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A Hybrid Model for Improving the Robustness of a Digital Video

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Abstract:- **Now a days the digital media applications are extensively used in the internet. In order to stop copying and distribution of digital video, the digital video applications needs copyright protection. So, the copyright protection for these digital media applications is important. For the copyright protection digital watermarking is one of the techniques. In this paper a hybrid model, which is mainly used for improving the robustness of a digital video.This hybrid method mainly uses two transforms namely Discrete Wavelet Transform (DWT) and Principal Component Analysis (PCA). The original Video is to be converted into the frames. The DWT decomposes the video frames into four sub bands and then finding the PCA score for the LL sub band. The PCA of the watermark logo are embedded to the PCA components of the sub blocks of original video frame. The proposed method is implemented and tested in MATLAB 2012b student version software. The watermarked video frame is subjected under numerous attacks and tested for the robustness.**

Key words: Digital Video, DWT, PCA, Robustness, Watermarking.

I. INTRODUCTION

In order to stop copying and distribution of digital video, the digital video applications needs copyright protection. Watermarking is one of the techniques for copyright protection [1]. Watermark embeds user information like ownership signature or an emblem within the video. Even though we are applying the emblem the video should not affect its visual quality. This watermark can be extract in the future to prove the owner when any dispute arises. The strengthness and the imperceptibility are the major factors for copyright protection. An unauthorized person can apply several attacks for the removal of watermark. Only through a proper extraction algorithm can extract the watermark. The watermark can be applied for an image, an audio or a video. This can be applied on both compressed or an uncompressed data [4].

The fast multiplication of media over web requests refined system for secure and productive access to data. There is developing need to demoralize unapproved duplication and utilization of advanced information. With the appearance of computerized feature, issues of copyright protection have gotten to be more critical, since the duplication of advanced feature signs does not bring about a characteristic diminishing in quality ordinarily endured by simple digital video [2]. Steganography and watermarking are systems utilized for the imperceptible inserting of data in the host information, with the aim data is put together with the host information holding mystery data. The primary contrast in the middle of steganography and watermarking is that steganograpic routines depend on the way that secretive correspondence is a point to point correspondence between trusting gatherings alone and that is obscure to outsiders. Subsequently, steganograpic systems are ordinarily not intended to be vigorous against endeavoured assaults. In watermarking routines the presence of the implanted data is obscure to unapproved gatherings that have entry to the information, and can endeavour unlawful assaults.

The web unrest is presently going full speed ahead, as with the developing media innovations, the centre is moving from engineering to substance. As business merchants and designers are attempting to utilize system engineering to convey media items for benefit. This movement in-evitably raises how to ensure proprietorship rights. Advanced watermarking has been proposed as an approach to recognize the source, maker, and manager, approved buyer of an archive or a picture [2]. It's destination is to for all time and unalterably stamp the picture.

Advanced watermarking will be the process of implanting data into a computerized sign which may be used to confirm its credibility or the personality of its holders. In computerized watermarking, the sign may be a picture, a sound, or a feature. In the event that the manager sign is replicated, then the data additionally conveyed in the duplicate. A sign may convey a few sorts of watermarks in the meantime. In unmistakable computerized watermarking, the data is obvious in picture or feature. Commonly, the data is content or a logo, which distinguishes the responsibility for interactive media. At the point when a TV telecaster adds its logo to the corner of a transmitted feature, it is additionally a noticeable watermark. Computerized archives are ordinarily scrambled to them unviewable without the unscrambling key. This method works well for transmission and capacity, however archive is decoded for review or printing, subs retransmission or scattering is not encoded.

II. ALGORITHM

The projected watermark method uses two transforms particularly

(a) Discrete wavelet Transform (DWT) and
(b) Principal Component Analysis (PCA)

(A) Discrete Wavelet Transform:

The DWT applies pair of filters namely low pass filter and high pass filter in every row dimension and then applied to every column. So that the 2-D image is divided in to four non- overlapping sub bands i.e. LL, LH, HL, and HH. The procedure could be rehashed to get multiple scale wavelet decay. The data of low recurrence area LL sub band is a picture near the original picture. The recurrence regions of LH, HL and HH separately speaks to the level detail, the upright subtle element and the slanting point of interest of the unique picture. As indicated by the character of HVS, human eyes are touchy to the change of smooth region of picture, yet not delicate to the modest change of edge, profile and streak. Installing the watermark in the larger amount sub groups expands the heartiness of the watermark.

