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Research Article

Hybrid DWT-SVD Based Video Watermarking For Copyright Protection Using Improved Artificial Bee Colony Optimization Algorithm

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Abstract: Watermarking is a component of inserting data into the multimedia, for example, image, audio or video. This study propose a method for video watermarking using hybrid DWT-SVD to protect the copy right of images. In order to improve the efficiency of video watermarking two main processes are used namely 1) watermark embedding process and 2) watermark extraction process. Before embedding process the input video sequence convert into number of frames. Here Singular Value Decomposition (SVD) transforms and DWT is applied in watermark image. The improved artificial bee colony algorithm is proposed for generating random frame for the embedding process. The result obtain from the watermark embedding process is the watermark video sequence. Next watermark extraction process is carried out. It is the reverse process of watermark embedding. In watermark extraction process, it extracts the watermark image from the watermark video sequence. The proposed method is implemented in MATLAB.

Keywords: Artificial bee colony, discrete wavelet transform, embedding, extraction, singular value decomposition, watermarking

INTRODUCTION

The rapid growth of multimedia content in digital form has increased the need to develop secure methods for legal distribution of the digital content. With the speedy growth of the Internet and multimedia systems in distributed environments, it is easier for digital data owners to transfer multimedia documents across the Internet. Therefore, there is an increase in the concern over copyright protection of digital content (Piva *et al*., 2002; Lu *et al*., 2001). Security of digital data has become more and more important with the omnipresence of internet. The advent of image processing tools has increased the vulnerability for illicit copying, modifications and dispersion of digital images. Against this background, the data hiding technologies for digital data such as digital watermarking have got a lot of attention recently (Akiyama *et al*., 2006). Digital watermarking is put into practice to prevent unauthorized replication or exploitation of digital data (Memon and Wong, 1998; Wang and Zhao, 2006). Digital watermarking is a technique that provides a way to protect digital images from illicit copying and manipulation. Watermarking is the process of embedding data into a multimedia element such as image, audio or video. This embedded data can later be extracted from, or detected in, the multimedia element for different purposes such as copyright protection, access control and broadcast monitoring (Cox *et al*., 2002).

A digital watermark is an imperceptible signal added to digital data, called cover work, which can be detected later for buyer/seller identification, ownership proof and so forth (Cox *et al*., 2002). It plays the role of a digital signature, providing the image with a sense of ownership or authenticity. The primary benefit of watermarking is that the content is not separable from the watermark. A watermark is capable of exhibiting numerous significant characteristics. These comprise that the watermark is hard to perceive, endures common distortions, resists malicious attacks, carries numerous bits of information, is capable of coexisting with other watermarks and demands little computation to insert or detect (Miller *et al*., 1999). In order for a watermark to be useful it must be robust to a variety of possible attacks by pirates. These include robustness against compression such as JPEG, scaling and aspect ratio changes, rotation, cropping, row and column removal, addition of noise, filtering, cryptographic and statistical attacks, as well as insertion of other watermarks (Pereira and Pun, 1999).

Digital watermarking technology has wide range of potential applications. The application areas are: copyright protection, authentication, image finger printing, hidden annotation, Broadcast Monitoring, Concealed Communication and more (Chen *et al*.,

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1999; Birk *et al*., 2008). Watermarks and watermarking techniques can be divided into various categories in various ways. According to the range of application, digital watermarking can be classified into image watermarking, video watermarking and audio watermarking (Wang and Zhao, 2006). Visible or invisible watermarks can be embedded into multimedia data by the process of watermarking. Visible watermarks are undoubtedly detectable in nature and a human observer can intentionally percept them. In order to prevent unauthorized access to an image visible watermarking is used (Mohanty *et al*., 2002). In contrast, the owner or the origin of the host image can be identified using the invisible watermarking that can also be employed to identify a customer or to prove ownership by the detection of any unauthorized image copies (Chae and Manjunath, 1997; Yeung and Minzter, 1997). Invisible watermarking can be classified into two parts, robust and fragile watermarks.

For digital watermarking of video, different characteristics of the watermarking process as well as the watermark are desirable (Deshpande *et al*., 2010; Moon and Ho, 2003; Bhattacharya *et al*., 2006; Agrawal, 2007; Mobasseri and Marcinak, 2005). These requirements are:

Invisibility: The digital watermark embedded into the video data should be invisible to the human observer.

Robustness: It should be impossible to manipulate the watermark by intentional or unintentional operations on the uncompressed or compressed video, at the same time, degrading the perceived quality of the digital video significantly thereby reducing its commercial value. Such operations are, for example, addition of signals, cropping, lossy compression, frame averaging, frame dropping and collusion.

Fidelity: A watermark is said to have high fidelity if the degradation it causes is very difficult for a viewer to perceive. However, it only needs to be imperceptible at the time that the media is viewed. If we are certain that the media will be seriously degraded due to other means such as transmission before being viewed, we can rely on that degradation to help mask the watermark.

