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Design and Implementation of Image Authentication Technique using Probabilistic Principal Component Analysis

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Abstract:

Digital watermarking play an important role in information security. It majorly focusses on the authentication of the information. The authentication provides the genuinity of the owner of the information. The present paper focuses on the development of a novel Probabilistic Principal Component Analysis based Transform domain wtaremerking method (PPCATDW). The proposed PPCATDW method uses wavelet transformation domain for watermarking process. It interanlly uses pricnipal component analysis based information for the identification of the influential representation points of the input image. The proposed method is experimented with the fourteen images and the results show the efficacy of the proposed method.

Keywords: *Wavelet, Watermark, Gray scale and PCA*

I. Introduction

In the recent years, the information is available in the form of multimedia. The security can be provided to the text. The text based security is considered as cryptography. The multimedia is in various forms like audio, video and image etc. with this form, the information can be transmitted in easily from one to another with the support of internet. With this increase of volume of information, the intruders can claim it as their own information. To overcome this problem, the digital watermarking methods are used. The watermarking method can be applicable to any form of the information. The image watermarking method [1] applied watermark to the image input and the owner of the watermarked images can be recognized efficiently. The watermarking method can be visible or invisible. The visible watermarking method can make the watermark visible to the public. The invisible watermarking method can make the watermark invisible to the public. The cryptography converts the input plain text to the cipher text where as the watermarking method converts the image to the watermarked images. With the cryptography, the existence of the message is known where as with the invisible watermarking method, the existence of the message is unknown to the intruder.

II. Related Work

The characters that are defined by the user can be considered as a feature [2]. This feature is found to be efficient for designing the invisible watermarking process. This uses the most significant bits of the selected region of the image. The identify problem is resolved with the multiple watermarking process. This process includes various transformation domain watermarking methods. Discrete Cosine Transformation (DCT) [3] can be used to design the invisible watermarking method. It divides the host image to m×n blocks. This will overcome various attacks of zooming and height-width etc. The Singular Value Decomposition (SVD) can be combined with Redundant Discrete Wavelet Transformation (RDWT) for designing the blind watermarking method [4]. It provides additional security by scrambling the input binary watermark. The spread spectrum [5] based method is found to be efficient for audio watermarking with PN sequence method. The watermark region of the input medical image can be used for the detection of the diseases [6]. It uses zero reversible watermarking method. The binary watermark image can be further processes by the mathematical morphology [7]. It uses the histogram normalization and region filling operations. The discrete wavelet and cosine transformations are used to design the hybrid watermarking process [8]. It yields improved PSNR value. The host image is decomposed in to various rectangular shaped blocks [9] and SURF features are estimated to select the region of interest for watermarking process. For the color image, the S and L blocks [10] are used to perform the digital watermarking methods. The watermarking with Fourier transformation, Wavelet transformation, Fast Wavelet transformation and Singular Value Decomposition [11, 12] is found to be robust.

III. Methodology

The Principal Component Analysis (PCA) is used for preprocessing the input information and further to perform the analysis. Thus, it is used for reduction of dimensionality. The Probablistic PCA (PPCA) consists of isotropic Gaussian Noise model. The present paper uses PPCA method for the selection of the region of interest. Thus, the present paper proposes a novel Probabilistic Principal Component Analysis based Transform domain watermarking method (PPCATDW). The PPCATDW method uses PPCA for estimating the principal axes with the isotropic error model. The PPCA is given in (1)

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$$y^T = W \times x^T + \mu + \varepsilon \qquad (1)$$

The present PPCATDW uses the wavelet transformation. The methodology of the proposed method is discussed in the following steps.

Step 1: Read the cover and watermark image

Step 2: Apply the Haar Wavelet transformation to the cover image.

Step 3: Select the LL sub band.

Step 4: Apply the PPCA to select the region of interest

Step 5: Insert the wateramark image in to the selected regions.

Step 6: Apply the inverse wavelet transfrmation to generate the watermarked images.

