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Compacted video based data hiding for motion vectors

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ABSTRACT

There are many researches that have been proposed for embedding data into digital video. However, most of those schemes extending data hiding technique for still images to videos by treating each single frame as a still image and embed data in intra-frame. In this paper, we propose an effective data-hiding scheme that embeds data in digital videos using the phase angle of the motion vector of the macro blocks in the inter-frame. The scheme can be applied to either compressed or uncompressed videos. Furthermore, the embedded data can be extracted directly without using the original video sequences. Our experimental results prove the feasibility of the proposed method. The method is implemented and tested for hiding data in natural sequences of multiple groups of pictures and the results are evaluated. The evaluation is based on two criteria: minimum distortion to the reconstructed video and minimum overhead on the compressed video size. Based on the aforementioned criteria, the proposed method is found to perform well and is compared to a motion vector attribute-based method from the literature.

Introduction

Information hiding techniques have recently become important in a number of application areas. Digital audio, video, and pictures are increasingly furnished with distinguishing but imperceptible marks, which may contain a hidden copyright notice or serial number or even help to prevent unauthorized copying directly. Military communications systems make increasing use of traffic security techniques which, rather than merely concealing the content of a message using encryption, seek to conceal its sender, its receiver or its very existence. Similar techniques are used in some mobile phone systems and schemes proposed for digital elections. Criminals try to use whatever trace security properties are provided intentionally or otherwise in the available communications systems, and police forces try to restrict their use. However, many of the techniques pro- posed in this young and rapidly evolving field can trace their history back to antiquity; and many of them are surprisingly easy to circumvent. In this article, we try to give an overview of the field; of what we know, what works, what does not, and what are the interesting topics for research. a steganographic algorithm in MPEG compressed video stream was proposed.

Literature Survey

In each GOP, the control information for to facilitate data extraction was embedded in I frame, in P frames and B frames, the actually transmitted data were repeatedly embedded in motion vectors of macro-blocks that have larger moving speed, for to resist video processing (Fabien A. P. Petitcolas, Ross J. Anderson and Markus G. Kuhn). Data extraction was also performed in compressed video stream without requiring original video. On a GOP by GOP basis, control information in I frame should be extracted firstly, then the embedded data in P and B frames can be extracted based on the control information. Experimental results show that the proposed algorithm has the characteristics of little degrading the visual effect, larger embedding capacity and resisting video processing such as frame adding or frame dropping. (Changyong Xu, Xijian Ping, Tao Zhang).The main advantage of the different block sizes used by the H.264 encoder during the inter prediction stage in order to hide the desirable data. It is a blind data hiding scheme, i.e. the message can be extracted directly from the encoded stream without the need of the original host video. Recent video data hiding techniques are focused on the characteristics generated by video compressing standards. Motion vector based schemes have been proposed for MPEG algorithms (Spyridon K. Kapotas, Eleni E. Varsaki and Athanassios N. Skodras). An effective data-hiding scheme that embeds data in digital videos using the phase angle of the motion vector of the macro block in the inter-frame. the embedded data can be extracted directly without using the original video sequences. Information-embedding capacities for the case of a colored Gaussian host signal and additive colored Gaussian noise attacks. We show that QIM methods achieve performance within 1.6 dB of capacity, and we introduce a form of post processing we refer to as distortion compensation that, when combined with QIM, allows capacity to be hybrid in-band on-channel digital audio broadcasting (DAB) is an example of such a multimedia application where one may employ information embedding methods to backwards compatibly upgrade the existing commercial broadcast radio system achieved (Brian chen and Gregory W. Wornell).

Existing System

Data hiding and watermarking in digital images and raw video have wide literature. Data hiding in motion vectors at the encoder replaces the regular pair, due to tampering the motion vectors, to become, where the superscript denotes hiding. The message should survive the video lossy compression and can be identically extracted. This robustness constrain should have low distortion effect on the reconstructed video as well as low effect on the data size (bit rate). A novel video watermark technique in motion vectors, the data is encoded as a region where the motion estimation is only allowed to generate motion vectors in that

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specified region. In Data hiding for digital video with phase of motion vector and a novel steganographic algorithm based on the motion vector phase embed the data in video using the phase angle between two consecutive CMV. These CMV are selected based on the magnitude of the motion vectors as in Video watermark technique in motion vector. The message bit stream is encoded as phase angle difference in sectors between CMV. The block matching is constrained to search within the selected sector for a magnitude to be larger than the predefined threshold.

Disadvantages of Existing System:

1. The Data size increase when extracting and embedding process takes place.
2. Robustness constrain should have low distortion effect on the reconstructed video as well as low effect on the data size (bit rate).
3. If extracting process takes place there may be lose of hidden data.

Proposed System

We take a different approach directed towards achieving a minimum distortion to the prediction error and the data size overhead. This approach is based on the associated prediction error and we are faced by the difficulty of dealing with the nonlinear quantization process. We overview lossy video compression to define our notation and evaluation metrics. At the encoder, the intra predicted (I)-frame is encoded using regular image compression techniques similar to JPEG but with different quantization table and step; hence the decoder can reconstruct it independently. The video is ordered into groups of pictures (GOPs) whose frames can be encoded in the sequence. The temporal redundancy between frames is exploited using block-based motion estimation that is applied on macro blocks of size in or and searched in target frames.