Interoperability: Even though many applications call for watermarking in the compressed video, it would be a desirable property if uncompressed video could compatibly be watermarked without having to encode it first. Also, the watermark should sustain the compression and decompression operations.

Constant bit rate: Watermarking in the bit stream domain should not increase the bit rate, at least for constant bit rate applications where transmission channel bandwidth has to be obeyed.

Objectives:

- Studied and analyzed various video watermarking techniques for improving the performance.
- Designed and developed an efficient method for watermarking in video sequence using optimal frame selection methods.
- Incorporated improved artificial bee colony algorithm for selecting the optimal threshold value.
- Extended the summarization approach by incorporated improved artificial bee colony method.
- Conducted different performance analysis and comparative analysis by different evaluation metrics.

REVIEW OF RECENT RESEARCHES

A handful of watermarking schemes, which employs the robustness schemes for improved performance, have been presented in the literature for protecting the copyrights of digital videos. A brief review of some recent researches is presented here.

Liu and Zhao (2010) have proposed a 1D DFT (one-dimensional discrete Fourier transform) and Radon transform based video watermarking algorithm. An ideal domain which obtains the temporal information without losing the spatial information has been generated by the 1D DFT for a video sequence. A fence-shaped watermark pattern has been embedded in the Radon transform domain of the frames with highest temporal frequencies which they have selected with comprehensive analysis and calculation. The adaptive embedding strength for diverse locations has preserved the reliability of the watermarked video.

Reyes *et al*. (2010) have presented a public video watermarking algorithm, a visibly identifiable binary pattern, such as owner's logotype has been embedded by their method. After separating the video sequences into distinct scenes, the scene blocks have been selected at random and the binary watermark pattern has been embedded into their Discrete Wavelet Transform (DWT) domain. The binary watermark pattern has been mapped to a noise like binary pattern by employing a chaotic mixing method to improve he security of their proposed method. The watermark has been proved to be invisible and robust to several attacks by means of simulation results.

Ahmed *et al*. (2009) have proposed a 2-level Discrete Wavelet Transform decomposition of each RGB video frame component dependant video watermarking method. Independent watermarks have been embedded into separate shots by their method. The shots have been matched to watermarks by means of a genetic algorithm. Based on a key, any one of the HL1 of red, green or blue components of each frame has been selected by their proposed method and the error correcting code has been embedded into it.

Ait Saadi *et al*. (2010) have proposed a grey-scale pre-processing and robust video watermarking algorithm for the copyright protection application in the emerging video coding standard H.264/ AVC. The watermark was first transformed by a Hadamard transform and modified to accommodate the H.264/ AVC computational constraints before it were inserted into video data in the compressed domain. The approach leads to good robustness and high capacity of embedding by maintaining good visual quality of the watermarked sequences. The experimental results proved the capability to embed the watermark in short video sequences and the effectiveness of the algorithm against some attacks such as re-compression by the H.264 codec, transcoding and some common processing.

Zhang *et al*. (2007) have proposed a robust video watermarking scheme of the state-of-the-art video coding standard H.264/AVC. 2-D 8-bit watermarks such as detailed company trademarks or logos can be used as inconvertible watermark for copyright protection. A grayscale watermark pattern was first modified to accommodate the H.264/AVC computational constraints and then embedded into video data in the compressed domain. With the proposed method, the video watermarking scheme can achieve high robustness and good visual quality without increasing the overall bit-rate. Experimental results showed that the algorithm can robustly survive transcoding process and strong common signal processing attacks, such as bit-rate reduction, Gaussian filtering and contrast enhancement.

Based on the observation that low-frequency DCT coefficients of an image are less affected by geometric processing, Choia *et al*. (2010) have proposed a blind MPEG-2 video watermarking algorithm robust to camcorder recording. The mean of the low-frequency DCT coefficients of the video was temporally modulated according to the information bits. To avoid watermark's drift into other frames, they embed watermarks only in the B-frames of MPEG-2 videos, which also allows minimal partial decoding and achieves efficiency. Experimental results showed that the proposed scheme achieves high video quality and robustness to camcorder recording and other attacks.

Ye *et al*. (2007) proposed an efficient video watermarking scheme through modifying the third decoded luminance differential DC component in each selected macro block. The modification was implemented by binary dither modulation with adaptive quantization step. The scheme was based on the observation that luminance differential DC components inside one macro block are generally space correlated, so the quantization step can be adjusted according to adjacent differential components, to utilize properties of Human Visual System (HVS). The method was very robust to gain attacks since amplitude scaling will have the same effect on differential components and the quantization step. Experimental results showed that it can be implemented in real time with better visual quality than uniform-quantizing scheme.

Jiang *et al*. (2009) have presented an efficient video watermarking scheme through modifying the third decoded luminance differential DC component in each selected macro block. The modification was implemented by binary dither modulation with adaptive quantization step. The proposed scheme was based on the observation that luminance differential DC components inside one macro block are generally space correlated, so the quantization step can be adjusted according to adjacent differential components, to utilize properties of Human Visual System (HVS). Experimental results showed that it can be implemented in real time with better visual quality.

