

CURRENT CHALLENGES IN EFFICIENT AND EFFECTIVE VIDEO PROCESSING : QUALITY WITH SECURITY

Swetha C K¹, Nivin V K²

¹ Student, Electronics And Communication Engineering, Malabar Institute Of Technology, Kerala, India

² Assistant Professor, Electronics And Communication Engineering, Malabar Institute Of Technology, Kerala, India

ABSTRACT

The main stages of video processing includes acquisition, compression, storage, and transport of video data. Distortions can be introduced at various stages of video processing. This leads to a loss in the quality of videos which include both the picture quality as well as audio quality. So a system must be designed to effectively manage the video content at all processing stages aiming to minimize distortions thereby improving the video quality. This paper takes a look at the most current aspect in video processing which includes an optical flow based full-reference video quality assessment (FR-VQA) with advanced video steganography (AVS) algorithm that mainly focus on the challenges that need to be tackled, that is high quality along with improved security which is beneficial for the new emerging digital multimedia applications.

Keyword : - Compression, MS-SSIM, Optical Flow, Steganography.

1. INTRODUCTION

A video is a visual multimedia source that combines a sequence of images to form a moving picture which may be complemented by audio information. The explosive growth of video content over the past decade has led to a very urgent need to effectively manage this content. The videos are captured, compressed, stored and transmitted in various digital forms with different types and amounts of impaired artifacts. Also each emerging video application has introduced different kinds of specific distortions. So a systems must be designed to minimize the perceptual distortion while optimally utilizing the available storage and communication resources. This calls for the development of an advanced video steganography (AVS) technique in combined with an optical flow based full reference effective video quality assessment (FR-VQA) algorithm[1]. This conceals image within a video file focussing on secure communication along with distortion minimization and there by high video quality maintaining. The main scope of this project lies in the concept of ensuring quality with security.

Video quality is the characteristics of video passed through a video transmission or processing system. It is a formal or informal measure of perceived video degradation typically compared with the original video. Here deals with the full reference method which is an objective video quality measurement. The main advantage of using this double ended method is that it involves the frame by frame comparison between the reference video and the test video. optical flow gives the motion information or flow information in its finest resolution. It is able to capture the temporal features and clears out the distortions. Video steganography is critical in systems which are mainly intended for currently challenging applications. This is an important approach in today's world of emerging multimedia applications and new technologies since it has a larger capacity for embedding useful information. Video steganography is the practice of concealing a message, image, or video within another video. Only the sender and the intended recipient detects the data send through it. The proposed system is three times secure than the existing system as three levels of security is added.

Hitherto, accurate video quality score and video quality type assessment along with better hiding techniques has not been proposed. Several quality assessment methods till now include error sensitivity approach

(ESA), structural distortion estimation method, visual information fidelity(VIF) approach, and Least significant bit (LSB) technique for steganography.

In Error sensitivity approach (ESA) the distorted signal is taken as the sum of reference signal and an error signal [2]. But actually distortions refers to the deviation of pristine flow statistics and thus this method is not accepted. The structural distortion estimation method to video quality assessment hypothesized that amount of distortion in the structure is a measure of perceived distortion [3]. But not only structural features but also both temporal and spatial features must be taken into account for effective and accurate video quality measurement. The visual information fidelity (VIF) approach, is an information theoretic framework based on Natural Scene Statistics (NSS) models. This model is based on human visual system (HVS) which is a subjective quality assessment [4]. This method is not found to be effective as it is an informal approach which asks users for video quality rating. The most common and easy method of image steganography is Least significant bit method where LSB of the host video frames carries secret data [5]. But here the secret data can be destroyed easily by file transformation and thus privacy is not attained.

The proposed simple and effective system gives an overview of the current challenges in efficient and effective video processing while considering an ameliorate quality with improved security.

2. SYSTEM DESIGN

The proposed system has three main stages :

- 1) Video quality score assessment
- 2) Video quality type assessment
- 3) Advanced video steganography

Fig. 1 shows the proposed architecture consisting of three stages. The HVS consists of the eye, the optic nerve, optic chiasm, tract, and the visual cortex. The responses of the neurons in the area 18 of the visual cortex are shown to be almost separable in the spatial and temporal fields.

This motivated to propose a three-stage approach, where in the *first stage* the spatial and temporal features are computed individually and later pooled to obtain a single quality score for the entire video. Temporal features are extracted from the optical flow which gives motion/flow information in its finest resolution. The optical flow is computed for the entire video sequence on a frame-by-frame basis. The flow is computed for the reference and distorted videos and the features are extracted from the flow information. The deviation of the distorted video features from the reference video features is considered as a measure of distortion. Also the algorithm is flexible enough to allow any robust MS-SSIM technique for spatial quality assessment. The MS-SSIM index is used to compute the spatial score on a frame-by-frame basis. The temporal and spatial features are finally pooled to obtain a spatio-temporal quality score for the entire video.