Advantages of Proposed System:

1. A single bit is hidden in the least significant bit of the larger component of each candidate motion vectors (CMV).
2. The video encoding/ decoding which makes it hard to be detected by image stag analysis methods and is lossless coded.
3. This method is found to have lower distortion to the quality of the video and lower data size increase.

4.2 Architecture of Proposed System:

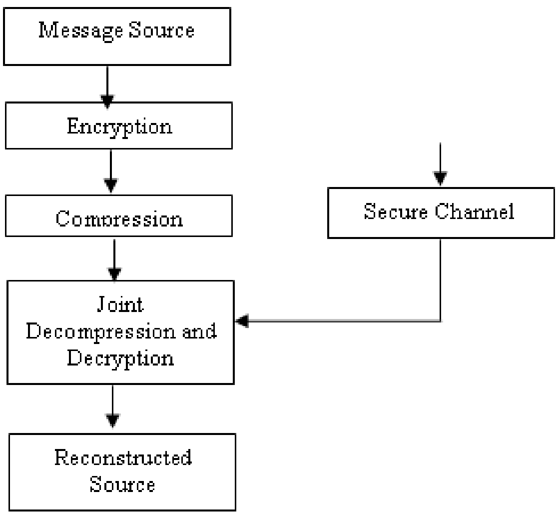

Figure 1: Proposed System Architecture

Implementatio5.1 selection of regular pair frames:

Data hiding in motion vectors at the encoder replaces the regular pair (d, E), due to tampering the motion vectors, where the superscript denotes hiding. We define data hiding in motion vectors of compressed video in the context. The secret message is hidden in the host video signal to produce the composite signal. The composite signal is subject to video lossy compression to become. The message should survive the video lossy compression and can be identically extracted. This robustness constrain should have low distortion effect on the reconstructed video as well as low effect on the data size (bit rate).

Data encoding using GOP:

The threshold used for each frame of initial threshold value is different, we hide their eight values for that GOP in the I-frame using any robust image data-hiding technique or sending them on a separate channel based on the application. Decreasing initial threshold value will decrease the payload and vice versa, thus the GOP tries to find the maximum feasible for each frame.

JPEG Compression:

The size of an image and is thus lossy compressed using JPEG compression reducing its data size. The lossy compression quantization stage is a nonlinear process and thus for every motion estimation method, the pair (d, E) will be different and the data size'd' of the compressed error 'E' will be different. The motion vectors are lossless coded and thus become an attractive place to hide a message that can be blindly extracted by a special decoder.

Data Validation:

The Validation algorithm tests the robustness of the hidden message to the quantization effect of the JPEG compression. For the prediction error, it performs the compression by the encoder followed by the decompression performed by the decoder. If the reconstructed prediction error maintains the same criterion it can be extracted by the eight values.

Data Extraction:

The data extractor operates to extract the hidden message as a special decoder. After data extraction from the consecutive GOPs the hidden message is reconstructed back by concatenation of the extracted bit stream.

Experimental Results

In our current scheme can also use the sub partitions of the 8×8 type (8×4, 4×8, 4×4), thus increasing the available bits for coding to 8. Apparently, the additional bits will increase the data capacity decreasing the number of the "twisted" macro blocks at the same time. Moreover, the scheme used consecutive macro blocks within a single frame in order to hide the data. Another improvement would have been if the macro blocks were spread within the frame or even better if the macro blocks were spread within multiple frames. This approach would improve the coding efficiency, since the "motion error", which is produced by the scheme, will not be accumulated in one place. In addition to that, the assignment of the binary codes could be modified so as to take into account some video statistics. For example the 16x16 block type appears more often than the other types. The message can therefore be coded using a Huffman coding and the Huffman code with the highest probability could be assigned to the 16x16 block type. The gain of this approach will be that our scheme will most likely choose the block type, which would have been chosen by the encoder.

Future Enhancement

Future work will be directed towards increasing the size of the embedded payload while maintaining the robustness and low distortions. So in the future, more effective methods should be taken into account to further increase the embedding capacity and enhance the security of the algorithm as well. Furthermore, modification was only done to motion vectors that have larger magnitude, it is equal to embedding data essentially in text areas and on edge, for smooth regions the modification is small or even zero, so high imperceptibility was achieved.

Conclusion

We proposed a new data-hiding method in the motion vectors of MPEG-2 compressed video. Unlike most data-hiding methods in the motion vectors that rely their selection on attributes of the motion vectors, we chose a different approach that selects those motion vectors whose associated macro blocks prediction error is high (low PSNR) to be the candidates for hiding a bit in each of their horizontal and vertical components. A greedy search for the suitable value of the threshold to be used for choosing the macro blocks corresponding to the CMV is done such that the candidates will be identically identified by the decoder even after these macro blocks have been lossy compressed. The embedding and extraction algorithms are implemented and integrated to the MPEG-2 encoder/decoder and the results are evaluated based on two metrics: quality distortion to the reconstructed video and data size increase of the compressed video. The method is compared to another one from the literature that relies on a motion vector attribute. The proposed method is found to have lower distortion to the quality of the video and lower data size increase.

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