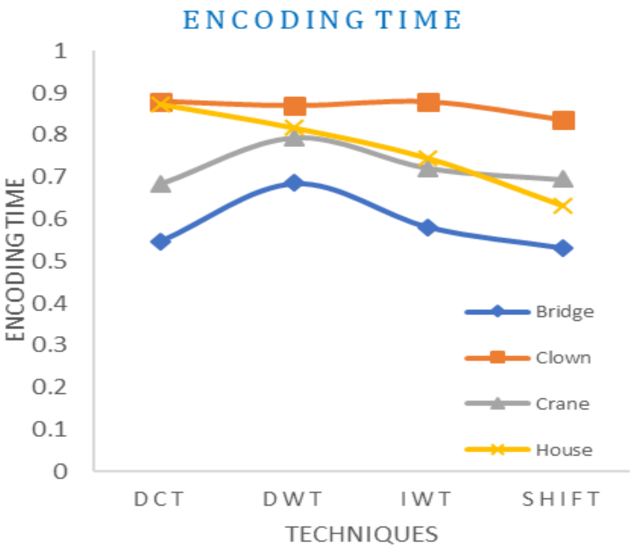

Figure 6: Show that the comparative performance of DCT, DWT, IWT, SHIFT Techniques for Encoding Time using Bridge, Clown, Crane, House images with sequence manner freemaster, Layer, plus, spiral watermark images on the behalf of our simulation model of watermarking and here we analyzed that encoding time of Shift Technique is compared less to all other techniques likes DCT, DWT, IWT in the case of all host images likes bridge, clown, crane and House. Shift technique shows better result compare to others technique.

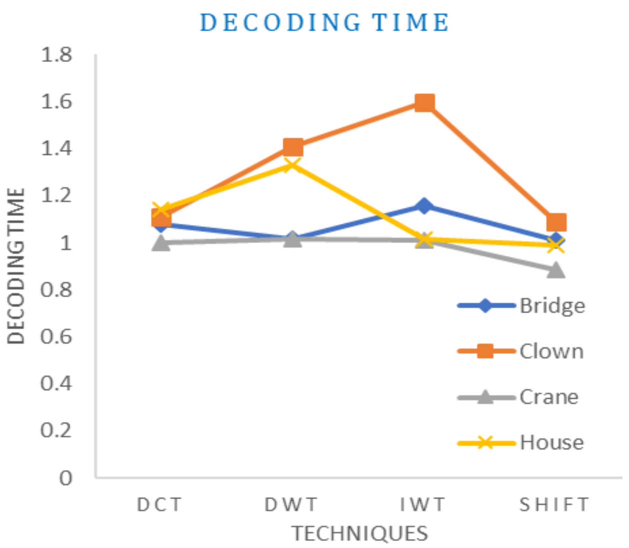

Figure 7: Show that the comparative performance of DCT, DWT, IWT, SHIFT Techniques for Decoding Time using Bridge, Clown, Crane, House images with sequence manner freemaster, Layer, plus, spiral watermark images on the behalf of our simulation model of watermarking and here we analyzed that decoding time of Shift Technique is compared less to all other techniques likes DCT, DWT, IWT in the case of all host images likes bridge, clown, crane and House. Shift technique shows better result compare to others technique.

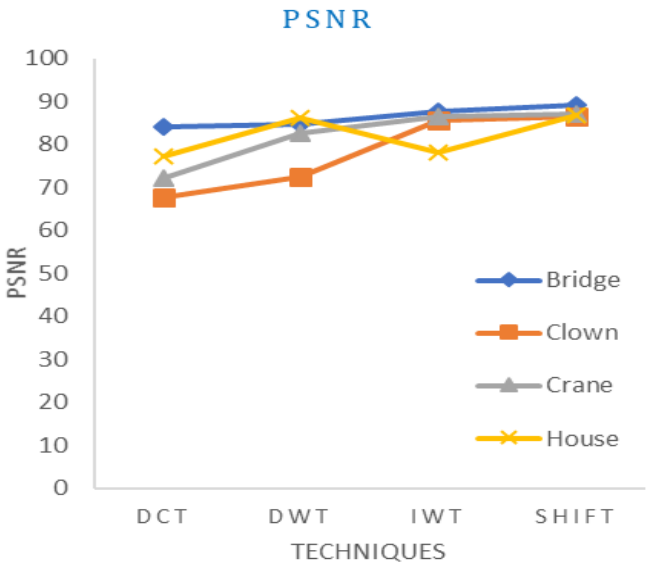

Figure 8: Show that the comparative performance of DCT, DWT, IWT, SHIFT Techniques for PSNR using Bridge, Clown, Crane, House images with sequence manner freemaster, Layer, plus, spiral watermark images on the behalf of our simulation model of watermarking and here we analyzed that PSNR of Shift Technique is compared more to all other techniques likes DCT, DWT, IWT in the case of all host images likes bridge, clown, crane and House. Shift technique shows better result compare to others technique.