On the other hand, the picture visual devotion may be lost, which might be measured by PSNR. With the DWT, the edges and surface might be effortlessly distinguished in the high recurrence band [5]. Subsequently it's difficult to cognizant that putting the watermarking indicator into the huge sufficiency coefficient of high-recurrence band of the picture DWT changed. At that point it can convey more watermark indicator and has great disguising impact.

(*B) Principal Component Analysis:*

Principal Component Analysis (PCA) is a measurable system that uses an orthogonal transformation to change over a set of perceptions of perhaps correlated variables into a set of estimations of directly uncorrelated variables are called main principal component parts.The quantity of straightly uncorrelated variables (central parts) are short or equivalent to number of the first variables. This change is characterized as the first foremost segments which are having the biggest covariance [3], and afterward each one succeeding parts thusly has the most noteworthy conceivable difference under the imperative that it is orthogonal to (i.e., uncorrelated with) the first essential parts. The Principal segments are characterized to be autonomous, if the information set is joint typically circulated. The Principal segment investigation is touchy to relative scaling of unique variables.

(C) Embedding Procedure:

1) Segregate the original video into frames.
2) The binary watermark image is changed into vector V= {v1, v2, v3,...., vn }.
3) Convert every frame from RGB to YUV color format.
4) Decompose every video frame in to four sub bands LL, LH, HL, and HH by applying DWT to Y component.
5) The required decomposed sub band LL is divided in to non-overlapping blocks. Each block must be same size and this size must be equal to the watermark logo.
6) The PCA must be done for the watermark vector and the non-overlapping blocks of LL sub band.
7) The PCA of watermark logo are embedded with the PCA score of every sub block with strength α.

$$pca_i^{'} = \mathrm{pca_i} + \propto \mathrm{W} \ldots\ldots (1)$$

Where pca_i represents the principal component matrix of the i^{th} sub block.

8) Perform the inverse PCA operation and IDWT to get the watermarked video frame.
9) Convert the YUV into RGB frames and combine the watermarked video frames into video.

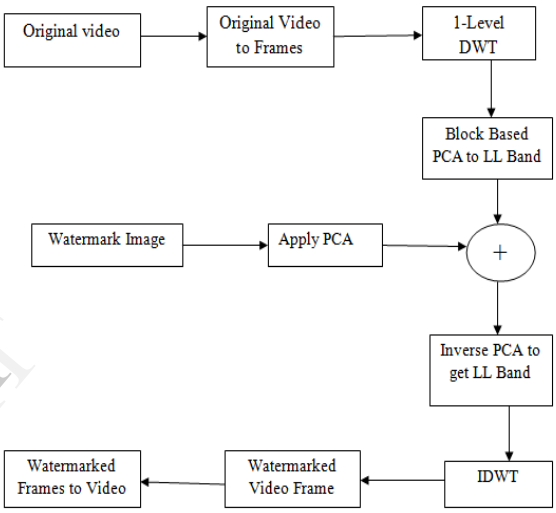

Fig.1: Watermark Embedding

(D) Extraction Procedure:

1) Load the watermarked video frame which may or may not be attacked.
2) Decompose the watermarked video frame in to four sub bands.
3) The LL sub band is divided into non-overlapping sub blocks.
4) Compute the PCA score for every sub block.
5) Differentiate the PCA sub block's score of watermarked video frame with the PCA sub block score of original video frame to extract the watermark.

$$W_i^{'} = \frac{pca_i^{'} - pca_i}{\alpha} \ldots\ldots\ldots\ldots (2)$$

Where $W_i^{'}$ watermark extracted from i^{th} sub block.

