IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

Implementation of Video Authentication using Sensor Pattern Noise

Urvi M. Mittal[1], Rohita P. Patil[2]

PG Student, Elect & Telecom Department, SKNCOE, Vadgaon (BK), Pune, India[1]

Asst. Professor, Elect & Telecom Department, SKNCOE, Vadgaon (BK), Pune, India[2]

Abstract: Video evidences play an important role in criminal investigations for obtaining detailed information from their own. To deduce whether the contents of the given video are authentic or exactly similar to the captured one is determined using video authentication technique. Video authentication techniques are used for detecting malicious tampering and preventing various types of forgeries, performed on video data. Pattern noises acquired are treated as the fingerprint of devices which is very useful in for device identification. Image/video source identification is a difficult task on typical embedded devices. The paper provides a hardware or FPGA implementation of Modified filter bank (FB) based orthogonal db2 DWT filter and an image denoising algorithm based on minimum mean square error estimation. Without decrease in authentication accuracy, there is saving in hardware and improvement in clock frequency.

Keywords: Video authentication; Sensor Pattern Noise;DWT; Denoising.

I. INTRODUCTION

The study of digital argumentation is needed for logical and enquiring techniques to spot, gather, study and store information that is kept or encoded, normally to provide correct proof of a particular or regular activity. Manipulation of video sequence in such a way that objects inside the frame area unit inserted or deleted exploitation common malicious video forgery operations. Digital cameras used in flick theaters by raiders to get replica of cheap nature which are later oversubscribed on an illicit business and transported to lower bit-rates for prohibited sharing over the web. This leads to important loss of wealth to the flick trade. To stop illegal repetition drawback and distribution, Video authentication is essential.

A general video authentication system provides the virtue of digital video and justifies about the given video that whether the video has been manipulated or not. For a present video, authentication action begins by means of extraction of frame. Using a distinct video authentication design program, the authentication data is produced exploiting the frame of the video. The obtained authentication information is enciphered and prepacked with the video as a mark or as an option it will be imbedded with the video substantive information as a watermark. The video integrity is certified by deriving new substantiated data for the video presented. The current authentication knowledge which is received after computation is compared with deciphered original substantiated data. If both are equivalent, the video is considered as authentic else it is deliberated as tampered video.The digital watermarking is only applicable once info imbedding structure is accessible and therefore the application standards/protocols are chased. Given this as a limitation it is of little doubt that unwatermarked multimedia can persevere being made and there's a giant range of unwatermarked media gift and hence, digital watermarking is not used for digital investigation.

The most reliable method for detection video forgery like piracy is supply camera identification as a result of it points the device that captures the video. This method informs concerning the association of image with characteristics of camera such as model and complete. Thus, Video authentication using detector pattern noise is the reliable technique because it is exclusive for camera.

The system proposes hardware architecture for video authentication exploiting a pixel-non uniformity noise theme. For image denoising proposal, a modified filter bank (FB) primarily based implementation of the orthogonal db2 DWT is computed. The paper presented involves a 2-D pulse implementation based on array for associate degree image denoising algorithmic program. FPGA is preferred as a result it suggests for fast implementation of projected design and support purposeful similarity.

The paper is formulated as follows: The techniques related to video authentication, related issues are mentioned in section I. Literature review is presented in section II. In section III, proposed system is explained. Conclusion and set of remarks presented at the finish of the transient is delineated in section IV.

II. LITERATURE REVIEW

Different strategies that are used to implement video authentication usingdetector pattern noise are conferred below.

Basic idea used for extraction of noise for associate degree image correlative is inevitable except for unrelated signal it's not inevitable. PNU extraction is done by calculating traditional parametric statistic.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

Calculate the local variance of each and every subband using MAP estimation, and by using Weiner filter obtain the denoised frame F_{dN} as shown in Eq.(1).

$$N = F - F_{dN} \quad (1)$$

Where, N is the extracted noise from frame F.
For proper visual effect, the noise is scaled up 10 times. As, the sensor pattern noise will get through the averaging while remaining noises likely to cancel out. Thus, the sensor pattern noise N can be expressed as:

$$N = \frac{1}{K}\sum_{1}^{K} N_i \quad (2)$$

Where, Ni is the noise derived from the i^{th}frame extraction process and k isthe number of the frames taken into consideration. For identification purpose compute the sensor pattern noise of the video to be processed and identified (N_v) and compare it with the sensor pattern noise derived from the camera (N_c) using the correlation coefficient:

$$corr(N_v, N_c) = \frac{(N_v - \bar{N}_v)(N_c - \bar{N}_c)}{llN_v - \bar{N}_v llllN_c - \bar{N}_c ll} \quad (3)$$

