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Data Hiding In Motion Vectors of Video

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Abstract: With the development technology data hiding has become an important issue.To improve the quality of videos embedded by data, the paper deals with data hiding in motion vectors of compressed video. Data is embedded in different frames of video. The transmitted data gets repeatedly embedded in motion vectors of the frames selected for processing. A threshold value is set for the motion vectors to achieve robustness while maintaining low error level. Secrete data gets embedded in the least significant bit of the motion vectors. While data extraction processing of video takes place frame by frame ,here original video is not required while extracting. Based on the aforementioned criteria and due to exploitation of spatial and temporal redundancies this method provides enhanced compression making the coefficients perturbation difficult to predict along with large embedding capacity.

Keywords: Data hiding, Motion vectors, Frames, steganography, Group of pictures

I. INTRODUCTION

Currently, Internet and digital media are getting more and more popular. So, requirement of secure transmission of data has also increased. Various good techniques are proposed and already taken into practice. Data Hiding is the process of secretly embedding information inside a data source without changing its perceptual quality. Data Hiding is the art and science of writing hidden messages in such a way that no one apart from the sender and intended recipient even realizes there is a hidden message. Generally, in Data Hiding, the actual information is not maintained in its original format and thereby it is converted into an alternative equivalent multimedia file like image, video or audio which in turn is being hidden within another object [1].

The carrier for steganography can be image, text, audio and video. Although BMP files are perfect for steganographic use, they are able to carry only small files. Also there are limitations to get much enough files to hide messages, also sequence of these images play vital role at data extraction. So steganographic method that has higher embedding capacity need to be studied. As video files are created out of bitmaps ,combined into piece, which are played in correct order and with appropriate time gap. Besides, the degradation of video quality cannot be observed only by naked eyes, for it may be aroused by video compression of lower quality.

Ding-YU Fang [3] proposed embedding information in phase angle of the motion vectors of macroblocks in the inter frame. By replacing the original motion vector to another local optimal motion vector. In [4], the data is encoded as a region where the motion estimation is only allowed to generate motion vectors in that specified region. Using the variable macroblock sizes (16x16,6x8,8x16,8x8) of H.264. Zhu et al proposes the diamond search algorithm for fast block-matching motion estimation[4]. Above the methods have the advantages of least influence on the videos and simple algorithms.

Steganography in video is classified into two main types as embedding data in uncompressed video which is compressed later [5] and the other is operating directly in compressed video stream. A steganographic algorithm for compressed video is introduced in this paper. In frames data is repeatedly embedded in motion vectors of macroblocks.

The paper is organized as follows. The related works that are done on the steganographic techniques and encryption techniques are provided in the section 2. The proposed research contribution with the motion vector technique, using compressed video , is placed in the section 3. The results and the discussions are given in the section 4.The paper is concluded with the results in section 5.

II. RELATED WORK

Spyridon K. Kapotas [2] et.al proposed a method were different block sizes used by the H.264 encoder during the inter prediction stage in order to hide the desirable data. It was proposed to be the blind data hiding scheme , i.e. the message could be extracted directly from the encoded stream without the need of original host video.

Dittmann proposed a video watermarking scheme [6] in first a position sequence is generated from the user key as a seed with a secure random number generator. Then,to improve the visual quality of the watermarked frame and integrate an error correcting code, inducts the smooth block and edge detection to check for HVS-characteristics. Finally, watermark information with the error corrections and redundancy was embedded.

Xiaoni Lil has proposed the differences of matching blocks in the 0.264 encoder during the interprediction,and and stage and enforce the size of the matching blocks to implement data hiding. Bit rate increases after being embedded by data, to resolve the problem, this paper mainly make use of the method of modifying the trailing coefficients sign-bit of fixed-length coding to control the bit rate in Context Adaptive Variable Length Coding (CAVLC).

III. Proposed Work

In this paper, we have considered some important features of data hiding. Our consideration is that of embedding information into video, which could survive attacks on the network.Data Embedding part is the first part of the proposed work. The block diagram of the data embedding system is as shown in the figure below.