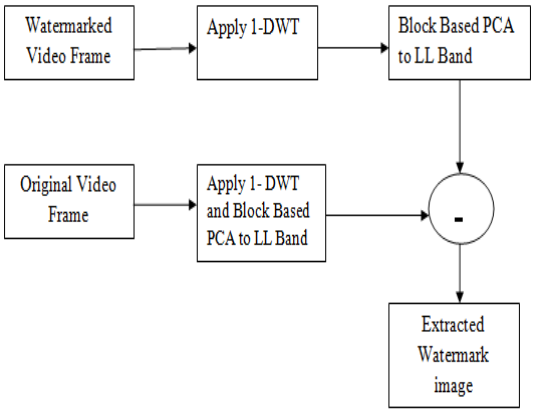

Fig.2: Watermark Extraction

(E) Finding Principal Component:

1) Change the non-overlapping sub blocks matrix into row vector R_i.
2) For every vector calculate mean u_i and variance σ_i.
3) Find the targeted scaled version of row vector R_i as

$$S_i = \frac{R_i - u_i}{\sigma_i} \dots\dots\dots\dots\dots\dots\dots (3)$$

4) calculate the PCA score as

$$pca_i = S_i * coeff_i \dots\dots\dots\dots (4)$$

Where pca_i represents the principal component score of the i^{th} sub block.

III. EXPERIMENTAL RESULTS

The projected method is applied to the 'new.avi' video with an 'mits.bmp' watermark emblem. The watermarked video is tested under numerous attacks and its robustness is tested by using the PSNR and the watermark is compared with the extracted watermark by using NC. This method is programmed and tested in the mathworks MATLAB 2012b software.

Fig.3: Original video frame

Fig.4: Watermark Image

Fig.5: Watermarked video frame

Fig.6: Extracted Watermark image

When the performance of the rule has been extracting and refining the quality of measured in terms of its imperceptibility watermark, a similarity measuring of the and strength against the potential attacks extracted and therefore referenced like noise addition, filtering, geometrical attacks etc.

PSNR:

The Peak Signal to Noise Ratio is employed to know the deviation of the watermarked or the attacked watermarked video frames to the original video frame and it is outlined as:

$$\text{PSNR}=10Log_{10}(255^2/MSE) \dots\dots\dots (5)$$

Where MSE is the Mean Square Error which measures the mean square error between the original video frame and the watermarked video frame which may or may not be attacked.

The MSE is outlined as:

$$\text{MSE}= (1/mn)\sum_{i=1}^{m} \sum_{j=1}^{n} [O(i,j)-O'(i,j)].(6)$$

Where O(i, j) = original video frame

and $O'(i,j)$ = watermarked video frame

The higher PSNR value indicates the additional imperceptibility of watermarking.

Normalized Coefficient (NC):

The NC measures the strengthness of watermarking whose maximum value is 1.

$$NC = \frac{\sum_i \sum_j W(i,j) \cdot W'(i,j)}{\sqrt{\sum_i \sum_j W(i,j)} \sqrt{\sum_i \sum_j W'(i,j)}} \qquad (7)$$

Where w (i, j) = watermark image and
w′(i, j) = extracted watermark image
When extracting and refining the quality of watermark, a similarity measuring of the extracted and therefore referenced watermark is employed for objective judgement of the extraction fidelity. The subsequent images represent stills taken from watermarked video when after attacks are been carried out on it.
The following table shows the robustness of watermark against various attacks.

PARAMETER	PSNR	NC
Without attack	38.71	0.7648
Gaussian Noise	27.9631	0.6921
Salt & Pepper Noise	26.4269	0.6842
Rotation	26.4241	0.6726
Compression	37.1628	0.5374
Median Filtering	38.78	0.5771

TABLE.1: RESULT ANALYSIS

IV.CONCLUSION

The rule enforced using the hybrid model increases the strength of the watermark embedding procedure. Even though we embedded the watermark by the proposed method it should not degrade the original video quality. For future work an independent watermark can be embedded to the group of frame sequence.

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