Several measurements like parallelization, selective frame processing and combining wireless finger print were taken to perform source identification in real time situation.
Blocking alters the extraction of sensor pattern noise in manifolds. Firstly, within the blocks the details and pattern noise both are lost. Secondly, the borders of blocking become a strong which will survive extraction & averaging. The correlation coefficient is between 0.1 &0.7 when Nv& Nc have same source. The correlation coefficient is higher when the video extracted (Nv,Nc) is of same bit rate.

The SPN (noise residue) is patterned as an Additive White Gaussian Noise (AWGN) in the extraction process with the help of Wavelet-based denoising filter to cancel out the impact of the contamination in the frequency domain from the image details is proposed.
The noise surplus extracted from an image processed is

$$w_k = I_k - F(I_k) \quad (4)$$

Where, F (I_k) denotes the denoised image.
The camera reference SPN y is computed by averaging the phase component and performing the operation of inverse DFT.

$$y = real\left(IDFT\left(\frac{\sum_{k=0}^{L-1} W_{\emptyset k}}{L}\right)\right) \quad (5)$$

L is the number of images used in extraction process of noise, y is a signal containing white noise. Its circular correlation function is a treated as a delta function.
The noise in a digital image originates from a number of different sources. The noise components that differ from image to image is collectively called shot noise, similarly the noise components that remain approximately the same from image to image is called pattern noise. If the imaging sensor takes a picture of an absolutely evenly lit scene, the digital image resulting will differences between individual pixels. The shot noise consists of a number of components, but is not interesting from a forensic point of view since its random nature makes it unfit for any identification because after extracting large number of frames and adding them the noises cancels out.
Pattern Response non-uniformity noise (PRNU) is a dominating component in sensor pattern noise which is contaminated by various noise introduced during acquisition process at different stages.
A pixel non-uniformity (PNU) noise (P) component which camera contains is present due to the varying pixel's-to-light sensitivity and attributes to the of silicon wafers and imperfections during the process of sensor manufacturing. Thus, PNU noise is a fingerprint of the device and independent of wetness and temperature, making noise as associate degree glorious alternative for video authentication functions. This character of the PNU noise proves that sensors coming from the similar wafer also exhibit different PNU patterns.

III. PROPOSED SYSTEM

The camera inserts a PNU footprint (P) through sensor in the camera into the image or video captured, for authentication purpose. The proposed system block diagram is shown in Fig.1. The extraction step which is proposed contains Forward and Inverse Discrete Wavelet Transform (DWT and IDWT) computation to convert the image to frequency sub-bands, which are then processed individually. For variance estimation of each subband, a maximum likelihood estimate (MLE) is used which is followed by MMSE estimation procedure to obtain denoised frame. The denoised frame obtained after IDWTis subtracted from the frame extracted to get an estimate of the PNU.

The reference PNU Pused for estimation of PNU is not directly available for most cameras; so it is obtained by averaging the past values of P^1 from a great number of past samples.

$$\boldsymbol{P = \frac{1}{N}\sum_{i=1}^{N} P^1} \quad (6)$$

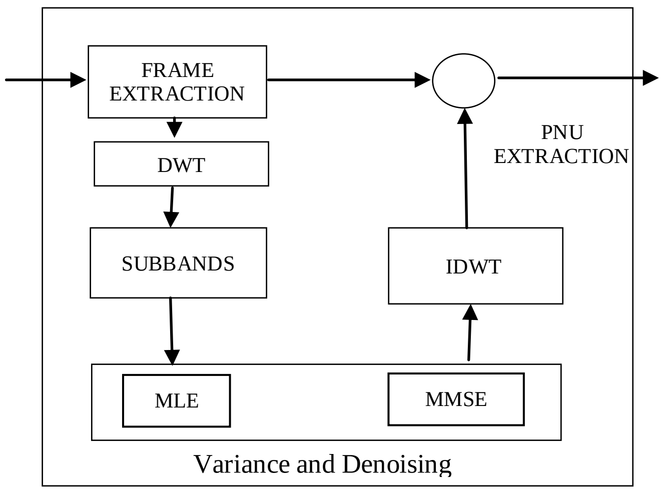

Fig.1Block diagram

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

where, P_i^1 is the PNU estimated from the i[th] frame of camera and N stands for number of samples. As the denoising process, gets rid of all noise and extracts the original image or frame.