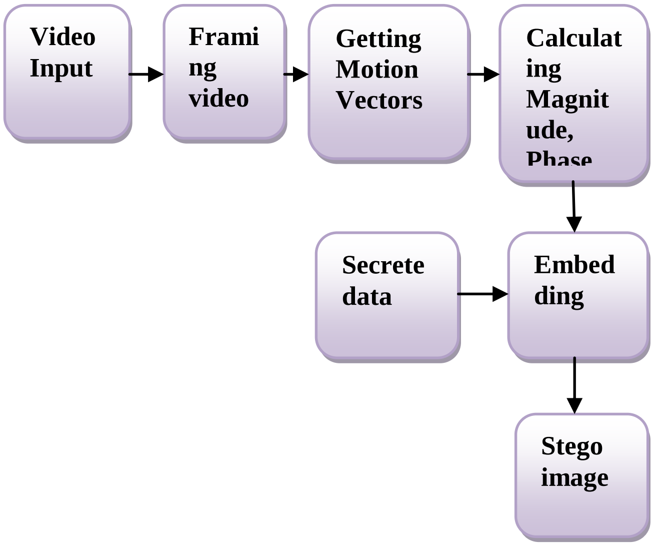

Fig. 1Data Embedding System

Data embedding is carried by taking video as input and framing the video. The process of data embedding is carried out only for the frames selected for processing.

A. Video Input

Video signals differ from image signals in several important characteristics. Of course the most important difference is that video signals have a camera frame rate of anywhere from 15 to 60 frames/s, which provides the illusion of smooth motion in the displayed signal. Another difference between images and video is the ability to exploit temporal redundancy as well as spatial redundancy in designing compression methods for video. Such video is taken as input.

B. Framing of video

A complete image captured from a video during a known time interval is called as frame. Such numbers of frames are obtained from a video. These frames are used for further processing of data embedding; frames in video are always sequentially placed so at the time of data retrieval there is no need for searching the sequence of the obtained video and its frames. Three types of frames are used in video compression I frames, P frames, and B frames. An I frame is an 'Intra-coded picture', in effect a fully specified picture, like a conventional static image file. A P-frame ('Predicted picture') holds only the changes in the image from the previous frame. A B-frames ('Bi-predictive picture') saves even more space by using differences between the current frame and both the preceding and following frames to specify its content.

C. Motion Vectors

In video compression, a motion vector is the key element in the motion estimation process. It is used to represent a macro block in a picture based on the position of this macro block (or a similar one) in another picture, called the reference picture. Motion Vectors are the result of an analysis which tells where every pixel of the current frame is going to or is coming from (in the previous or following frame).

Macroblock is a processing unit in image and video compression formats based on linear block transforms. An inter coded frame is divided into blocks known as macroblocks. After that, instead of directly encoding the raw pixel values for each block, the encoder will try to find a block similar to the one it is encoding on a previously encoded frame, referred to as a reference frame. This process is done by a block matching algorithm.

D. Magnitude and Phase Angle of Motion vectors

In the proposed method, the data were not embedded in each motion vector of P frames and B frames, but the motion vectors with larger magnitude. The larger magnitude indicates the faster moving speed of the macro-blocks. In this case, the distortion introduced by data embedding is minimal comparing to modify all motion vectors include those with slight movement or even still.

Calculation of Magnitude of Motion Vector is done using the formula.

$MV[i] = \sqrt{\,}H\text{^}\,2[i] + V\,\text{^}2[i]$ ---------1

Calculation of Phase Angle of Motion vector is done using formula.

$\theta[j] = \arctan(V[j] / H[j])$ ----------2

if, θ is acute then data is to be hidden in horizontal component of motion vector.

θ

A. Embedding

Least significant bit (LSB) is the most popular method of embedding scheme where information is hidden in the spatial domain of an image. This method is probably the easiest way of hiding information in an image and yet it is surprisingly effective. While Embedding data the number of motion vectors available are compared with the number of characters in data that is to be hidden. Then the data is embedded in the motion vectors.

