Approach to Video Watermarking Methods on Mobile Devices

Venugopala P.S., Dr. Sarojadevi H., Dr. Niranjan N. C.

Abstract: - Video watermarking is the technique of embedding cryptographic information into the video file for the purpose of copyright protection. The user viewing the video cannot identify the difference between the marked and unmarked video. Security factor of the watermark should resist the attempt of attack by sophisticated attackers to remove watermark in video without changing the original video quality. Watermarking can be done is spatial and frequency domain. Here a spatial domain and a frequency domain method are implemented. Video watermarking on a mobile device is a challenge due to the limited resource of the device. Various methods of video watermarking proposed in the literature are having their own merits and demerits for applying to the mobile device. In this paper we made an attempt to implement few image watermarking method and extend the same to video. Results of the experiments are compared in terms of noise introduced to measure the quality.

Index Terms— Digital Watermarking, Mobile Device, Image and video watermarking, Image security, Copyright Protection, Digital rights management.

1. INTRODUCTION

Watermarking is the process of inserting identifiable, distinguishable information in digital data. Textual data or image may be embedded as watermark in a video signal. Video watermarking has many applications like copyright protection, copy control and document integrity, fingerprint, document indexing. Insertion of watermark may be carried out in spatial or frequency domain of the signal. Temporal feature of the video is also used in some approaches.

The video watermarking mainly have three issues, robustness, security, perceptual fidelity. The watermark should resist attempt made by the attacker to modify the video or the watermark.

The organization of this paper is as follows. Section 2 is the review of the work done by various researchers in the field of watermarking. Section 3 is the discussion on video watermarking approaches on mobile devices. In section 4 we discuss some of the observation we made from the literature. Section 5 discusses some of the implementation results and the paper is concluded in section 6

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2. BACKGROUND

Wiem Trabelsi and others [1] have introduced a new watermarking method based on multi signature. Here authors design, implement and evaluate a new watermarking solution that aims to optimize the issues of watermarking namely, robustness-invisibility-capacity. The proposed approach involves applying a frequency domain watermarking based on singular value decomposition (SVD) and exploiting the mosaic made from all video frames as well as inserting a double signature in order to increase watermarking algorithm capacity.

Gui Feng and others have introduced a new watermarking method in [2] for H.264/AVC video encoding standard, the term is named as zero watermarking technology. It breaks traditional idea of digital watermarking technique; the important characteristics of video data were used to construct the watermark information. Zero watermark information is constructed based on the characteristics of DCT quantization coefficients by intra-prediction. The algorithm is not only real-time but also simple and efficient. In H.264 standard quantitative DCT transformation was adopted, and the main energy was focused on DC coefficient, the coefficient value is bigger, after different attacks, its value can still retain larger, so

the luminance DC coefficients of 4 x 4 sub-blocks in I frame to construct the watermark is selected.

Anita Jadhav and others have introduced a new 3D DCT based watermarking method in [3]. In this paper, the result of implementation of static 3D DCT is shown. It is observed that this scheme works well on correlated videos. But it does not take care of scene change in the video. Hence a new dynamic size 3D-DCT technique with "scene change detection" for embedding binary/ gray scale/ color watermark on a color digital video is proposed and compares the results with existing fixed length 3D-DCT technique. The method converts the video to YCbCr representation and inserts the watermark in Y component of the extracted frame of the video. It is observed that Videos having considerable scene changes exhibit more distortion with the static DCT technique compared to dynamic DCT technique.

Jiali Bao and others have introduced a new scheme in [4], to protect the region of interest (ROI) in the scalable video coding (SVC) with watermark. By embedding watermarks only in ROI, the most important contents of video are protected and less important areas are not touched, so the video protection is more efficient with less computing cost. In this scheme, ROIs in the video are detected and watermark is inserted in that area using the luminance part of the DCT matrix. Different watermarks can be offered for different ROIs in different layers of video. The method is blind watermarking; watermark can be detected without original signal. The authors draw the conclusion as those watermarking schemes that need the original image to extract the watermark are more robust than those that do not need the original ones; spatial domain methods are much faster than transform domain methods. Besides testing the watermark robustness, subjective evaluation of the image quality is of high importance. There is still no watermark scheme that is desirable, to the watermark researchers in all respects

Y.J.Song and others have done comparison on watermarking technique in [5], here four typical watermarking techniques from various domain namely, DCT based, wavelet base, SVD methods are compared and tested extensively, which not only include the private system, the semi-private system but also the public schemes. The comparisons mainly focus on the evaluation of robustness, visual image quality and watermark capacity.

Xiaojun Guo and others have introduced a new scheme in [6], here a scheme to extract keyframes from compressed video stream is proposed. It firstly computes the similarity set of adjacent I frames DC images, secondly applies clustering algorithm to the similarity set, and finally selects key frames with the clustering results. The experiment results show that proposed method is able to extract proper key frames from test video files fast and easily.