Sun *et al*. (2009) have proposed a video watermarking scheme based on motion location. In the scheme, independent component analysis was used to extract a dynamic frame from two successive frames of original video and the motion is located by using the variance of 8×8 block in the extracted dynamic frame. According to the located motion, they choose a corresponding region in the former frame of the two successive frames, where watermark is embedded by using the quantization index modulation algorithm. The procedure above was repeated until each frame of the video (excluding the last one) was watermarked. The simulations showed that the proposed scheme has a good performance to resist Gaussian noising, MPEG2 compression, frame dropping, frame cropping and more.

Liu and Zhao (2010) proposed a video watermarking algorithm based on the 1D DFT (one-dimensional discrete Fourier transform) and Radon transform. The 1D DFT for a video sequence generates an ideal domain, in which the spatial information is still kept and the temporal information was obtained. With detailed analysis and calculation, they have chosen the frames with highest temporal frequencies to embed the fence-shaped watermark pattern in the Radon transform domain of the selected frames. The adaptive embedding strength for different locations keeps the fidelity of the watermarked video. The performance of the proposed algorithm was evaluated by video compression standard H.264 with three different bit rates; geometric attacks such as rotation, translation and aspect-ratio changes; and other attacks like frame drop, frame swap, spatial filtering, noise addition, lighting change and histogram equalization. They conclude the introduction of the 1D DFT along temporal direction for watermarking that enables the robustness against video compression and the Radon transform-based watermark embedding and extraction that produces the robustness against geometric transformations.

Problem definition:

- The main motive of our proposed work is to solve the problems arising like copyright protection, copy protection, fingerprinting, authentication and data hiding.
- To improve the security.
- The demerits such as low PSNR and less correlation coefficient were also to be considered.
- Discrete Wavelet Transform is found to be an important tool in decomposing the images.
- The project implemented to extract the image having a good quality of data.
- To test the reliability of attacks such as removal, interference, geometric, cryptographic and protocol attacks.

The problem of resistance to video attacks, it is known that robustness is the critical issue affecting the practicability of any watermarking method.

PROPOSED METHOD

There is an insistent require for copyright protection against pirating in quick growth of network distributions of images and video. To address this matter of ownership identification different digital image and video watermarking schemes have been suggested. This research suggests a competent scheme for video watermarking scheme by means of discrete wavelet transform to guard the copyright of digital images. The competence of the suggested video watermarking technique is achieved by two main steps:

- Watermark embedding process
- Watermark extraction process

Using shot segmentation the input video sequence segment into shots before the embedding process. Next, the segmented video shots are divided into number of frames for the embedding process. Below, the detailed process proposed method is elucidated and the block diagram of the proposed method is demonstrated in beneath (Fig. 1).

Shot segmentation: Let as consider the input database contain i num of video sequence $V_i|I = 1, 2, \ldots n$. At initial step, the input video sequence is divided into