B. Stego-Images

After data embedding the stego images are created these stego images look similar to the images without hidden data

.The quality of the stego images compared with the original images is measured by peak signal to noise ratio.

IV RESULTS AND DISCUSSIONS

Table I below shows the information of the video that is taken as input and the frame rate that is obtained.

TABLE I

Length of video	00:00:04
Frame Rate	29 frames/sec
Total number of frames	141
Frame width	320
Frame Height	240
Number of motion vectors required to hide single character	8

Conversion of a video in each frame the quality may be differing from one video to other depending on the video. Figure 2 below shows the frames that are obtained when a video of about 4 sec is taken as input. Total frames obtained are 141 Size of the frames obtained is 320 x 240.These frames are further converted to gray scale.

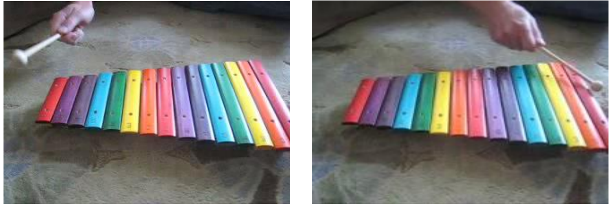

Fig 2

Figure 3 below shows the superimposed motion vectors for the single frame. These motion vectors help to know where every pixel of current frame is coming from or going to. Total number of motion vectors available for a single frame is approximately 1200 this number of motion vector varies from frame to frame. From the available motion vectors it is necessary to calculate the eligible motion vectors by setting a threshold value depending on the magnitude values. Phase values calculated decide the component of motion vector to be used for data hiding.

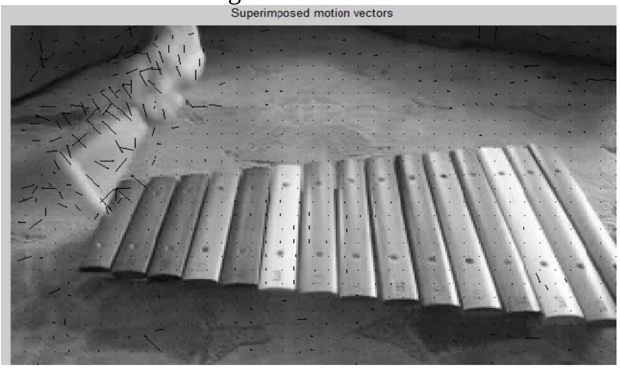

Fig 3

Figure 4 shows the reconstructed image with hidden text which is more identical to the original frame. Here LSB technique is used to hide the data in the eligible motion vectors. Changing the lsb bit does not have much effect on the image quality.

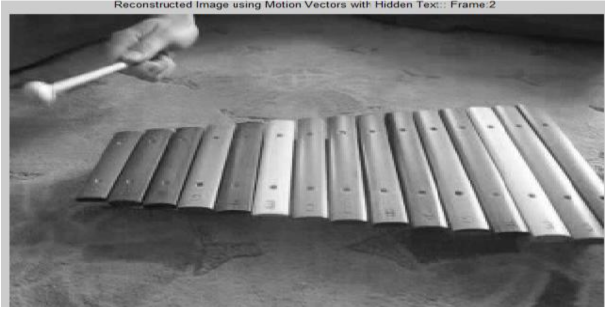
Reconstructed Image using Motion Vectors with Hidden Text:: Frame:2

Fig 4

Stego frames are obtained at the output. Psnr values help to know the quality of the frame after data hiding when compared with the frame before data hiding All the frames are then collected and the video is reconstructed. Due to hiding data only in strong motion vectors and without affecting any other parameters of video the video quality can be maintained and good security for data transmission could be achieved.

V.CONCLUSION

A steganographic algorithm for data embedding is proposed in this paper which directly operates on compressed video. A greedy search for the suitable value of the threshold is to be done to select the embeddable macroblock and which allows large data embedding capacity. which provides good robustness to the system, along with a balance between capability to resist video processing and security. A good result of psnr at ouput shows the robustness of the system.

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