Hitesh Panchal and others have introduced DWT based scheme for color video scheme in [7]. Here digital watermarking is achieved on extracted key frames from uncompressed color video with another color watermark video using DWT. So, more information is embedded into original video while reducing the computation time and complexity compared to other schemes. This scheme is robust against attacks of frame dropping, frame averaging, noise addition and statistical analysis. Experimental results are shown to verify effectiveness and imperceptibility.

Ankita.P.Chauhan and others have introduced a method based on scene change in [8], here an effective scene change detection method for an uncompressed video is proposed. Authors have divided frames into blocks and applied a Canny edge detector in consecutive frames. Then, count the number of pixels (ones) in each block and compare it with consecutive frames. If scene change occurs, then number of pixels per block will change, based on that change one can detect scene change in consecutive frame. Here authors have presented a hybrid approach, in which they have used scene change detection along with block based motion estimation algorithms (BME) to compress video.

Venugopala P S and others have introduced a watermarking method based on scene change concept in [9]. Here the authors have implemented a scene change detection method and a watermarking method in the frames of each scene. The developed method embeds 8 bit-plane images, obtained from single grayscale watermark image, into different scenes of a video sequence. Some of the luminous values in the video pictures are selected and divided into groups, and the watermark bits are embedded by adjusting the relative relationship of the member in each group. A sufficient number of watermark bits will be embedded into the video pictures without causing noticeable distortion. The watermark will be correctly retrieved at the extraction stage, even after various types of video manipulation and other signal processing attacks.

3. WATERMARKING APPROACHES ON MOBILE DEVICES

Mobile devices like smart phones and tablet are equipped with image and video capturing facilities. Increased use of internet on mobile device to publish and share photos captured by the integrated camera of mobile device to the web has led to need for the protection of these photos and their intellectual property rights. An effort is being made to insert the watermark in the mobile device in which the video was captured. The video is to be watermarked using the mobile phone, without transferring the contents to a computer. The algorithms discussed in section 2 are analyzed in terms of resource usage to be made compatible with the resource available in the mobile phone.

Lianhe Cui[10] had proposed a method for video watermarking on mobile where watermarking is used in mobile video transmission. Processing of the customized watermarking data is performed at a communication device utilizing received global positioning (GPS) data and communicating the watermarked video data to a receiving communication device. Watermarking data is adjusted based on the feedback received from the receiving device. The device parameters may comprise one or more of: a power state, a device resolution, a screen size and a display setting of the receiving communication device. The watermarked video data communicated to the receiving communication device may be adjusted based on one or more device parameters corresponding to the receiving communication device. These parameters are sent as a response to the communication received. Intermediate communication devices are used in the communication. Embedding of the watermark is performed in an edge device after receiving the video and GPS data. A hardware circuit is also proposed to be implemented on a mobile device. This circuit uses conditional access (CA) descrambler, a one-time programmable (OTP) memory, a combinational function block, a watermark message parser, an embedded CPU, a time stamp counter, a watchdog timer, a main CPU, a copy protection (CP) scrambler, a CP descrambler, a video decoder and a watermark detector.

In the paper [11] by Arun Kejariwal, analysis of the energy profile of various watermarking algorithms is performed. They also study the impact of security and image quality on energy consumption. The author proposes a method of transferring the watermarking process to a proxy server. This leads to lower energy consumption on the handheld without compromising the security of the watermarking process. Authors propose a task partitioning scheme for wavelet-based image watermarking algorithms in which computationally expensive portions of the watermarking are "offloaded" to a proxy server. The proxy server acts as an agent between the content server and the handheld device. A watermark is embedded either in the spatial domain or in the frequency domain. The watermark is extracted from the image by applying a process that is almost the inverse of the embedding process. Then the extracted watermark is compared with the original watermark. In general, a threshold is defined for the comparison.

A paper by M. Mitrea [12], estimates the noise on the video captured on mobile phone. The frames are extracted and noise detection method was applied on each frame in sequence. The algorithms were based on considering the video as a 1D random process. The watermarking procedure starts by applying the DCT to each frame in the sequence and by recording R coefficients per frame alongside their locations. In order to find out whether the method features robustness, several types of transforms were applied to marked video: change of file format (from avi to MPEG), temporal & spatial cropping, and small rotations.