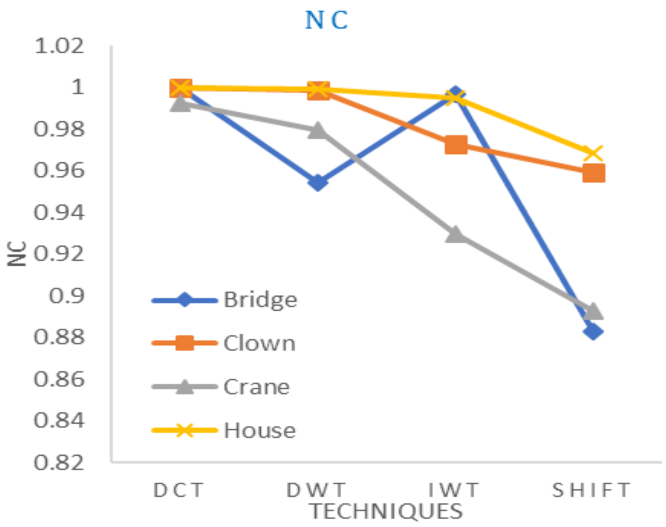

Figure 9: Show that the comparative performance of DCT, DWT, IWT, SHIFT Techniques for NC using Bridge, Clown, Crane, House images with sequence manner freemaster, Layer, plus, spiral watermark images on the behalf of our simulation model of watermarking and here we analyzed that NC of Shift Technique is compared less to all other techniques likes DCT, DWT, IWT in the case of all host images likes bridge, clown, crane and House. Shift technique shows better result compare to others technique.

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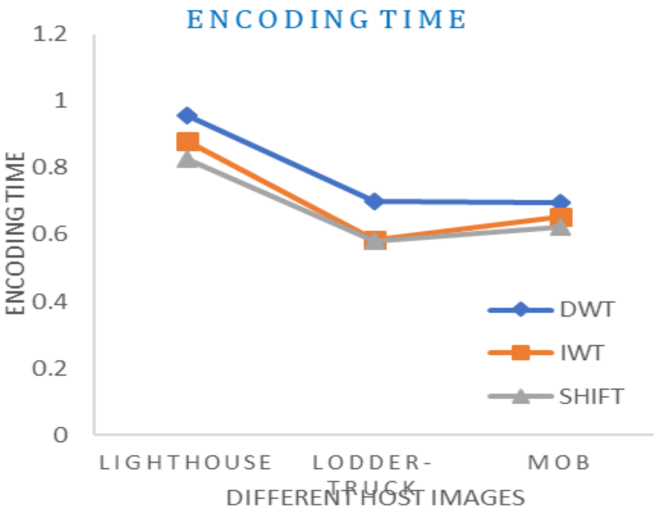

Figure 10: Show that the comparative performance of DWT, IWT, SHIFT Techniques for Encoding Time using lighthouse, Lodder-truck, mob images with sequence manner star, freemaster, getmark watermark images on behalf of our simulation model of watermarking and here we analyzed that encoding time of Shift Technique is compared less to all other techniques likes DWT, IWT in the case of all host images likes lighthouse, Lodder-truck, mob. Shift technique shows better result compare to others technique.

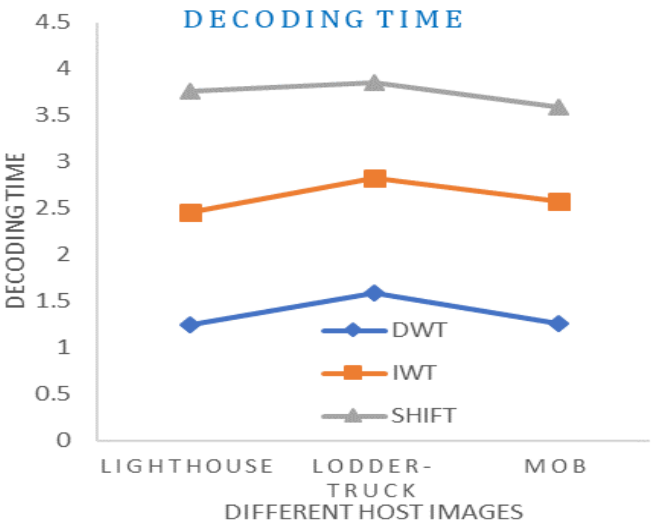

Figure 11: Show that the comparative performance of DWT, IWT, SHIFT Techniques for Decoding time using lighthouse, Lodder-truck, mob images with sequence manner star, freemaster, getmark watermark images on behalf of our simulation model of watermarking and here we analyzed that decoding time of Shift Technique is compared less to all other techniques likes DWT, IWT in the case of all host images likes lighthouse, Lodder-truck, mob. Shift technique shows better result compare to others technique.