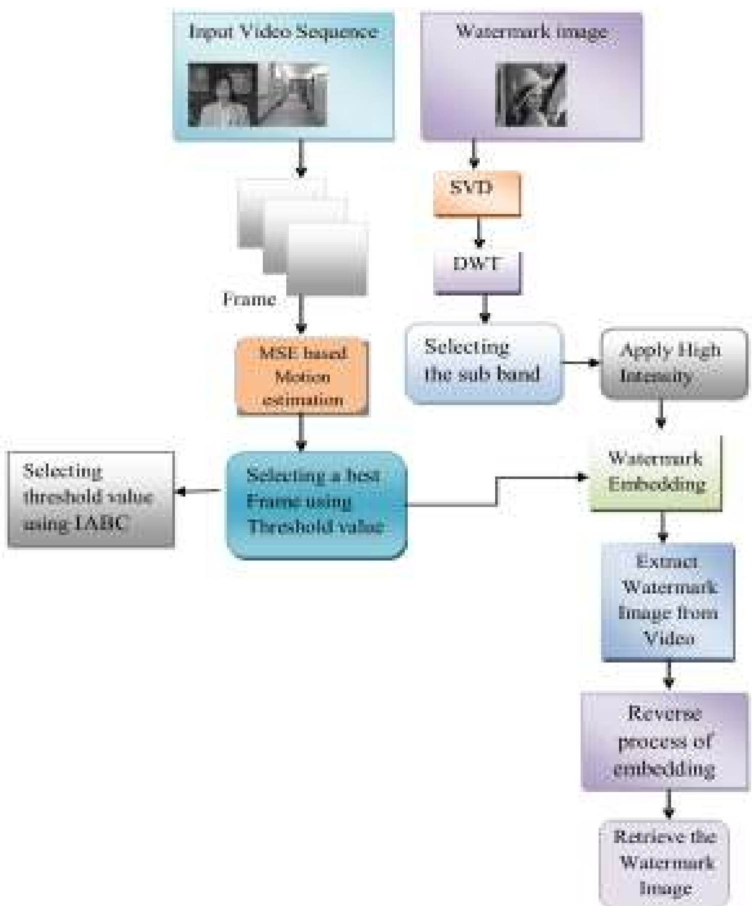

Fig. 1: Block diagram of proposed method

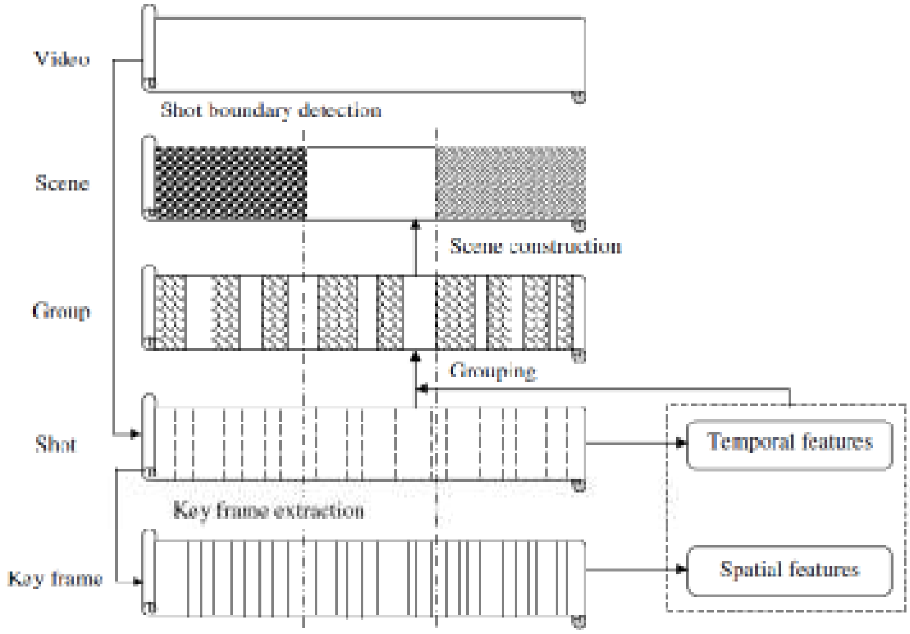

Fig. 2: Shot segmentation

shots then the segmented shots are divided into j number of frames. It's demonstrated in beneath (Fig. 2).

Motion estimation: Motion estimation is the process of finding out the motion vector that explains the transformation from one 2D image to another; usually from adjacent frames in a video sequence. Then by comparing each nearest frames for finding image quality the Mean Square Error (MSE) is computed. If the mean square error value is greater than the threshold value then choose that frame as the best frame.

$$\text{MSE} = \text{Distance between two frames} \quad (1)$$

If MSE>threshold, then select that frame as the best frame for embedding process. Here the threshold value is optimized using Improved Artificial Bee Colony Algorithm.

Improved artificial bee colony: Artificial Bee Colony (ABC) is motivated by the intelligent behavior of honey bees. It contains three components namely, employed bees, onlooker bees and scout bees. In ABC system, artificial bees fly around in a multidimensional search space and some (employed and onlooker bees) select food sources depending on the experience of themselves and their nest mates and fine-tune their positions. A few (scouts) fly and select the food sources arbitrarily without by means of experience. If the nectar amount of a novel source is higher than that of the earlier one in their memory, they memorize the novel position and forget the earlier one. In Fig. 3, the flowchart for the Improved Artificial Bee Colony is illustrated.

Preliminary step: Initially, produce the initial food source S_i (i = 1, 2, 3…, N) where N indicates the number of food source. This procedure is called initialization process. Using fitness function, the fitness value of the food source is computed to find the best food source. It's demonstrated in beneath:

$$fitness = MSE \quad (2)$$

where, f_i is an objective function for the particular problem. The iteration is set to 1 after finding the fitness value. Next the employed bee phase is performed.

Employed bee phase: Using the subsequent equation the novel food source are produced in the employed bee phase:

$$S_{ij}^{new} = S_{ij} + \gamma(S_{ij} - S_{kj}) \quad (3)$$

where, S_{ij} is the j^{th} parameter of the i^{th} employed bee; s_{ij}^{new} is a novel solution for S_{ij} in the j^{th} dimension; S_{kj} is the neighbor bee of S_{ij} in employed bee population; γ is a number arbitrarily chosen in the range of [-1, 1]; Next the fitness value is found for every novel food source and choose the best food source. After choosing the best food source next use greedy selection process. Using the Eq. (5), find the possibility of the chosen food source is calculated:

$$P_i = \frac{fitness_i}{\sum_{n=1}^{SN} fitness_n} \quad (4)$$

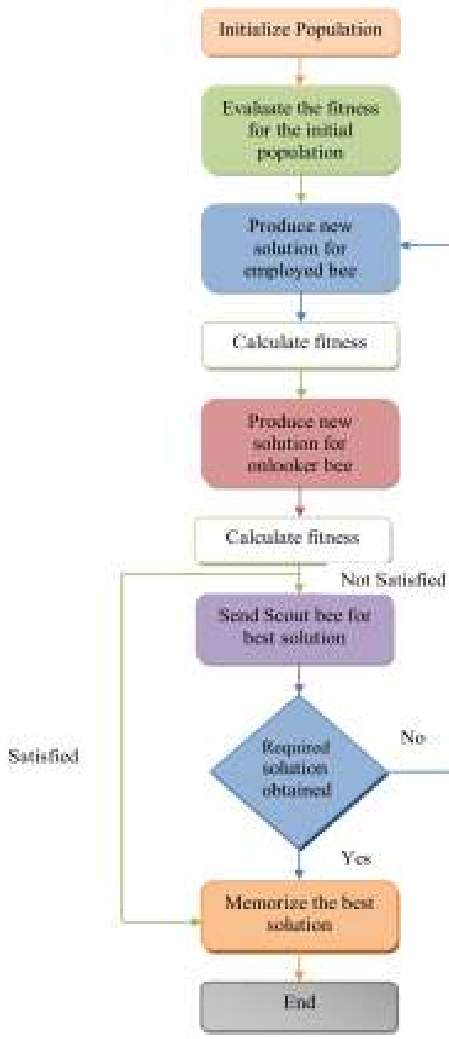

Fig. 3: The flowchart for improved artificial bee colony

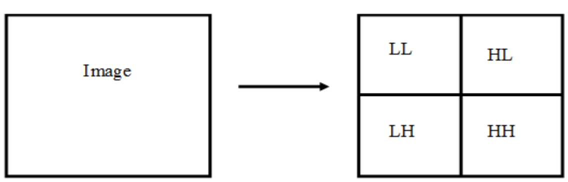

Fig. 4: DWT level

where, fit_i is a fitness value of i^{th} employed bee.

Onlooker bee phase: Only after calculating the possibility of the chosen food source number of onlooker bee is generated. At the same time novel solution is produced for the onlooker bee and fitness functions are computed for the novel solution next use greedy selection process in order to find the superlative food source.

Scout bee phase: Discover the Abandoned solution for the scout bees. If any discarded solution is present, after that substitute that with the novel solution discovered by scouts by means of the Eq. (5) and computes the fitness value. After that memorize the best solution attained so far. After that the iteration is increased and the process is prolonged till the stopping criterion is accomplished.

Watermarking: Watermarking is the sheltered methodology of embedding information into the data, for instance, audio or video and images. This procedure needs different properties depending on the real world applications, for example, robustness against attacks such as frame dropping, frame averaging attack. In proposed watermarking process initially read the watermark image next use the Singular Value Decomposition (SVD) and Discrete Wavelet Transform (DWT). It contains the subsequent steps the detailed procedure is elucidated below:

- Singular Value Decomposition (SVD)
- discrete wavelet transform (DWT)

Singular value decomposition: In order to improve the robustness, Singular Value Decomposition (SVD) has been employed in watermark methods. This method decays a matrix in three matrices P, Q, R. The equation of the matrices shown in below:

$$X = PQR^T \quad (5)$$

where, X is the original matrix, Q is the diagonal matrix of the eigenvalues of X. These diagonal values are as well called as singular values. P is orthogonal matrices and the transpose of an orthogonal matrix R. P columns are called left singular vector and the Q columns are called right singular vectors of X. The basic design behind SVD technique of watermarking is to find out the SVD of image and the differing singular values to implant the watermark.

Discrete wavelet transform: Discrete Wavelet Transform (DWT) decays the image into four sub bands (LL, LH, HL, HH) with similar bandwidth. The filter used in 1D DWT id biorthogonal filter. The subband is separated by using this filter. This change can be replicated on the sub bands (Fig. 4).

In each sub band symbolizes LL (Approximate sub band), HL (Horizontal sub band), LH (Vertical sub band) and HH (Diagonal sub band). LL symbolizes the low frequency component of the image while HL, LH, HH contain high frequency component. Image degradation is caused by sub band in low frequency. There by watermark is not embedded in this LL band. Relatively the high frequency sub bands are first-class sites for watermark insertion as human visual system does not sense transforms in these sub bands. However in high frequency sub band HH has information about edges and textures of the images, so implanting is not desired in this band. Now the sub band HL is the most approximate site for watermarking. DWT based watermark, the chosen band can develop the watermark robustness.

Watermark embedding steps:

Input: Input video sequence and watermark image.
Output: Watermark video sequence.

- Divide the input video sequence ($V_i|i = 1, 2, \ldots n$) into number of shots next the segmented shots are divided into j number of frames.
- Mean square error is found out in motion estimation by comparing the each nearest frames. If the MSE value is greater than the threshold values choose that frame as the best frame for watermark embedding.
- The threshold value is optimized by using Improved Artificial Bee Colony algorithm.
- After that choose the watermark image.
- After choosing the watermark image use singular value decomposition to the chosen watermark image.
- After that use 1D-DWT to the original watermark image. Four sub bands attained in the DWT level. The four sub bands are symbolizing as LL, LH, HL and HH.
- Select the LL sub band and find the high intensity value.
- Attain watermark video sequence.