The calculation is carried out as,

$$H = G.Q \quad (1)$$

$$FLO-SIM = \sum w . \sum H \quad (2)$$

$$W = \frac{\text{Number of frames in a particular region}}{\text{Total number of frames in the video}} \quad (3)$$

where, G is the temporal quality score, Q is the spatial quality score, w is the weight assigned to each frame and H is the spatio-temporal quality score.

The *second stage* is the video quality type assessment which determines whether the video is of high quality or low quality based on the MS-SSIM index used for the spatial feature calculation. Eventhough a video includes both the temporal features and spatial features, for quality type assessment we choose only the spatial score.

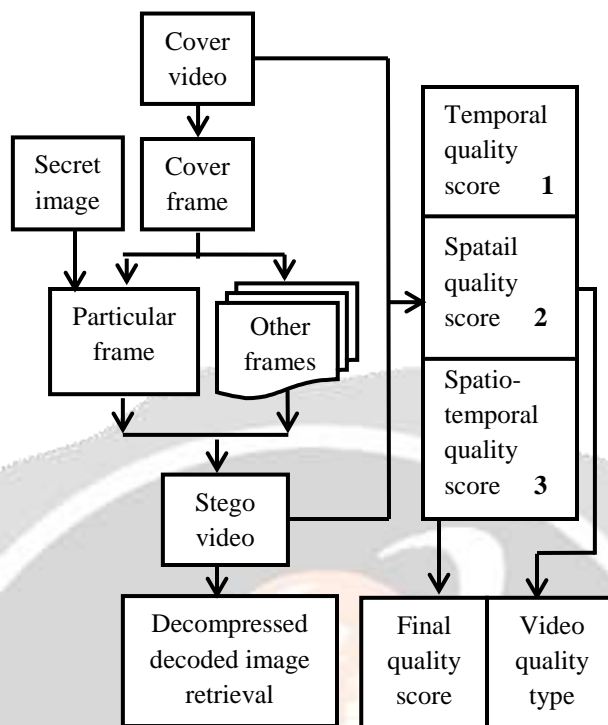


Fig -1: Proposed architecture

This is because the word temporal is related to the term ‘non persistent’ where the features changes continuously in a frame by frame basis. And the spatial is related to term ‘persistent’ where the features are noted for the entire video. So a specific range of -1 to 1 for the spatial score determines the quality type in which the value between -1 and 0 specifies that the video is of low quality and a value between 0 and 1 specifies that the video is of high quality. This is based on the concept that the value 1 indicates the compared sets of data which includes reference and test frame are identical with no attacks existing.

The *third stage* involves the highly secured and versatile hiding technique called the advanced video steganography (AVS). Video Steganography is the art of writing hidden data inside videos, in such a way that no one instead of the sender and intended recipient realizes the existence of a hidden data. Steganography mostly uses repeating portions of the video files to embed the secret data. There are many techniques for hiding data in video, here we use steganography technique along with huffman compression and encoding of the secret data for more privacy. This method does not create any type of distortions and hence the output spatial score value used for the quality type assessment remains between 0 and 1 itself, with the same score obtained as if the quality of a distorted video alone is calculated. Thus a high quality is obtained for the entire video.

3. FEATURES OF PROPOSED SYSTEM

Video processing is a must-have skill for engineers working on products and solutions for rapidly growing markets such as video surveillance, video conferencing, medical imaging, military imaging, digital broadcast equipment, displays and countless consumer electronics applications. The proposed FR-VQA method with AVS has many *advantages* which mainly portraits about video processing tasks where video signals are basically any sequence of time varying images.

- 1) The proposed system is more simple and effective compared to previous methods of quality assessment and data hiding techniques.
- 2) Accurate video quality score calculation since full-reference (FR) approach is chosen.

- 3) Subjective video quality assessment is not considered here, instead focus on the FR objective video quality models.
- 4) Frame by frame computation is considered for video quality score calculation.
- 5) Detects sudden changes in frame quality.
- 6) Estimates the naturalness of a video by making use of temporal and spatial features.
- 7) Determines the video quality type in an easier way with MS-SSIM index of spatial features.
- 8) Distortionless AVS method maintains the video quality as high.
- 9) AVS serves as one of the best method, which provides improved or high security for secret data sharing.
- 10) More privacy and hence imperceptibility of secret image.
- 11) Since video is taken as the cover file, it has a larger capacity for embedding useful informations.
- 12) The problems like versatility, distortions, low embedding rate and insecurity has been solved.
- 13) This paper serves as an optimal work for ensuring quality with security which is beneficial for the new emerging digital multimedia applications.

