

Enhancement of Differential Time Lapse Video Technique Using Visible and Invisible Video Watermarking Techniques

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Abstract—Time lapse video technique is visualization technique that transforms regular time-lapse footage into composite images, accentuating periodic and long-term events. Basically in this technique, a series of photographs of the subject are taken at regular or irregular intervals and then arranged sequentially to create a small movie of all those shoots. This technique is a very powerful technique to document extremely slowly hanging, developing, moving phenomenon. Time lapse video technique in documentary reduces time for analysis and size of the document. Visible video watermarking used for real time application to display time and date at which video is captured. And invisible video watermarking is to increase the encryption of taken video. MATLAB based algorithm is used for generating the differential time lapse video along with the visible and invisible video watermarking.

Keywords: Time Lapse Video technique, visible & invisible video watermarking, PDV, PDC, PDT, LSB, DWT, PSNR, MSE.

I. INTRODUCTION

Time lapse technique is a cinematography technique whereby frames are captured at a rate much slower than it will be played back. Time-Lapse is an effective tool for visualizing motions and processes that evolve too slowly to be perceived in real-time. Time-Lapse videos are regularly used to capture natural phenomena and to provide artistic cinematic effects. The live streams of frames are captured, by the camera connected to the system. MATLAB directly can access these live streams of frames. Periodic Time Lapse Video can be generated by sampling the live frames at regular rate. Periodic Time Lapse Videos are useful to show effectively natural phenomenon only. In order to show non-natural phenomena effectively, a special type of non-periodic time lapse Video, namely differential time lapse video can be used [1].

A differential time lapse video can be generated by the arranging the different frames in specific order, captured by the capturing device in the video file. The first frame captured is stored in the video file. The next frame is compared with the last frame stored by pixel to pixel bit mapping algorithm. If the pixel value is differed by the amount greater than the Pixel Difference Value (PDV), the pixel is counted as modified pixel. The total numbers of modified pixel are counted. If the total number or modified pixel are greater than 10% (can take some other value depends on application requirement) of total number of pixel in the frame, the frame is selected and store in video file else frame is discarded. The selected frames are date and time stamped using visual watermarking technique. The

watermarking used here is lossless technique. The purpose of the watermarking is to make sure that the event time is recorded over each frame which is recorded into the differential time lapse video.

Digital watermarking is one of the ways to prove the ownership and increase security of the media. The advance of computer technologies and the proliferation of the Internet have made reproduction and distribution of digital information easier than ever before. One way for copyright protection is digital video watermarking, which means embedding of certain specific information about the copyright holder (company logos, ownership descriptions, etc.) into the media to be protected. Digital watermarking methods for videos are usually categorized into two types: invisible and visible. [2]

The first type aims to embed copyright information imperceptibly into host media such that in cases of copyright infringements, the hidden information can be retrieved to identify the ownership of the protected host. It is important for the watermarked image to be resistant to common image operations to ensure that the hidden information is still retrievable after such alterations. Methods of the second type, on the other hand, yield visible watermarks which are generally clearly visible after common image operations are applied. In addition, visible watermarks convey ownership information directly on the media and can deter attempts of copyright violations.

II. DIFFERENTIAL TIME LAPSE VIDEO TECHNIQUES

In order to select the frame out of live streaming captured by the video capturing device, motion detection technique, edge detection technique, bit wise pixel mapping technique etc. can be used. The simple bit by bit pixel mapping based algorithm is used to detect the motion. The simplified algorithm of selection criteria of frames for generating differential time lapse video is shown in Fig. 1. The first frame captured by the capturing device, get stored in the video file. The next frame captured is compared with the previous frame. If variations found enough, the frame get selected to be stored in video file else get discarded [2]. The variation calculation is done by pixel to pixel bit mapping algorithm. The previously stored frame is compared with the recently frame captured by pixel to pixel. If pixel intensity having the value difference more than some pre-define Pixel Difference Threshold (PDT) level then, it consider as the change in the pixel. The PDT value is kept around 20 to make sure that the change in the pixel value is not due to the surrounding environmental change, but due to the change in the object only.