Watermark extraction steps: The specified procedure of watermark extraction is described beneath. Watermark extraction step is the opposite process of watermark embedding process. No necessitate for the original video in watermark extraction process. For extraction steps only the watermark video and location of the embedding process are necessary.

Input: Watermark video sequence
Output: Extract watermark image

- Find high intensity value of all embed frames.
- Then compare intensity value with the motion frames.
- After that extract the watermark image from each embed frames.
- Use Inverse 1D level DWT.
- To bring back the watermark image.

EXPERIMENTAL RESULTS

The experimental result of the proposed video watermarking using hybrid DWT-SVD is explained below. In this study efficiently embedded the watermark image into input video sequence and extract back from the watermark video sequence. The output of the proposed video watermarking has been calculated by PSNR and NC (Normalized cross Correlation). The visual quality is evaluated by the PSNR criterion for watermarked video. The extracting fidelity is computed by the NC value between the original watermark image and the extracted watermark image. The performance of the proposed watermarking method is evaluated by using two video sample sequences namely Akiyo and Hall. The result of the Akiyo video sequence of the watermark image is shown in Fig. 5.

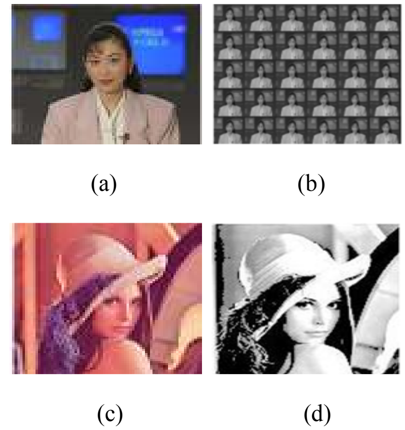

Fig. 5: (a) Input Akiyo video sequence, (b) Watermark video sequence, (c) Watermark image, (d) Extracted watermark image

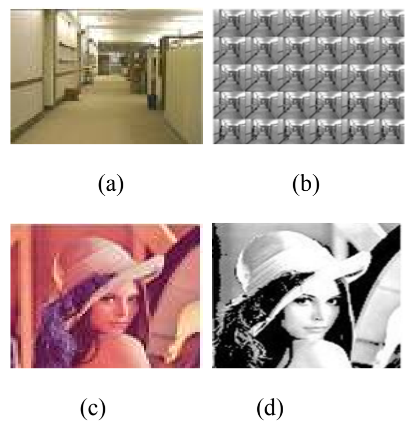

Fig. 6: (a) Input Hall video sequence, (b) Watermark video sequence, (c) Watermark image, (d) Extracted watermark image

The result of the Hall video sequence of the watermark image is shown in Fig. 6.

Evaluation metrics: The quality of the system is evaluated using the quality metrics. The quality metrics calculated in our proposed methodology are:

- PSNR
- NC

Table 1: PSNR values for Akiyo with and without optimization

	PSNR values for Akiyo	
Images	Without optimization using IABC	With optimization using IABC
Frame 1	100	100
Frame 5	61.4639	100
Frame 10	52.2662	57.4326
Frame 19	60.7383	61.3275
Frame 25	62.9450	61.1408

Table 2: PSNR values for Hall with and without optimization

	PSNR values for hall	
Images	Without optimization using IABC	With optimization using IABC
Frame 1	64.2878	63.3159
Frame 5	60.9552	62.0665
Frame 10	61.3617	63.8340
Frame 19	65.0782	67.5914
Frame 25	61.5439	61.1408
Frame 30	61.1265	59.9546