4. OBSERVATIONS

Most of the video watermarking approaches are using DCT and its derivatives for inserting the watermark [2][3][7]. Selective watermarking are done by [4] and [6] using the ROI concept with in a frame and using key frames. Method used in [9] needs the entire video to be processed for inserting watermark in each frame by inserting each bit place in all the frames of the scene. The concept proposed in [10] introduces extra hardware on mobile device or the video ad to be first communicated to an edge device, which is meant for watermark insertion and then communicated to destination. Also, it will be responsive for the feedback received from the receiver. The method in [11] had introduced the use of proxy server for watermark insertion and saves 80% of power in hand held device. This method is used for image watermarking. In this paper LSB based method and DCT based method are used on images to insert the watermark. The image and key are sent to proxy, which intern inserts the watermark and sends to the receiver. Receiver extracts

the watermark coefficients and sends back to server for decoding. Thus by transferring the watermarking process to a server, processing on the mobile device is reduced. The paper then discusses the security and energy tradeoff of the proxy based image watermarking. The methodology of [12] is applied for the low bit rate video and claimed that it is suitable for video on mobile phone applications.

5. EXPERIMENTAL RESULTS

The video captured on a mobile device will be in mp4 format which is a compressed format. The watermarking is to be done on this compressed form. As per the literature, DCT or any of its derivatives are the most used method for watermarking. But the aim is to have less of computation. Many of the papers in literature have implemented the video watermarking, considering video as a sequence of frames which are images. We made an attempt to implement the image watermarking in frequency and spatial domain. This method can be further extended to video.

Experiments were conducted on image watermarking using DCT and LSB for the color image, by inserting watermark in R, G and B channels separately and in combination. DCT watermarking with voter will consume more power than the LSB method. Replacing the 1st LSB will produce less noise compared to 8th LSB. The amount of mathematical computations is more in DCT based methods that lead to more resource and hence power consumption. Power consumption of the application on the Android Smartphone platform is found out using PowerTutor application. Figure 1 shows the power consumption of the applications as given by the PowerTutor application. Two methods are implemented in spatial domain and frequency domain, with considering a voter and without voter [13]. Considering the voter will increase the efficiency of the method, but introduces power consumption overhead.

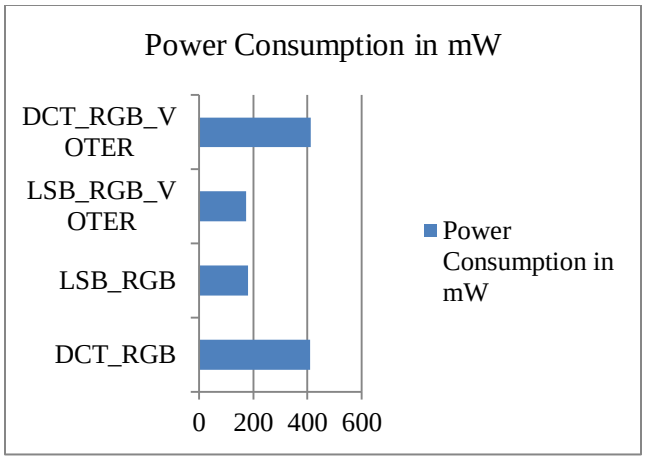

Fig 1: Power Consumption of watermarking applications

After inserting the watermark using DCT method, Peak Signal to Noise Ratio (PSNR) is 45.7 in DCT with voter and 45.5 in DCT without voter. Fig. 2 shows the PSNR values for LSB method, when the bits are used from various color channels.

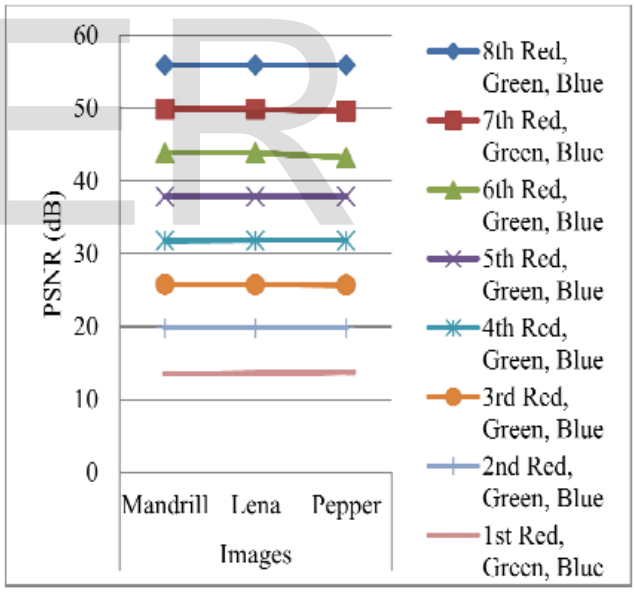

Fig 2. The Graph showing the Comparison of PSNR values for RGB Channels for various LSB positions.

6. CONCLUSION

In this paper various digital video watermarking are studied and observations are discussed. An attempt is made to design and implement a image watermarking method for executing on a mobile phone. The issues to be considered while designing the method are resource availability, size of watermark and the size of the video

to be watermarked. Image watermarking methods are implemented for android device and their performance is compared in terms of PSNR and power consumption. The video as being considered as a sequence of frames, the image watermarking methods can be extended for the video watermarking.

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