REAL-TIME AND NON-INTRUSIVE METHOD BASED ON THE DIFFUSION SPEED OF SINGLE IMAGE

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Abstract : In today's world, with the increasing demand for high level security in devices and systems several techniques are developed. Face recognition from image is a widely used topic for biometric purpose . In many public places usually have CCTV cameras for capturing the videos and these cameras have their significant value for security purpose. In this paper a real-time method is proposed based on the diffusion speed. The diffusion speed of a single image is obtained to address this problem. Liveness detection is the key idea in surface properties between live and fake faces can be efficiently estimated. SVM classifier is proposed to define whether the given face is fake or not. The significant advantage of this method is that, as compared to previous approaches, it accurately identifies varied malicious attacks regardless of the medium of the image, e.g., paper or screen.

IndexTerms **-** Spoofing, Diffusion speed, Local speed pattern, Local binary pattern, SVM classifier, Face liveliness detection.

I. Introduction

With the increasing demand for high-level security in mobile devices, such as smart phones and tablets, biometric techniques have gained substantial attention because of their important characteristics. Thus, fingerprint verification systems have been actively researched and are now deployed in various secured systems. But the problem arises where these systems are liable to spoofing attack. Spoofing attack arises where a person personations as other person and gains an illegal access into a secured system. To address the problems of spoofing attacks, a novel and simple method for detecting face liveness from a single image is proposed. The key idea of this problem is that the difference in surface properties between live and fake faces can be efficiently estimated by using diffusion speed. More clearly, computing the diffusion speed by utilizing the total variation (TV) flow scheme and extracting anti-spoofing features based on the local patterns of diffusion speeds, which are called as local speed patterns (LSPs). These features are finally given as input into a linear SVM classifier to determine the liveness of the given face image. As compared to previous approaches, this method will perform well regardless of the image medium for face detection .

Biometrics is one of the fastest growing segments of security industry. In Biometric technology measuring and analyzing the human body characteristics by using different methods such as facial recognition, fingerprint recognition, handwriting verification and hand geometry. Among all these techniques, the one which has rapidly developed in recent years is face recognition technology. Face recognition technique is more direct, user friendly and very much convenient compared to other methods. A human can determine a live face or a fake face without much effort, because a human can easily recognize the physiological indications of liveliness, for example, facial expressions, mouth movement, head movement, eye blinking. But sensing these clues is very difficult for a computer.

II. LITERATURE REVIEW

This section explains the existing methods for face liveliness to destroy spoofing attacks.

A. Diffusion Speed

In this section, we aim to efficiently show the diffusion speed in which illumination characteristics are clearly revealed. To this end, we first conduct nonlinear diffusion on the original face image I,

$$\boldsymbol{u^{k+1} = u^k + div\Big(d\big(\nabla u^k \mid \nabla u^k\big)\Big)}, \qquad \boldsymbol{u(k=0)=1} \qquad \textbf{(1)}$$

where k denotes the iteration number. For the diffusivity function d(x), we propose adopting the total variation (TV) flow,

$$\boldsymbol{d(x) = \frac{1}{\varepsilon + N}} \qquad \textbf{(2)}$$

Where ε is a small positive constant. In a given image, the TV flow has been proven to comply with the following rules. 1) Pixels belonging to a small region move faster than those belonging to a large region, e.g., a homogenous region, and 2) the two boundary pixels adapt their value with half that speed. These rules lead to a very useful consequence: by simply computing the difference in pixel values of the original and diffused images generated by the TV flow, we can easily estimate the relative diffusion speed of each pixel.

In this section the distinction in surface properties between live and fake faces that is obtained using diffusion speed and Specifically, computing the diffusion speed by utilizing the total variation (TV) flow scheme and extracting anti-spoofing features supported the local patterns of diffusion speeds, the so-called local speed patterns (LSPs). These options area unit later input into a linear SVM classifier to work out the liveness of the given face image.

B. Face Detection

Face detection has been a vigorous analysis space. The face detection analysis has many disciplines like image process, machine learning approach, pattern recognition, laptop vision, and neural networks. Classification is that the main drawback. within the method of face detection it includes, to coach the face pictures from the glorious people so to classify the new returning take a look at pictures into one among the categories.