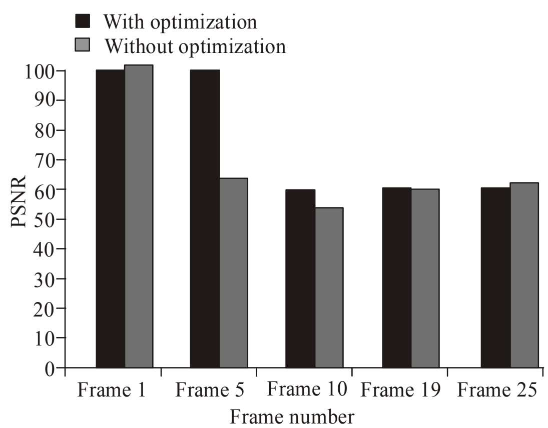

Fig. 7: PSNR values by varying the frame number for Akiyo

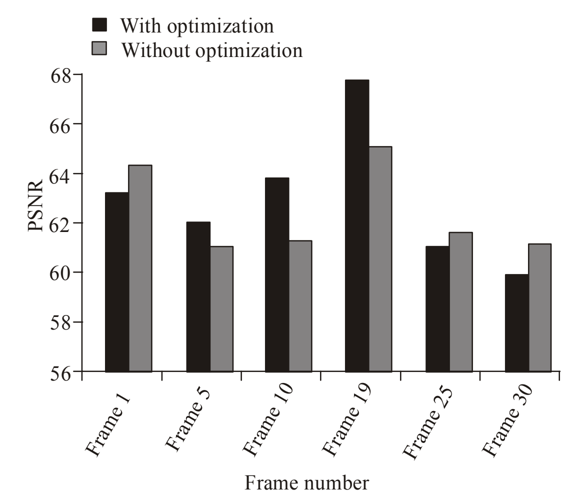

Fig. 8: PSNR values by varying the frame number for Hall

PSNR (Peak Signal to Noise Ratio): PSNR is the logarithmic value of ratio between signal and noise. It is expressed in decibels. The PSNR value is calculated using the following equation. It's shown in below:

Table 3: NC values for Akiyo with and without optimization

	Normalized cross correlation values for Akiyo	
Images	Without optimization using IABC	With optimization using IABC
Frame 1	1	1
Frame 5	0.9524	1
Frame 10	0.0947	0.7291
Frame 19	0.9811	0.8672
Frame 25	0.9762	0.8845

Table 4: NC values for Hall with and without optimization

	Normalized cross correlation values for hall	
Images	Without optimization using IABC	With optimization using IABC
Frame 1	0.2168	1
Frame 5	0.8859	1
Frame 10	0.9412	1
Frame 19	0.7090	0.9480
Frame 25	0.9480	1
Frame 30	0.9402	0.9602

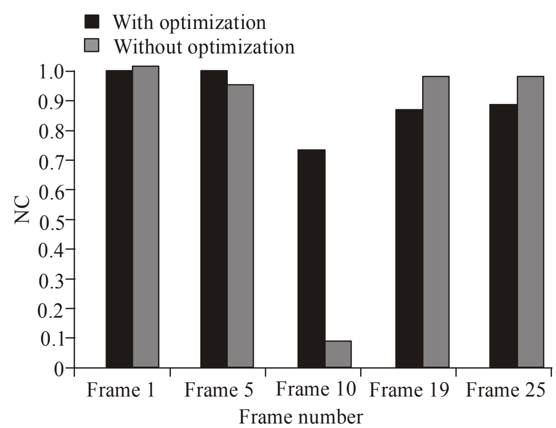

Fig. 9: NC values by varying the frame number for Akiyo

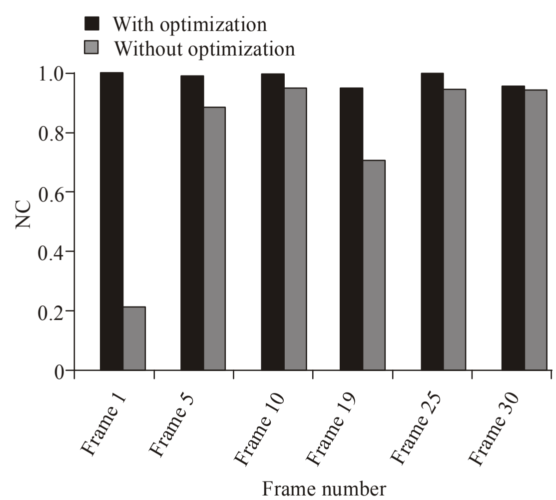

Fig. 10: NC values by varying the frame number for Hall

$$PSNR = 20\log_{10}\left(\frac{MAX_i}{\sqrt{MSE}}\right) \tag{6}$$

Table 5: Performance metrics with and without applying different types of attacks for Akiyo

Performance metrics	Without attack	Intensity attack	Salt and pepper noise attack
Mean PSNR	43.5134	40.9971	40.7514
Mean NC	0.9018	0.8837	0.8935

Table 6: Performance metrics with and without applying different types of attacks for Hall

Performance metrics	Without attack	Intensity attack	Salt and pepper noise attack
Mean PSNR	40.2199	39.3844	38.6122
Mean NC	0.8716	0.8610	0.8549

Table 7: Comparison during attacks for Akiyo video

	Proposed method with attack		Existing method (Yeung and and Minzter, 1997)	
Attacks	NC	PSNR	NC	PSNR
Salt and pepper noise attack	0.8935	40.7514	0.6548	23.459
Rotation	0.9212	42.654	0.6510	27.825
Ometric transform	0.8912	43.198	0.5313	40.0710
Intensity attack	0.8837	40.99	Not given	Not given

where,

MSE = Mean square error

MAX_i = The maximum possible pixel value of the image

Table 1 and 2 represent the PSNR values of the both input Akiyo and hall video sequence with and without optimization.

Figure 7 and 8 represent the PSNR values by varying the frame number for both Akiyo and Hall video sequence.