Wavelet-domain denoising using MMSE estimation found to be very effective and takes into consideration natural image boundaries, which appears in several denoising algorithms as a component of noise pattern. The denoised frameI ≈ Nobtainedfrom process is subtracted from the extracted frame (EF) to derive an estimate of the PNU.The proposed diagram consists of following blocks:

1)**DWT**:For denoising purpose, the first step is to perform DWT for converting frames into subbands for easy computation. db2 orthogonal wavelet is used for performing DWT and reduces area and computational requirement for hardware implementation. The coefficients are given in Table1.

Table 1 Coefficients of db2 Wavelet Filter

	Lo_D	Hi_D
1	-0.12940952255091	-0.48296291314461
2	0.224143868041857	0.83651630373746
3	0.836516303737465	-0.22414386804185
4	0.482962913144691	-0.12940952255091

The Video is converted into frames in MATLAB. The extracted frame of resolution 256x256 is loaded onto block RAM so as to perform algorithm operation on images. The DWT computation is done using modified filter bank implementation as shown in Fig.2.

Modified Filter bank implementation using db2 wavelet reduces hardware utilization and give almost same accuracy as DWT filter designed using db8 wavelet.

4 different cameras were taken to verify the accuracy of wavelet. The filter coefficients for db2 wavelet filter are expressed as

$$\boldsymbol{Lo_D(z) = a_1 + a_2 z^{-1} + a_3 z^{-2} + a_4 z^{-3}}$$
$$\boldsymbol{Hi_D(z) = b_1 + b_2 z^{-1} + b_3 z^{-2} + b_4 z^{-3}} \qquad (7)$$

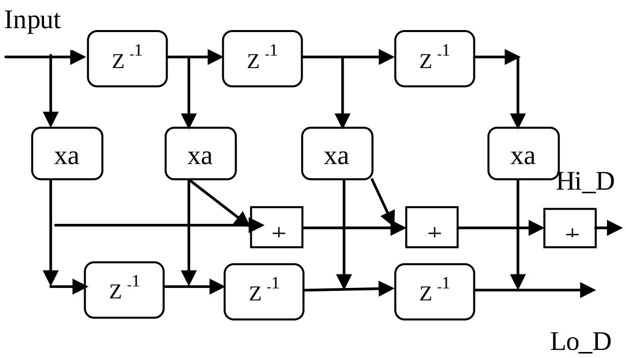

Fig.2 Modified Filter Bank Implementation

Where, a_1, a_2, a_3, a_4 represent low pass filter coefficients and $b_4 = a_1$, $b_3 = -a_2$, $b_2 = a_3$ and $b_1 = -a_4$ are respectively high pass filter coefficients.Fig.3 shows the simulation results of db2 filter. The modifies filter bank implementation uses orthogonal db2 filter coefficients as it requires fewer adders and multipliers than other filter because it reuses the multiplier computation and achieves highest clock frequency.

Table 2 Hardware required for implementation

	'db2' MFB
Adders	6
Multipliers	4

Fig.3 Simulation results of db2 filter

The periodic extension mode of DWT is used, because it produces least wavelet coefficients and increases throughput.Fig.4 shows the 3[rd] level of DWT of frame computed using db2 filter.

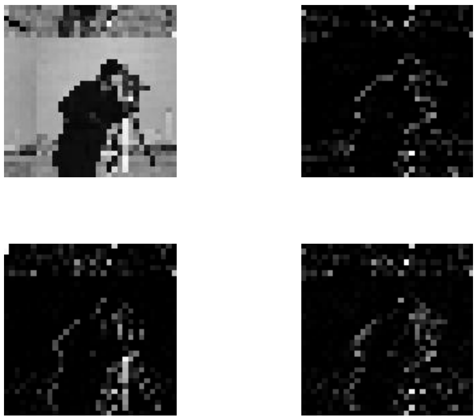

Fig.4 3[rd] Level of DWT

2) **Variance and Denoising**:Three levels of DWT are taken into consideration and subands except LL3 i.e approximation coefficients of levels are transfered independently for calculation of variance and denoising process. The MLE estimation is calculation of variance by employing of mask size 3 x 3 but the performance of denoising is not affected by this masks as it is used for variance estimation.For each mask variance is calculated as $\hat{\sigma}^2$.