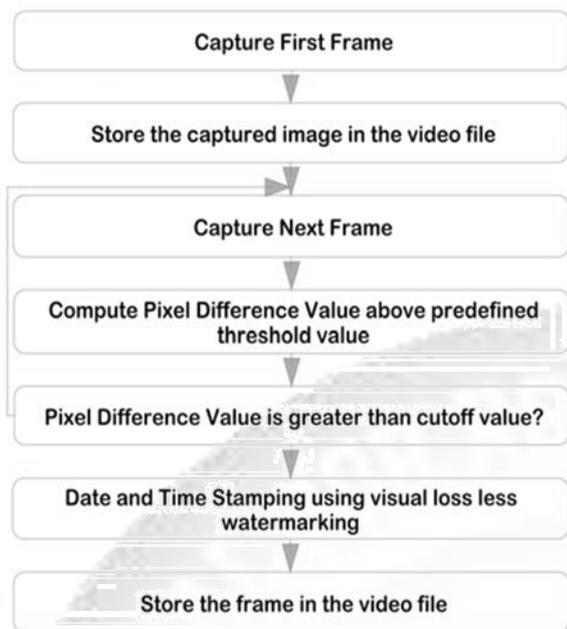


Fig.1: An algorithm for frame selection criterion

This value selected is also depends on the object of the focus and the environment of the observe location. The pixel difference value is one the parameter which defines the quality of differential time lapse video.

The total number of such modified pixel are calculated, are known as Pixel Difference Value (PDV). It the PDV is found above the some pre-defined cut-off value, Pixel Difference Cut off (PDC) then the frame gets selected to be stored in video file, else discarded. The pixel difference cut off value is another parameter which defines the quality of the differential time lapse video as frame selection or rejection criteria depends on this value.

III. FRAME SELECTION CRITERION

The first frame captured by the camera is directly stored. The next frame captured by the camera is compared with the last frame stored Thus, while comparing the frame we will not consider the change bellowed some threshold value, kept around 10 to 20 depends on application.

If the change in the pixel intensity is above the threshold value then we will consider it as change in intensity and not as motion and will able to discard it. Though it is not easy to define the value, after much experiment the value can be finalized with lots of experiments.

The pixel to pixel calculations is made between the last frame stored and recently received frame, then find out the how many pixel are having different intensity. If the count of number of change in pixel intensity variation goes above the 10% value of the total number of pixel in the frame, now onwards known as pixel difference value (PDV) consider that this frame is needed to be saved. It is not necessary to kept it at 10%; we can keep it at any value. Experiments shows that it should be around 10% for indoor recording and around 5% for outdoor (long shots) recording, thought this values are depends on application and varies with the situation, atmosphere and surrounding environment.

Videos are often projected at 25 FPS, meaning that 25 images appear on the screen every second. Under normal circumstances a video camera will record images at 25 FPS.

Since the projection speed and the recording speed are the same, the images onscreen appear to move normally. Even if the video camera is set to record at a slower speed, it can be projected at 25 FPS. Thus the image on screen will appear to move faster.

In the first part of Fig-2 the frames are captured at 25 FPS (frames per second) normal rate and total time duration is of 1 second. In the second part of Fig-3 the frames are captured at 5 FPS and during given period of 1 second only 5 frames are captured. In the third part of Fig-2 frames are captured at 4 FPS and during given period of 1 second only 7 frames are captured. Thus, depends on how many frames we are lapse here depend on that frame rates are changed. It should be note that frame rate may goes below the 1 sec also for really slowly moving phenomena such like growth rate of plant, aging effect on building or hills etc. and it should be a bit higher for a bit more fast changing phenomena such as movement of the sun or moon, water drop dispersion over cloth etc.

When Frames are Captured at Normal Rate : 25 FPS



When Frames are Captured at Rate : 5 FPS



When Frames are Captured at Rate : 4 FPS



Fig.2: Time-lapse Technique Interpretation while capturing frames

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Time: 9: 39: 19 ** Date: 7- 3-2013 : 9235.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 9673.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 9665.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 9580.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 9214.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 9398.000000
Time: 9: 39: 19 ** Date: 7- 3-2013 : 10254.000000
FRAME RECORDED : Time: 9: 39: 19 ** Date: 7- 3-2013 : 10254.000000
Time: 9: 39: 20 ** Date: 7- 3-2013 : 17877.000000
FRAME RECORDED : Time: 9: 39: 20 ** Date: 7- 3-2013 : 17877.000000
Time: 9: 39: 21 ** Date: 7- 3-2013 : 32879.000000
FRAME RECORDED : Time: 9: 39: 21 ** Date: 7- 3-2013 : 32879.000000
Time: 9: 39: 21 ** Date: 7- 3-2013 : 15258.000000
FRAME RECORDED : Time: 9: 39: 21 ** Date: 7- 3-2013 : 15258.000000
Time: 9: 39: 22 ** Date: 7- 3-2013 : 25457.000000
FRAME RECORDED : Time: 9: 39: 22 ** Date: 7- 3-2013 : 25457.000000
Time: 9: 39: 23 ** Date: 7- 3-2013 : 25576.000000
FRAME RECORDED : Time: 9: 39: 23 ** Date: 7- 3-2013 : 25576.000000
Time: 9: 39: 24 ** Date: 7- 3-2013 : 71933.000000
FRAME RECORDED : Time: 9: 39: 24 ** Date: 7- 3-2013 : 71933.000000
Time: 9: 39: 24 ** Date: 7- 3-2013 : 8530.000000
Time: 9: 39: 24 ** Date: 7- 3-2013 : 9670.000000
  
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Fig.-3 Backlog files of recorded video

After selecting the frame per second criterion there is need to calculate the pixel difference value(PDV).To decide the pixel difference value need to set Pixel Difference Threshold(PDT) and Pixel Difference Cut off (PDC). In general PDT is set between 20 to 30 and PDC value is set like 5000,9000,12000,17000 etc.