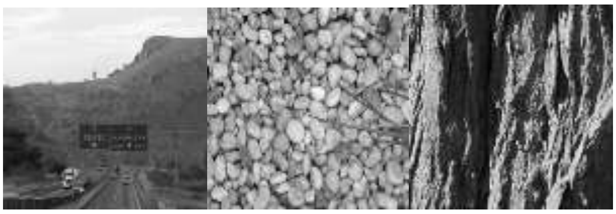
IV. Results and Discussions

The present paper proposes a novel Probabilistic Principal Component Analysis based Transform domain watermarking method (PPCATDW). The PPCATDW is experimented with fourteen images as shown in Fig. 1. All the cover images are used for the watermark images as shown in Fig. 2. The watermarked images with WM Image1 watermark image is shown in Fig. 3. The watermarked images with WM Image2 watermark image is shown in Fig. 4. The watermarked images with WM Image3 watermark image is shown in Fig. 5. From these results, it is clear that the proposed method is robust and efficient for any type of cover image and watermark image.

(a) (b) (c)

(d) (e) (f)

(g) (h) (i)



(j) (k) (l)

(m) (n)

Fig. 1. Original Images (a) Human Image1 (b) Human Image2 (c) Animal Image1 (d) Animal Image2 (e) Flower Image1 (f) Flower Image2 (g) Fruit Image 1 (h) Fruit Image2 (i)Landscape Image1 (j) Landscape Image2 (k) Texture Image1 (l) Texture Image2 (m) Winter Image1 (n)Winter Image2.

(a) (b) (c)

Fig. 2. Watermark Images (a) WM Image1 (b) WM Image2 (c) WM Image3.

(a) (b) (c)

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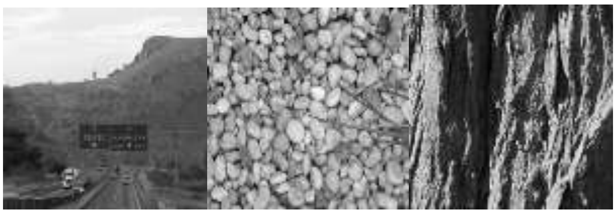
(d) (e) (f)

(g) (h) (i)



(j) (k) (l)

(m) (n)

Fig. 3 PPCATDW Watermarked Results with WM Image1 (a) Human Image1 (b) Human Image2 (c) Animal Image1 (d) Animal Image2 (e) Flower Image1 (f) Flower Image2 (g) Fruit Image 1 (h) Fruit Image2 (i)Landscape Image1 (j) Landscape Image2 (k) Texture Image1 (l) Texture Image2 (m) Winter Image1 (n)Winter Image2.

(a) (b) (c)

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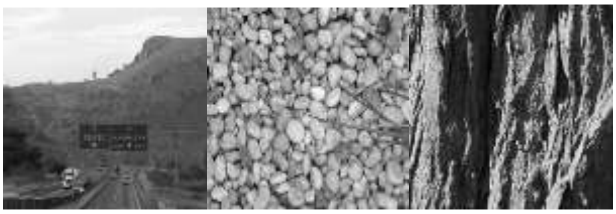
(d) (e) (f)

(g) (h) (i)



(j) (k) (l)

(m) (n)

Fig. 4 PPCATDW Watermarked Results with WM Image2 (a) Human Image1 (b) Human Image2 (c) Animal Image1 (d) Animal Image2 (e) Flower Image1 (f) Flower Image2 (g) Fruit Image 1 (h) Fruit Image2 (i)Landscape Image1 (j) Landscape Image2 (k) Texture Image1 (l) Texture Image2 (m) Winter Image1 (n)Winter Image2.

