

ENHANCEMENT OF TIME LAPSE VIDEO TECHNIQUES USING VISIBLE AND INVISIBLE WATERMARKING

(A real time application)

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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 techniques 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 watermarking used for real time application to display time and date at which video is captured. And Invisible watermarking is one of the ways to prove the ownership and the authenticity of the media. MATLAB based algorithm is used for generating the differential time lapse video along with the visible and invisible watermarking.

Keywords—Time Lapse Video technique, visible & invisible watermarking, PDV,PDC,PDT.

I: INTRODUCTION

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. Time lapse technique is a cinematography technique whereby frames are captured at a rate much slower than it will be played back. 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/photograph 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 the authenticity 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. Copyright protection of intellectual properties has, therefore, become an important topic. One way for copyright protection is *digital 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 images 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 simplex algorithm should be selected to make it run faster and smoother in real time. The simple bit by bit pixel mapping based algorithm is used to detect the motion. The simplified algorithm is shown in the figure 1. The simplified algorithm of selection criteria of frames for generating differential time lapse video is shown in figure 1. The first frame captured by the capturing device, get stored in the video file. The next frame captured is tested for variation from 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 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.

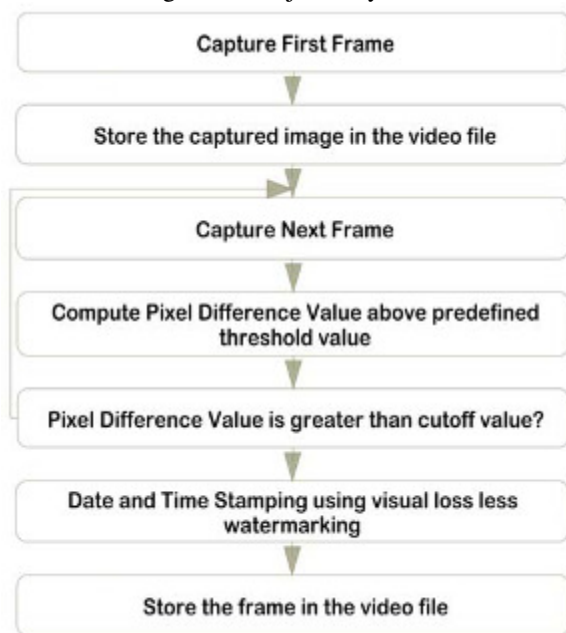


figure-1 An algorithm for frame selection criterion

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). If 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



figure-2 Sequence of snapshots for time lapse video

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 below 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 be 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 keep it at 10%; we can keep it at any value. Experiments show that it should be around 10% for indoor recording and around 5% for outdoor (long shots) recording, though these values depend on application and vary 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.

Fig-3 shows that time-lapse technique where all the frames are captured at continuous time duration. In the first part of Fig-3 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-3 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 noted that frame rate may go 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.

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

The MATLAB tool generates one simple text file along with starting the capture frame. The second frame it captures is compared with the previous file and the Pixel Difference value is calculated. The date, time and this pixel difference values are stored for each frame. Each frame generates the one line in log file. The log file will be converted into the protected document for at the end of the algorithm and hence than it can't be tampered. The backlog file is as shown in figure-4.

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



figure-3 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
Time: 9: 39: 24 ** Date: 7- 3-2013 : 9697.000000
Time: 9: 39: 25 ** Date: 7- 3-2013 : 9139.000000
Time: 9: 39: 25 ** Date: 7- 3-2013 : 10416.000000
FRAME RECORDED : Time: 9: 39: 25 ** Date: 7- 3-2013 : 10416.000000
Time: 9: 39: 25 ** Date: 7- 3-2013 : 30112.000000
FRAME RECORDED : Time: 9: 39: 25 ** Date: 7- 3-2013 : 30112.000000
Time: 9: 39: 26 ** Date: 7- 3-2013 : 49838.000000
FRAME RECORDED : Time: 9: 39: 26 ** Date: 7- 3-2013 : 49838.000000
Time: 9: 39: 27 ** Date: 7- 3-2013 : 59627.000000
FRAME RECORDED : Time: 9: 39: 27 ** Date: 7- 3-2013 : 59627.000000
Time: 9: 39: 27 ** Date: 7- 3-2013 : 55358.000000
FRAME RECORDED : Time: 9: 39: 27 ** Date: 7- 3-2013 : 55358.000000
    