In given Fig. 4 (log file) PDT is 20 and PDC is 10000,and the file shows how many frames are stored.

The algorithm checks the overlapped image and where ever it found '1' on this character map it keeps the bit intensity as it is and where ever if found '0' on this character map it complement the pixel value whether the image is bright or dark. This makes this particular location brighter and hence the embedded character will be easily seen. This can be seen in above example that time stamping can be read easily in both the cases. These watermarking is purely loss less technique here and image can be reconstructed easily.

V. INVISIBLE VIDEO WATERMARKING USING LSB AND DWT

Still considering and manipulating of the human visual system (HVS), the LSB method involves replacing the 1 least significant bit of each pixel of a container image with the data of a hidden image. Since human visual system is not very attuned to small variations in colour, the method adjusts the small differences between adjacent pixels leaving the result virtually unnoticeable. Following Fig. shows the way in which we have embedded the message behind the container image in the spatial domain[4],[5].

The watermarking techniques in which the information is stamped onto the LSB of the image pixel values are unlikely to produce visual artifacts in the image. If an image is altered, the LSB is likely to be changed such that the verification will be able to determine the modification. Such LSB manipulation, however, is not secure against malicious attacks: it is relatively easy to create a system that alters the visual content of an image without changing the LSB of every pixel value, to a degree that the whole image can be modified while the LSB is kept intact. Verification based on the LSB then fails to detect the alterations.

Here only one frame of captured video is shown. For video watermarking first video is converted in number of frames. Then watermarking is applied. After applying watermarking all frames are combine and converted to the video.

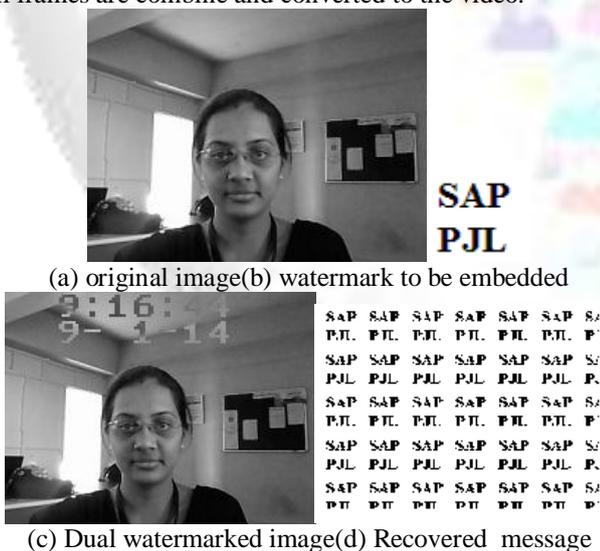


Fig. 7: Dual watermarking using LSB

To understand the basic idea of the DWT let us focus on one dimensional signal [9]. The signal is passed through a low pass filter and a high pass filter so as to get both high and low frequency parts of the signal. High frequency part contains edge components wherein low frequency part contains information components. The same process is

repeated for the low frequency part so as to get second level low and high frequency components[10,11]. The number of decomposition levels depends on the application of interest. So far as watermarking and compression is concerned a maximum of five levels of decomposition are computed. The original signal can also be reconstructed from the knowledge of DWT coefficients. This process of reconstruction (synthesis) is called the inverse DWT (IDWT).

To embed a message in video using DWT the video is first converted into the number of frames. Then pn sequence code is generated. Color space conversion is done for good quality of color image. The watermark and pn sequence is embedded with original video. Inverse DWT is done to get watermarked frame. By using different DWT coefficient ,the quality of video and encryption can be increased.