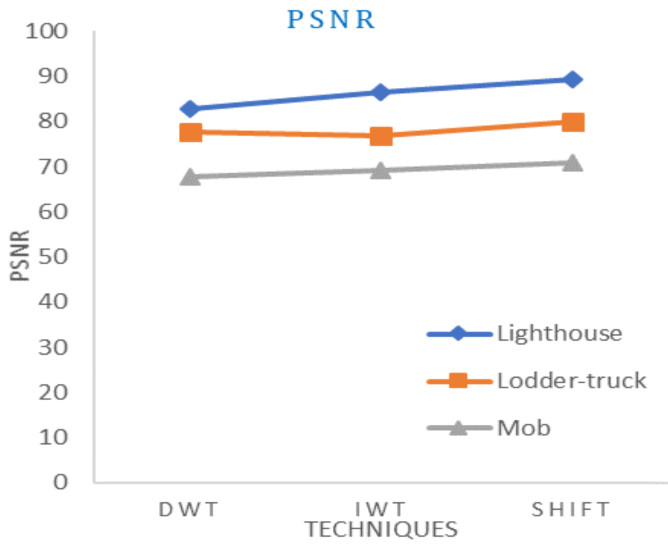

Figure 12: Show that the comparative performance of DWT, IWT, SHIFT Techniques for PSNR using lighthouse, Lodder-truck, mob images with sequence manner star, freemaster, getmark watermark images on behalf of our simulation model of watermarking and here we analyzed that PSNR of Shift Technique is compared more to all other techniques likes DWT, IWT in the case of all host images likes lighthouse, Lodder-truck, mob. Shift technique shows better result compare to others technique.

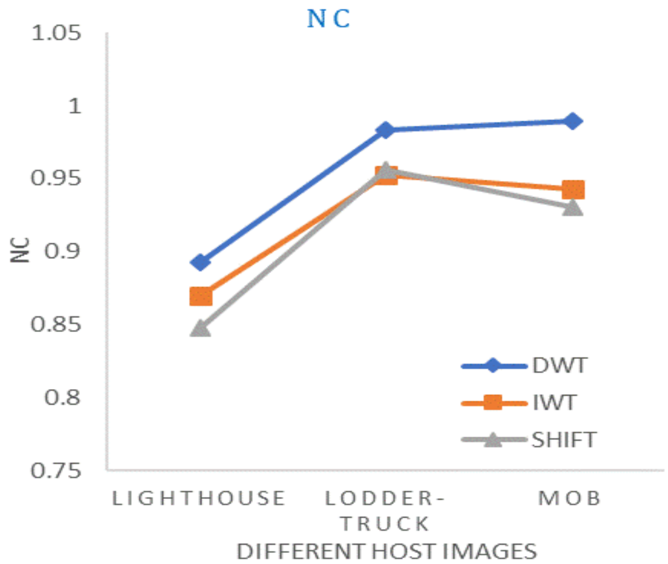

Figure 13: Show that the comparative performance of DWT, IWT, SHIFT Techniques for NC using lighthouse, Lodder-truck, mob images with sequence manner star, freemaster, getmark watermark images on behalf of our simulation model of watermarking and here we analyzed that NC of Shift Technique is compared less to all other techniques likes DWT, IWT in the case of all host images likes lighthouse, Lodder-truck, mob. Shift technique shows better result compare to others technique.

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IV. Conclusion & Future Scope

Security and content authentication are always a challenging task for the digital multimedia data. For the authentication and security used digital watermarking techniques. In digital watermarking, the new area of research feature-based watermarking technique. The process of digital watermarking used SIFT transform function. The SIFT transform function produces better features point in the level of local and better texture features instead of another transform function such as DWT and IWT and DCT. Our experiential results indicate the robustness of digital image watermarking. The minimum value of NC indicates the strong combination of embedding and the high value of PSNR indicates the better quality of the watermark image. The process of analysis finds the features-based image watermarking methods required the feature selection and feature optimization process for the better value of PSNR and NC. In future used feature optimization and neural network for the processing of digital image watermarking.

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