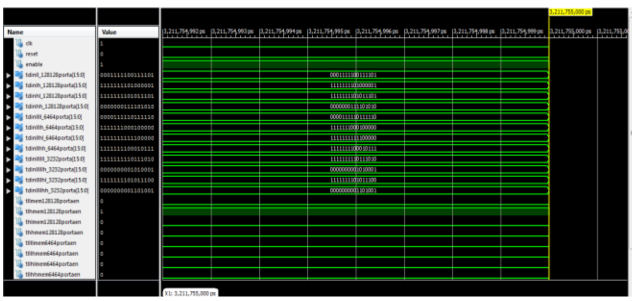

Fig.5 Simulation Results

After calculation of variance the predictor for a denoised subbands and is expressed by following relation:

$$\overline{S(i,j)} = \frac{S(i,j) \times \widehat{\sigma^2(i,j)}}{\sigma^2(i,j) + \sigma_0^2} \quad (9)$$

The value of $\sigma_0$is taken as 5 for 8-bit pixels.After obtaining denoised subbands as shown in Fig.5,the subbnads are processed with IDWT to obtain denoised image($\bar{I}$).The PNU estimate is computed as subtraction between subband pixel and denoised subband pixel.

$$P^1(i,j) = I(i,j) - \overline{I(i,j)} \quad (10)$$

Where image $\bar{I}$is result of inverse DWT operation on the denoised subbands.

$$\bar{\mathrm{I}} = \mathrm{IDWT}\ (\text{all subbands}\ \bar{\mathrm{S}})$$

Compute the correlation between pixels in PNU P and P^1.

$$\rho = \mathrm{corr}(\mathrm{P}, \mathrm{P}^1) = \left(\frac{(\mathrm{P}^1 - \overline{\mathrm{P}^1})(\mathrm{P} - \bar{\mathrm{P}})}{\left\|\mathrm{P}^1 - \overline{\mathrm{P}^1}\right\| \|\mathrm{P} - \bar{\mathrm{P}}\|} \right) \quad (11)$$

Where $\bar{\mathrm{P}}, \overline{\mathrm{P}^1}$ denotes mean of the pixel value in P and $\mathrm{P}^{1.}$ The correlation value obtained (ρ) above a pre-calculated threshold identifies successful authentication of the video by identifying proper camera.

IV. CONCLUSION

In video surveillance, law enforcement, forensic investigations, and content ownership the authenticity of video info is of prime interest. The manufacturing process of imaging sensors introduces various defects which create noise in the pixel values.The pattern noise present in digital images can be observed as a non-periodic signal with different interruption, as the PRNU noise is treated as effect of per-pixel. To represent a signal by different frequency components he Fourier transform is useful, but it has a major drawback that the Fourier transform is not able to restrict the spectral components in time.To overcome this problem, the wavelet transform approach is introduced. A system dealing with DWT and IDWT implementation is proposed on FPGA, which results into less number of the hardware requirements of a modified filter bank (FB) depending on the implementation of the DWT using orthogonal db2 filter.

ACKNOWLEDGMENT

The author would like to express wholehearted thanks to guide Prof. Rohita R. Patil for her support and encouragement. And gratefully acknowledge her for imparting valuable basic knowledge of project.

REFERENCES

[1] Pandeet al.: "Hardware Architecture for Video Authentication Using Sensor Pattern Noise "in IEEE transactions on circuits and systems for video technology, vol. 24, no. 1, January2014.
[2] Ce Guo and Wayne Luk:"Accelerating Maximum Likelihood Estimation for Hawkes Point Processes"in IEEE ,2013
[3] Mihajlo Katona, et al"A Real-TimeWavelet-Domain Video Denoising Implementation in FPGA" EURASIP Journal on Embedded SystemS, Article ID 16035, Pages 1–12, 2006.
[4] Hun Seok Kimet al"A Practical, Hardware Friendly MMSE Detector forMIMO-OFDM-Based Systems"EURASIP Journal on Advances in Signal Processing, Article ID 267460, 14 pages,2008.
[5] DhahaDia, MedienZeghidet al"Multi-level Discrete Wavelet Transform Architecture Design"Proceedings of the World Congress on Engineering 2009 Vol I WCE 2009, July 1 - 3, 2009.