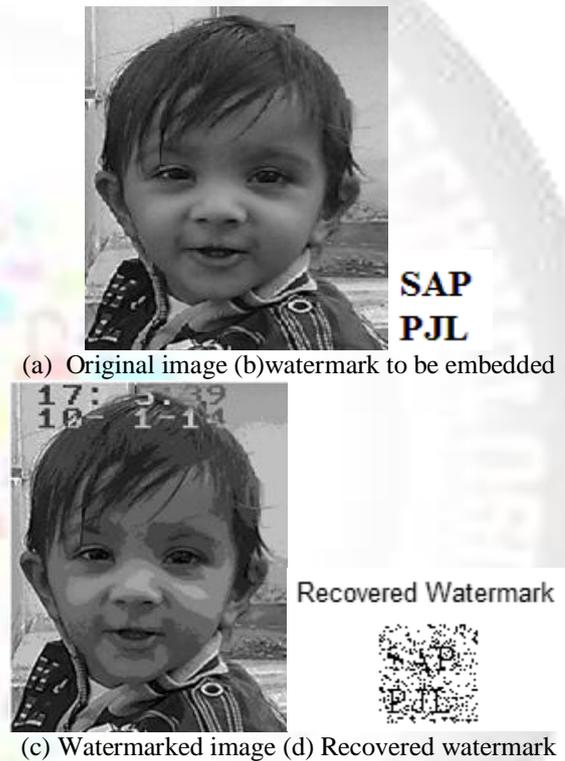


Fig. 8: Dual watermarking using DWT

The performance of various schemes of watermarking can be evaluated on the bases of some of the visual quality matrices given in equations 1.1 and 1.2. These matrices give the idea of visual degradations of the cover medium because of the embedding of the message. These values also give the idea of strength of both watermark and the algorithm. All these matrices depend on the difference created after embedding the watermark information and modifying the watermarked documents.

$$MSE = \frac{1}{M \cdot N} \sum_{x=1}^M \sum_{y=1}^N \{(f(x,y) - f'(x,y))^2\} \quad (1.1)$$

$$PSNR = 10 \cdot \log \frac{255^2}{MSE} \quad (1.2)$$

Here MSE – Mean Square Error
 PSNR – Peak Signal to noise Ratio
 f (x, y) – Original Frame of the video
 f' (x, y) – Watermarked Frame of the Video.

The abbreviation PSNR, called peak signal-to-noise ratio, is used to measure difference and also similarity between an image in its original form and in its modified form. As per the equations it is observed that measurement of PSNR includes the measurement of MSE, Mean Square Error which actually finds the difference between the signal and modified version of the same. PSNR is measured in the logarithmic scale and MSE is measured in the general scale.

VI. EXPERIMENTAL RESULT

By doing this experiment the differential time lapse video is created with LSB and DWT watermarking. In Fig. the snapshot of video and sequential frames are shown. Comparative analysis is also shown according to PSNR and MSE value.



(a) snapshot of video



(b) Sequence of recorded frame of video

Fig.9: Differential time lapse video using LSB and Time/Date stamping

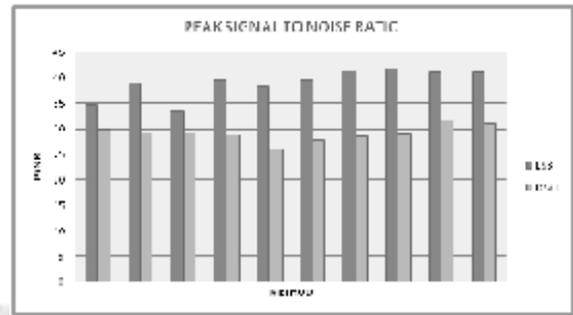


(a) snapshot of video

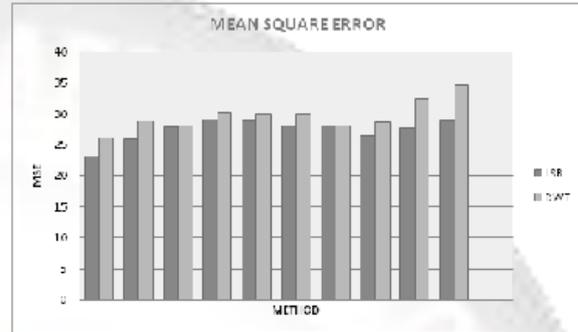


(b) Sequence of recorded frame of video

Fig.9: Differential time lapse video using DWT and Time/Date stamping



(a)



(b)

Fig. 10: Comparative analysis according to PSNR and MSE

VII. CONCLUSION

In this paper we proposed a technique for generating the time lapse video to make effective video communication system over the bandwidth limited channels based on the digital processing of the frame. The video frames are effectively proceeding using the digital signal processing techniques. The information can be hiding using the watermarking technique into the differential time lapse video also for many purposes. The lossless visual watermarking can be done over the image for time and date stamping. The other information can be placed also to support the water marking. The selected frames are stored in differential time lapse video, hence the size of the video becomes very less and replaying back time is shorter too, helps to save the time and storage space. The logs are created for selected and discarded frames, which is helpful to prove the authenticity of the differential time lapse video for legal issues. The differential time lapse video can be generated in real time along with the time-stamping, invisible watermarking and log creation. The watermarking techniques like DWT and LSB made the differential time lapse video more robust for security purpose and not degraded the video information. Both of them DWT is more robust watermarking technique.

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