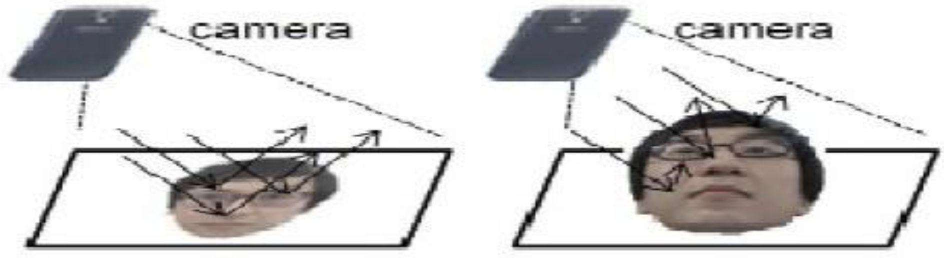

fig. 1. (a) and (b) different characteristics of illuminations on a fake and a live face

The problems or limitations for a machine learning face recognition system are:

1. facial features
2. Illumination variation
3. Ageing
4. face variation
5. Scaling issue like size of the image
6. Presence and absence of spectacles, beard, hair etc.
7. Occlusion due to scarf, mask or obstacles.

C. Support Vector Machine (SVM) Classifier

In automatic face recognition system the most difficult task is that it involves detection of faces from a untidy background, facial feature extraction, and face recognition. There area unit such a lot of classifiers area unit developed to find the face liveness however largely used classifiers like Artificial Neural networks and support vector machine (SVM). we have got used SVM classifier because it constructs a hyperplane or a collection of hyperplanes during a high or infinite-dimensional space. To overcome the matter of classification within the face liveliness detection SVM is employed.

The input to a SVM algorithm is a set $\{(X_i, Y_i)\}$ of labeled training data, where X_i is the data and Y_i = -1 or 1 is that the label. The output of a SVM algorithm is a set of Ns support vectors SI, coefficient weights ai, class labels Yi of the support vectors, and a constant term b. The linear decision surface is

$$w \times z + b = 0,$$

$$w = \sum_{i=1}^{N_s} a_i y_i s_i \quad (3)$$

SVM can be extended to nonlinear decision surfaces by using a kernel K ("). The nonlinear decision surface is

$$\sum_{i=1}^{N_s} a_i y_i K(s_i, z) + b = 0 \quad (4)$$

We are going to model the dissimilarities between faces. Let T = {t 1, ... , t M} be a training set of faces of K individuals. with multiple images of each of the K individuals. From T we will generate two classes. The first is the within-class differences set, which are the dissimilarities in facial images of the same person. Formally the within-class difference set is

$$C_1 = \{t_i - t_j | t_i \sim t_j\} \quad (5)$$

The set C1 contains within-class differences for all K individuals in T. not dissimilarities for one of the K individuals in the training set. The second is the between-class differences set which are the dissimilarities among images of different individuals in the training set. Formally

$$C_2 = \{t_i - t_j | t_i \sim t_j\} \quad (6)$$

Classes C_1 and C_2 are the inputs to our SVM algorithm, which generates a decision surface. In the pure SVM paradigm, given the distinction between facial images P_1 and P_2, the classifier estimates if the faces in the two images are from the same person.The classification returns a measure of similarity $\delta = w \times (P_1 - P_2) + b$.

This similarity measure is the basis for the SVM-based verification and identification algorithms will be presented in this paper.In verification process, there is a gallery $\{g_j\}$ of m known individuals. The algorithm will presenting with a probe p and a claim to be person j in the gallery. The first step of the verification

$$\delta = \sum_{i=1}^{N_s} a_i y_i K(s_i g_j - p) + b \quad (7)$$

The second step accepts the claim if $\delta \leq \Delta$. Otherwise. The claim is rejected. The value of Δ is set to meet the desired tradeoff between P_V and P_F.

In identification there is a gallery $\{g_j\}$ of m known individuals. The algorithm will presenting with a probe p to be identified. The first step of the identification algorithm computes a similarity score between the probe and each of the gallery images.

$$\delta_j = \sum_{i=1}^{N_s} a_i y_i \, K(s_i g_j - p) + b \qquad (8)$$

In the second step, the probe is identified as person j that has minimum similarity score δ_j. An alternative method of reporting identification results is to order the gallery by the similarity measure δ_j.