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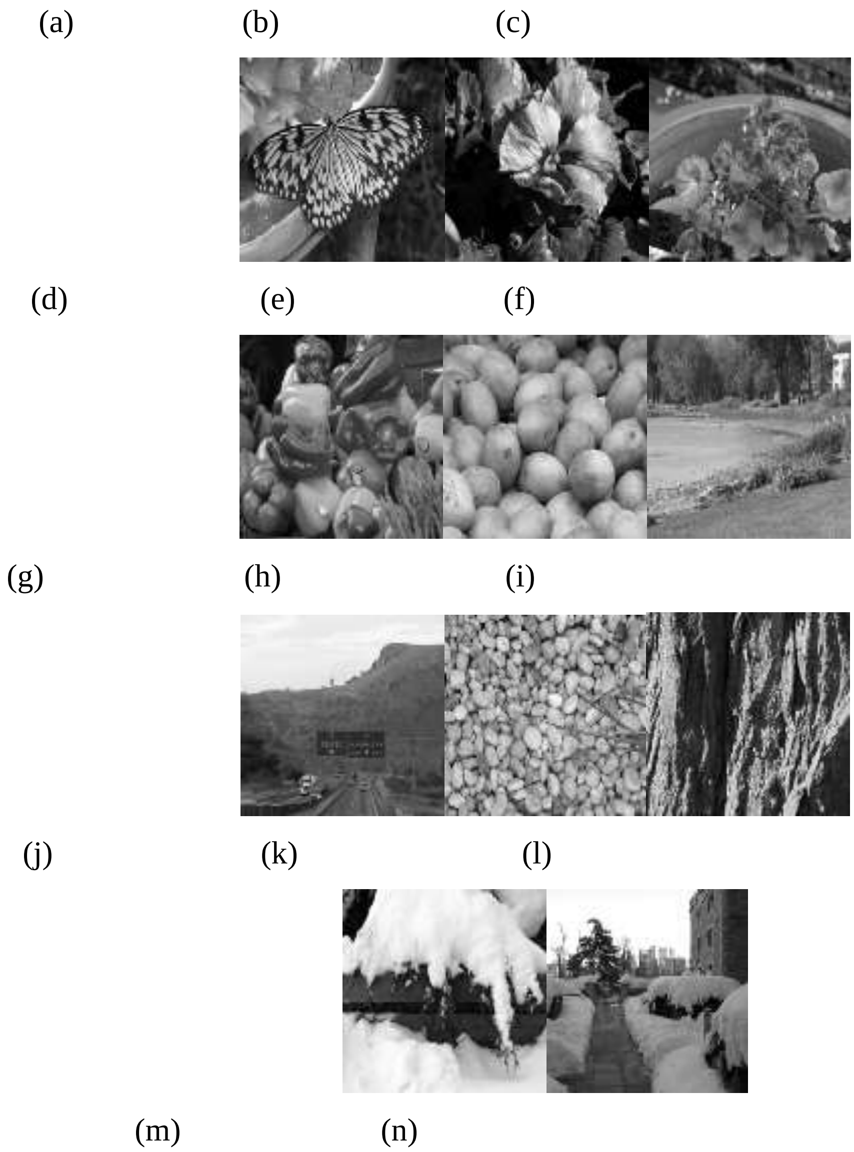

Fig. 5 PPCATDW Watermarked Results with WM Image3 (a) Human Image1 (b) Human Image2 (c) Animal Image1 (d) Animal Image2 (e) Flower Image1 (f) Flower Image2 (g) Fruit Image 1 (h) Fruit Image2 (i)Landscape Image1 (j) Landscape Image2 (k) Texture Image1 (l) Texture Image2 (m) Winter Image1 (n)Winter Image2.

To estimate the performance of the proposed PPCATDW method, various performance measures viz., Mean Absolute Error (MAE), Mean Square Error (MSE), Root Mean Square Error (RMSE), Peak Signal to Noise Ratio (PSNR), Signal to Noise Ratio (SNR) and Root Signal to Noise Ratio (RSNR) are estimated. The estimated performance measures for the proposed PPCATDW with

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WM Image1 are listed in Table 1. The estimated performance measures for the proposed PPCATDW with WM Image 2 are listed in Table 2 and the estimated performance measures for the proposed PPCATDW with WM Image 3 are listed in Table 3. The results indicates the strength of the proposed watermarking method.

Table 1. Estimated Performance Measures for PPCATDW with WM Image1.