NC (Normalized cross Correlation): The Normalized Cross-Correlation (NC) is calculated using the following equation. It's shown in below:

$$NC = \frac{\sum_{i=1}^{i=n-1}\sum_{j=1}^{j=n-1} W(i,j).W'(i,j)}{\sqrt{\sum_{i=1}^{i=n-1}\sum_{j=1}^{j=n-1}(W(i,j))^2}.\sqrt{\sum_{i=1}^{i=n-1}\sum_{j=1}^{j=n-1}(W'(i,j))^2}} \quad (7)$$

where,

$W(i, j)$ = Pixel values of the original watermark

$W'(i, j)$ = Pixel values of the detected watermark

Table 3 and 4 represent the NC values of the both input Akiyo and hall video sequence with and without optimization.

Figure 9 and 10 represent the NC values by varying the frame number for both Akiyo and Hall video sequence. It's shown in below.

Robustness evaluation: To verify the robustness of the proposed video watermarking scheme, the experimental results are conducted with various attacks for the watermark image.

Intensity attack: It's a type connected with attack by which attacker transform the intensity on the watermarked picture to weaken the watermark data:

- Photographic negative (using imcomplement function)

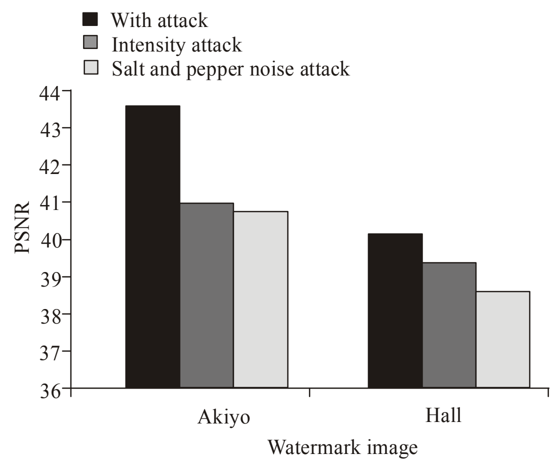

Fig. 11: PSNR value for watermark image with and without applying different types of attacks

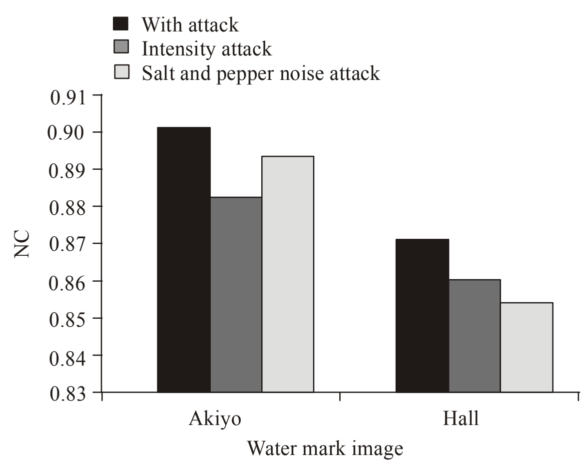

Fig. 12: NC value for watermark image with and without applying different types of attacks

- Gamma transformation (using imadjust)
- Logarithmic transformations (using c*log(1+f))
- Contrast-stretching transformations (using 1./(1+ (m./(double (f)+eps)).^E)

Salt and pepper noise attack: Here we use the salt and pepper noise for the noise attack. The salt and pepper noise is added to the watermark image. After applying the salt and pepper noise, the noise attacked image is extracted from the watermark image.

Outside of all above we will find so various attacks including resizing, popping, scaling, sharpening, JPEG compression etc. which affects the quality of watermark photograph and watermark far too.

For examine the criteria firstly assault the image with all of these attack. From then on recover the actual watermark details from attacked image. Compare the excellent of watermark image recovered by non-attacked along with recovered by attacked image. Thus anyone can examine the robustness of criteria against these attacks. Table 5 and 6 represent the performance metrics with and without applying different types of attacks for watermark image both Akiyo and Hall video sequence.

Figure 11 and 12 represent the PSNR value for watermark image with and without applying different types of attacks both Akiyo and Hall video sequence.

Here in Table 7 the proposed methodology performance is compared with the existing method (Saurabh *et al*., 2013). The robustness of the watermarking scheme is analyzed based on two different attacks such as Salt and Pepper noise attack and Intensity attack. In this table Salt and pepper noise attack of Akiyo video is compared with existing technique (Saurabh *et al*., 2013). Our proposed method gave better robustness when compared to the existing method.

CONCLUSION

In this study modified artificial bee colony algorithm is proposed. Watermark embedding and watermark extraction are the two main process implemented in the work in order to improve the efficiency. The input video sequence converted into number of frames before the embedding rocess. In watermark image singular value decomposition is applied. The improved artificial bee colony algorithm is proposed for generating random frame for the embedding process. The result obtain from the embedding process is watermark video sequence. Watermark extraction is the reverse process of embedding, it extract the watermark image from the watermark video sequence.

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