D. Datasets

The dataset been used for our experiment that is most generally available commonplace benchmark datasets: NUAA dataset. The projected technique is evaluating by NUAA dataset. None of the faces contains any apparent motion, like eye blink or head movement. To form fake examples, the authors of captured photos of every subject employing a usual Cannon camera and printed them on photographic paper and normal A4 paper. During this projected work a group of original and fake images at totally different environments with variable illumination conditions.

(a) *(b)*

Fig. 2. (a) original image (b) Diffused image

III. PROPOSED PLAN OF WORK

Detection of life signs can be of two types. First one assumes certain known interaction from the user. In this situation the user needs to perform a certain task to verify the liveness of his face image. This task can be a certain move that can be considered as a challenge response or a motion password. Users who will perform their task correctly are assumed to be real. The second category does not assume any interaction from the user, but focuses on certain movements of certain parts of the face, such as eye blinking [8], mouth movement [9], head rotation [10] and will consider those movements as a sign of life and therefore a real face. Life sign based liveness detection based approach is very hard to spoof by 2D face images and 3D sculptures. Most of the current face detection systems are based on intensity images and equipped with a generic camera.

An anti-spoofing method without additional device is more preferable. It could be easily integrated into the existing face detection systems. LBP [8] is an order set of binary comparisons of pixel intensities between the center pixel and its eight surrounding pixels. LBP classifiers consider local features.

$$\text{LBP}(x_a y_a) = 7\textstyle\sum_{n=0} s\,(i_m i_a) 2^n \qquad (9)$$

Where ia corresponds to the value of the center pixel (xa,ya), im to the value of eight surrounding pixels, function f(x) is defined as:

$$f_{(x)} = \begin{cases} 1, & if\ x \geq 0 \\ 0, & if\ x < 0 \end{cases}$$

Local speed pattern we can utilize the ability of the diffusion speed model to efficiently extract anti-spoofing features. More specifically, the value of the diffusion speed itself at each pixel position as our baseline features, given as

Fbase = {s(x, y)|0 < x ≤ W, 0 < y ≤ H},

where W and H denote the width and height of the detected face region, respectively. We propose defining the local speed patterns to efficiently capture even small differences between the diffusion speed maps of live and fake faces as

$$\mathbf{f_{LSP}(x, y)} = \sum_{1 \leq i \leq n} \mathbf{2^{i-1}\, LSP^i(x, y)}$$

$$\mathbf{LSP^i(x, y)} = \begin{cases} \mathbf{1} & \mathbf{if\ s(x, y) > s(x_i y_i)} \\ \mathbf{0} & \mathbf{otherwise} \end{cases} \qquad \mathbf{(10)}$$

LSP-based feature vector generation for the given face image is generated the dimension of the proposed feature vector is 59 × K, where K is the number of image blocks and FLSP is obtained.