4. RESULTS AND DISCUSSION

For obtaining the quality score we choose reference or cover file as the video displayed for a duration of 18 seconds. Since video is composed of a sequence of image frames, 15 frames are displayed per second with a total of 270 frames in the entire video. These frames are called as the cover frames. The video has a frame width of 256 and a frame height of 256. That is, video size of $M \times N$ is divided into non-overlapping regions of 256×256 . The entire processing tasks is done on to this cover video based on the requirements such as quality score assessment, quality type assessment and secret image hiding inside the video. Five different types of distortions or attacks are added to the test video frame to measure the deviation of local statistical properties of the flow relative to undistorted flow. Since a total of 270 frames are there for the given video only 2 frames are checked for the calculation convenience. Seperate values for the quality features are obtained after running for video frame 1 and frame 2. The output result shows the spatial quality score (Q), temporal quality score (G) for each of the required frames as defined by the user, and finally spatio-temporal quality score (FLO-SIM) for the full video sequence.

Total frames : 2

Enter 1 : salt & pepper noise attack

Enter 2 : gaussian noise attack

Enter 3 : speckle noise attack

Enter 4 : for motion blurring attack

Enter 5 : for Image sharpening attack

Enter your attack style: 1

Running for frame 1

Elapsed time is 0.021624 seconds.

compression ratio (CR) = 3.456700

Running for frame 2

Elapsed time is 0.022924 seconds.

compression ratio (CR) = 3.456700

- *For entire video*

Q = [0.6256] -- Spatial features --

- For frame 1

$G = [1 \times 256 \text{ double}]$ -- Temporal features --

$g3 = 0.6256$ --- Spatial quality score --

$FLO_SIM = [-9.6892]$ -- Final score --

High Quality

- For frame 2

$G = [1 \times 256 \text{ double}] [1 \times 256 \text{ double}]$

$g3 = 0.6256$

$FLO_SIM = [-9.6892] [-38.9105]$

High Quality

The Fig.2 shows the reference video frame where the optical flow is smooth and distortions are not affected. And Fig.3 shows the test video frame affected by salt and pepper noise so that optical flow is inconsistent and hence features are affected.



Fig -2 Reference video frame.



Fig -3 Test video frame.

Here the obtained spatial quality score 0.6256 lies between 0 and 1 for which the tested video is treated as a high quality video sequence.

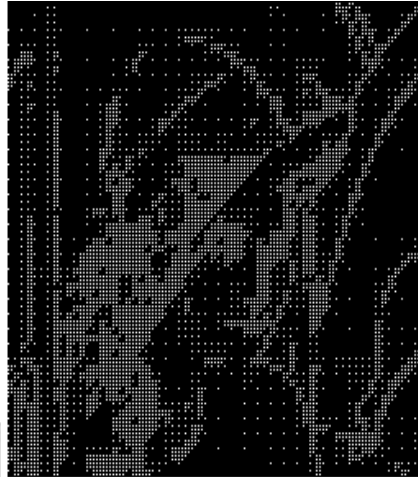


Fig -4 Decompressed secret image

The Fig.4 shows the secret lena image retrieved by huffman decoding and decompression, after adding noises to the stego video. Due to the presence of small amount of salt and pepper noise the exact embedded gray scale image is not obtained at the output. Still there is only a slight variations for the input secret image and so one can identify the output clearly. The compression and encoding of the secret image before embedding is done by huffman coding which is a lossless compression method. It has a better rate of compression and uses variable length code which makes encoding more easier.

Elapsed time specified in the output result is simply the amount of time that passes from the beginning of score calculation to its end for each frame and compression ratio (CR) is the rate at which the embedded secret image is compressed and is given as,

$$CR = \frac{\text{Amount of bits in original image}}{\text{Amount of bits in compressed image}} \quad (4)$$

The original secret image taken for this work before compression contains 8 bits and after compression process the number of bits is reduced to 2 giving a compression ratio of 3.456700 where the main advantage of steganography process lies. So the contribution of this paper work describes and depicts the performance and flexibility of the proposed algorithm by testing three important aspects of real time video processing.

5. CONCLUSIONS

This paper gives an overview of the video processing challenges and solutions that are relevant to today's real time issues in video processing. That is, mainly considers the scenario of identifying reasonable issues and current day challenges in video processing. Given the enormous, large size and affluent information of video data it is important to design highly efficient and effective video processing technique. The best technique is to hide the secret data along with the quality of the cover video. So a combination of an optical flow based full reference video quality assessment (FR-VQA) algorithm with an advanced video steganography (AVS) process serves as a best method with the aim of ensuring quality along with security. The proposed approach has proved to be a better solution for the drawbacks like distortions, versatility, low embedding rate, and security problems. Since the video quality is compromised with improved security the proposed method outperformed than existing techniques with many useful features.

The application areas of this work includes multimedia technology, network quality monitoring, military, industrial, and biomedical. In future we plan to embed a secret video inside another video and finding the video quality score and quality type.

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