S.No.	Image	MAE	MSE	RMSE	PSNR	SNR	RSNR
1	Human1	0.000641	0.000458	0.021395	90.85258	270988.7	520.5657
2	Human2	0.000641	0.000458	0.021395	90.85258	244372.6	494.3405
3	Animal1	0.000885	0.000641	0.025315	87.93001	194912.3	441.4887
4	Animal2	0.000641	0.000458	0.021395	90.85258	202166.5	449.6293
5	Flower1	0.000427	0.000305	0.017469	94.3744	232733.5	482.4246
6	Flower2	0.000641	0.000458	0.021395	90.85258	204720	452.4599
7	Fruit1	0.000427	0.000305	0.017469	94.3744	299219.3	547.0094
8	Fruit2	0.000641	0.000458	0.021395	90.85258	283110.1	532.0809
9	Landscape1	0.000427	0.000305	0.017469	94.3744	394266.7	627.9066
10	Landscape2	0.00116	0.000839	0.02897	85.58775	170316.3	412.694
11	Texture1	0.000244	0.000168	0.012956	99.56715	713800.9	844.8674
12	Texture2	0.000641	0.000458	0.021395	90.85258	197856.5	444.8106
13	Winter1	0.000641	0.000458	0.021395	90.85258	346701.7	588.8138
14	Winter2	0.000641	0.000458	0.021395	90.85258	270988.7	520.5657

Table 2. Estimated Performance Measures for PPCATDW with WM Image2.

S.No.	Image	MAE	MSE	RMSE	PSNR	SNR	RSNR
1	Human1	0.001938	0.001709	0.04134	79.41064	72586.26	269.4184
2	Human2	0.001938	0.001709	0.04134	79.41064	65456.94	255.8455
3	Animal1	0.002579	0.002304	0.048001	76.81546	54214.01	232.839
4	Animal2	0.001938	0.001709	0.04134	79.41064	54151.74	232.7053
5	Flower1	0.001297	0.001114	0.033375	83.12854	63762.59	252.5126
6	Flower2	0.001938	0.001709	0.04134	79.41064	54835.71	234.1703
7	Fruit1	0.001297	0.001114	0.033375	83.12854	81977.89	286.3178

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8	Fruit2	0.001938	0.001709	0.04134	79.41064	75833.06	275.378
9	Landscape1	0.001297	0.001114	0.033375	83.12854	108018.3	328.6613
10	Landscape2	0.003189	0.002869	0.05356	74.91184	49826.59	223.2187
11	Texture1	0.000732	0.00058	0.02408	88.79933	206626.6	454.562
12	Texture2	0.001938	0.001709	0.04134	79.41064	52997.28	230.2114
13	Winter1	0.001938	0.001709	0.04134	79.41064	92866.52	304.7401
14	Winter2	0.001938	0.001709	0.04134	79.41064	72586.26	269.4184

Table 3. Estimated Performance Measures for PPCATDW with WM Image3.

S.No.	Image	MAE	MSE	RMSE	PSNR	SNR	RSNR
1	Human1	0.001862	0.001465	0.038273	80.74958	84683.97	291.0051
2	Human2	0.001862	0.001465	0.038273	80.74958	76366.43	276.3448
3	Animal1	0.00209	0.001633	0.040407	79.80732	76507.62	276.6001
4	Animal2	0.001862	0.001465	0.038273	80.74958	63177.03	251.3504
5	Flower1	0.001602	0.001236	0.035156	82.2253	57465.05	239.7187
6	Flower2	0.001862	0.001465	0.038273	80.74958	63975	252.9328
7	Fruit1	0.001602	0.001236	0.035156	82.2253	73881.31	271.8112
8	Fruit2	0.001862	0.001465	0.038273	80.74958	88471.91	297.4423
9	Landscape1	0.001602	0.001236	0.035156	82.2253	97349.8	312.0093
10	Landscape2	0.002533	0.002075	0.045554	77.72422	68877.93	262.4461
11	Texture1	0.001373	0.001038	0.032212	83.74482	115467.8	339.8055
12	Texture2	0.001862	0.001465	0.038273	80.74958	61830.16	248.6567
13	Winter1	0.001862	0.001465	0.038273	80.74958	108344.3	329.1569
14	Winter2	0.001862	0.001465	0.038273	80.74958	84683.97	291.0051

V. Conclusions

The Present paper proposes a novel Probabilistic Principal Component Analysis based Transform domain wtaremerking method (PPCATDW). This method focuses on the selection of the efficient region for the watermarking process, The proposed method is evaluated with various images and the result indicates that the proposed method is roust to various watermark images.

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