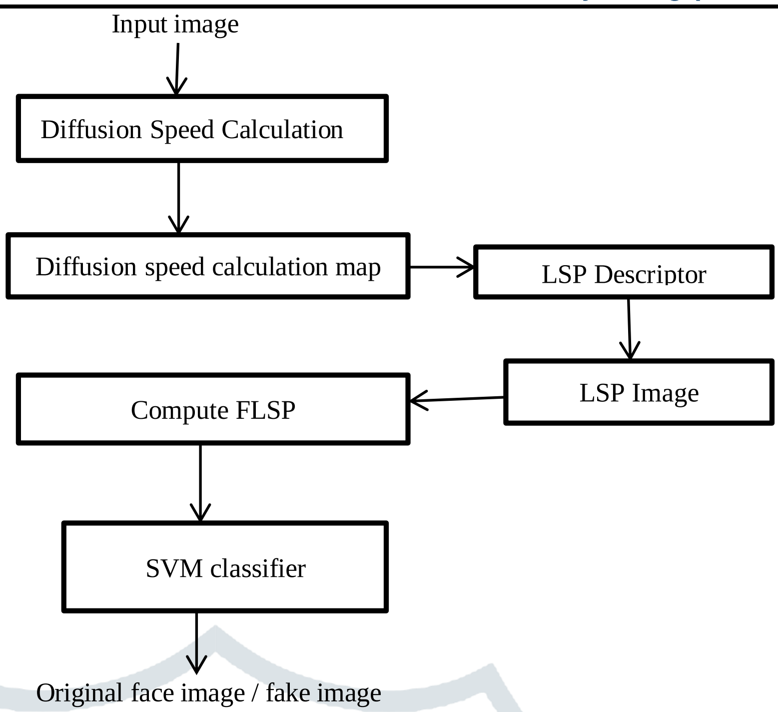

fig. 3. methodology of proposed work

IV. CONCLUSION

A simple and robust technique for face liveness detection is mentioned in this paper.SVM yield high performance on the event set, however area unit less effective on the test set. This may be explained by the very fact that the classification threshold is chosen on the event set, that for NUAA is really a set of the training set, as we tend to perform cross-validation. Solely documented person will use the system further.To capture the distinction between live and fake faces a lot of effectively, encoding the local pattern of diffusion speed values, the supposed local speed pattern (LSP).

V. REFERENCES

1) Athira Prem1, Bineesh, V2," Anti-Spoofing of a Face Image Using Diffusion Speed Model," in IJIRSET,Vol. 5, Issue 8, August 2016
2) M.L.Athirai, Dr M.Sujaritha, "Diffusion speed based face liveliness detection to expose spoofing attack" in International Journal of Scientific & Engineering Research, Vol 7, Issue 3, March-2016.
3) G.Pradeepkumar, V.Parameshwari, V.Logeswari, "A Diffusion Speed Model to Detect Face Liveness for a Video Based Anti-Spoofing System " in Journal of Network Communications and Emerging Technologies (JNCET),Vol 6, Issue 6, June (2016).
4) Faizan Ahmad1, Aaima Najam2 and Zeeshan Ahmed3, **"**Image-based Face Detection and Recognition: "State of the Art", " in IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 6, No 1, November 2012.
5) Kavita , Ms. Manjeet Kaur, "A Survey paper for Face Recognition Technologies ", in International Journal of Scientific and Research Publications, Volume 6, Issue 7, July 2016.
6) J. Yang, Z. Lei, S. Liao, and S. Z. Li, "Face liveness detection with component dependent descriptor," in Proc. IEEE Int. Conf. Biometrics (ICB), Jun. 2013, pp. 1–6.
7) W. Bao, H. Li, N. Li, and W. Jiang, "A liveness detection method for face recognition based on optical flow field," in Proc. IEEE Int. Conf. Image Anal. Signal Process., Apr. 2009, pp. 233–236.
8) G. Pan, L. Sun, Z. Wu, and S. Lao, "Eyeblink-based anti-spoofing in face recognition from a generic webcamera," in Proc. IEEE 11th Int.Conf. Comput. Vis. (ICCV), Oct. 2007, pp. 1–8.
9) K. Kollreider, H. Fronthaler, M. I. Faraj, and J. Bigun, "Real-time face detection and motion analysis with application in 'liveness' assessment," IEEE Trans. Inf. Forensics Security, vol. 2, no. 3, pp. 548–558, Sep. 2007.
10) W. Bao, H. Li, N. Li, and W. Jiang, "A liveness detection method for face recognition based on optical flow field," in Proc. IEEE Int. Conf. Image Anal. Signal Process., Apr. 2009, pp. 233–236.
11) I. Kukenys, B. McCane, Support Vector Machines for Human Face Detection, in Proceedings of the New Zealand Computer Science Research Student Conference, 2008.
12) E. Osuna, R. Freund, and F. Girosi, 1997. Training Support Vector Machines: An Application to Face Detection, In IEEE Conference on Computer Vision and Pattern Recognition, pp.193-199.
13) Wonjun Kim, Sungjoo Suh and Jae-Joon Han, in "Face Liveness Detection From a Single Image via Diffusion Speed Model" in IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 24, NO. 8, AUGUST 2015.
14) I. Chingovska, A. Anjos, and S. Marcel, "On the effectiveness of local binary patterns in face anti-spoofing," in Proc. IEEE Int. Conf. Biometrics Special Interest Group (BioSIG), Darmstadt, Germany, Sep. 2012, pp. 1–7.
15) T. Brox and J. Weickert, "A TV flow based local scale measure for texture discrimination," in Proc. 8th Eur. Conf. Comput. Vis. (ECCV), May 2004, pp. 578–590.

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