```

figure-4 Backlog file of recorded video
From the above figure it is clear only twelve frames are recorded according to given value of PDC(10000) and PDT(20).

IV: VISIBLE WATERMARKING

The major point of digital watermarking is to find the balance among the aspects such as robustness to various attacks, security and invisibility. The invisibility of watermarking technique is based on the intensity of embedding watermark. Better invisibility is achieved for less intensity watermark. So we must select the optimum intensity to embed watermark. In general there is a little trade off between the embedding strength (the watermark robustness) and quality (the watermark invisibility). Increased robustness requires a stronger embedding, which in turn increases the visual degradation of the images. For a watermark to be effective, it should satisfy the following features. They are:

- Imperceptibility - It should be perceptually invisible so that data quality is not degraded and attackers are prevented from finding and deleting it. A watermark is called imperceptible if the watermarked content is perceptually equivalent to the original, unwatermarked content
- Readily Extractable - The data owner or an independent control authority should easily extract it.
- Unambiguous - The watermark retrieval should unambiguously identify the data owner.
- Robustness – It should tolerate some of the common image processing attacks. A watermark is called robust if it resists a designated class of transformations. Robust watermarks may be used in copyright protection applications to carry copy and access control information

The frames which are selected to be stored in the video file, shows the frame which contain some changes from the previously stored frame. The change might require some finite time and hence, in order knowing the frame timing time and date should be labelled with the time and date. Lossless visual watermarking technique is used for stamping the date and time over the frame. The date and time of the system with whom the capturing device is connected is taken as reference time. This date and time is stamped over the selected frame, which are going to be stored in differential time lapse video. The stamping is done with the 20x18 pixel character stamping. The character is made on the 20x18 pixel image with binary presentation as shown in figure 5 [3].

The algorithm finds out the pattern for each character to be stamped and its corresponding pixel image of 20x18. On the predefine location pixel to pixel mapping is done. If the pixel value in character image is 1, then corresponding image pixel is kept as it is, else the corresponding image pixel value is increased by factor 40 or decreased by factor 40 depends on whether the pixel is bright or dark respectively. The time stamping and recovered images are shown the figure 6. It can be easily seen that, visual watermarking done here is loss less[6].

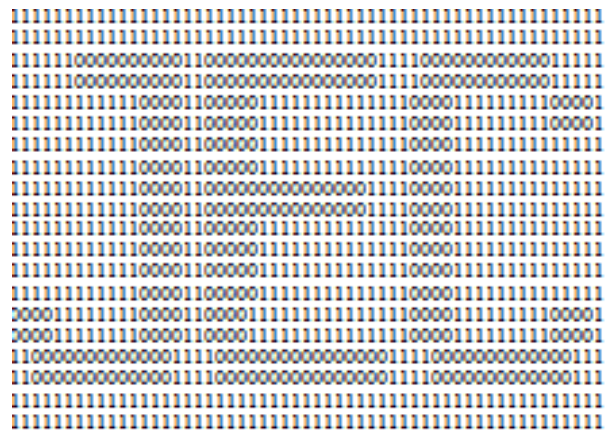


Figure 5. Text to image conversion for time and date stamping



Original image



Time-stamped image



Recovered image

Figure 6. Time-stamping using Visual lossless Watermarking

The numbers are stored in terms of binary digits only having array of 20x18 characters. The number which is listed with '0' are highlighted and its shows the character to be displayed. The simple MATLAB based algorithm is used for embedding the time-stamping over the frame. The time-stamp locations are fixed over the pixel values from 1:20 x 1:144 for date stamping and 21:40 x 1:144 for time-stamping. 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 WATERMARKING

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 figure 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. Another limitation of some existing techniques is that they cannot determine the exact regions of modification in the verification process; instead, they can only provide a binary answer of whether an image has been modified or not. Such information may be valuable for better security measures.

We use a colour visible watermarked image in the test we are about to make. The least significant bits of a colour image encode the most minor variations in pixel colour. Therefore, replacing the LSB bits of a pixel, results in an imperceptible image variation. However, this largely depends on the number of bits used to be replaced. If many bits are replaced in the container image, the result will behave in a reverse order, meaning the container turns to be an embedded message. Optimized number of bits is used depending on the container image nature and the

embedded message by experimenting on several alternatives.



a. original image

**SAP
PJL**

b. message to be embedded



c. Dual watermarked image

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SAP SAP SAP SAP SAP SAP SA
PJL PJL PJL PJL PJL PJL P
SAP SAP SAP SAP SAP SAP S
PJL PJL PJL PJL PJL PJL P
SAP SAP SAP SAP SAP SAP S
PJL PJL PJL PJL PJL PJL P
SAP SAP SAP SAP SAP SAP S
PJL PJL PJL PJL PJL PJL P
SAP SAP SAP SAP SAP SAP S
PJL PJL PJL PJL PJL PJL P
    
```

d. Recovered message

figure-7 Dual watermarking

VI: EXPERIMENTAL RESULT

By doing this experiment the differential time lapse video is created and one of the snapshot of video is shown in figure-8.



figure-8 Time Lapse Video

The sequence of frames to create this video ,which are recorded as per the frame selection criterion in which the value of PDC and PDT is defined. is as shown in figure-9.



figure-9 Sequence of recorded frame for generation of time lapse video

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 Differential Time Lapse Video is new concept in the image processing era and will grow faster. When comes to communication, the differential time lapse video is important technique for long distance communication where the information need to transfer from remote location to the destination. If all the information send over the channel then lots of frames needs to send, but however all that frame does not contain the information. The differential time lapse helps to send the selected frames only which are contained information.

To secure the data lies in Time lapse video, invisible watermarking is used with security message. And visible watermarking shows the real time and date at which the video is recorded.

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