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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.*

Keywords:*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 analysing 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 liveness, for example, facial expressions, mouth movement, head movement, eye blinking. But sensing these clues is very difficult for a computer.

II. Methods And Material

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

A. Diffusion Speed

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.

$$uk+1 = uk + \mathrm{div}(d(|\nabla uk|\nabla uk), u(k = 0) = I, \qquad (1)$$

where k denotes the iteration number. For the diffusivity function $d(\cdot)$, we propose adopting the total variation (TV) flow, defined as

$d(x) = \frac{1}{x+\xi}$, (2)

where ξ is a small positive constant. In a given image, the TV flow has been proven to comply with the following rules [11]. 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.

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. With in 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.

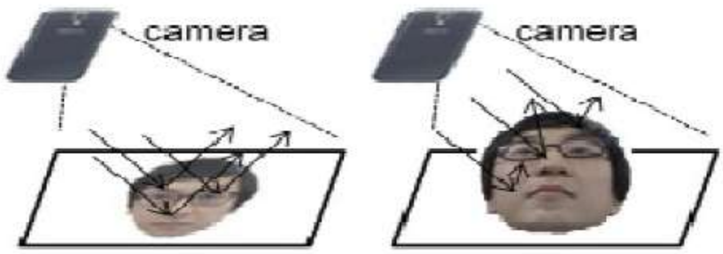


Figure1.(a)and(b)Different characteristics of illuminations on a fake and a live face

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.

$f\text{LSP}(x, y) = \sum_{1\leq i\leq n} 2i - 1\text{LSP}i\ (x, y),$ (3)

$\text{LSP}i\ (x, y) = \begin{cases} 1, & if s(x,y) > s(xi\ , yi\ ), \\ 0, & otherwise, \end{cases}$ (4)

where n is the number of sampling pixels in the neighborhood of 3 × 3 pixels, i.e., $n = 8$ in our implementation. $(xi\ , yi\ )$ denotes the position of the neighborhood pixels centered at (x, y), where $i \in \{1, 2, \cdot\cdot\cdot, 8\}$. Thus, the range of $f\text{LSP}(x, y)$ is [0, 255] and can be represented as a gray-scale image (LSP image). Figure 7 shows the overall procedure to generate an LSP image using (3).

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)

Figure2.(a) original image (b) Diffused image

III. Experimental Results

A. Methodology

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, mouth movement, head rotation 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.

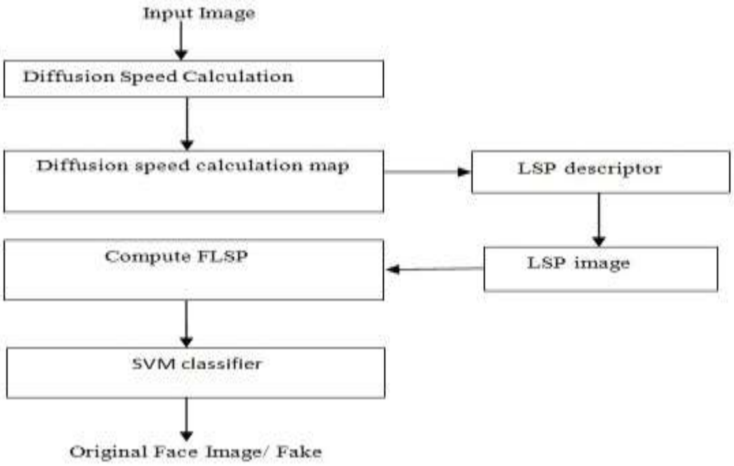


Figure3. Methodology of proposed work

The simulation scenario is created where the input image is given from NUAA dataset [12]. Following figures is the output obtained. SVM yield high performance on the development set, but are less effective on the test set. This can be explained by the fact that the classification threshold is chosen on the development set, which for NUAA is actually a subset of the training set, as we perform cross-validation. This problem can be taken as an indication for the necessity of a precise protocol with separate training, development and test set in spoof-attack databases.

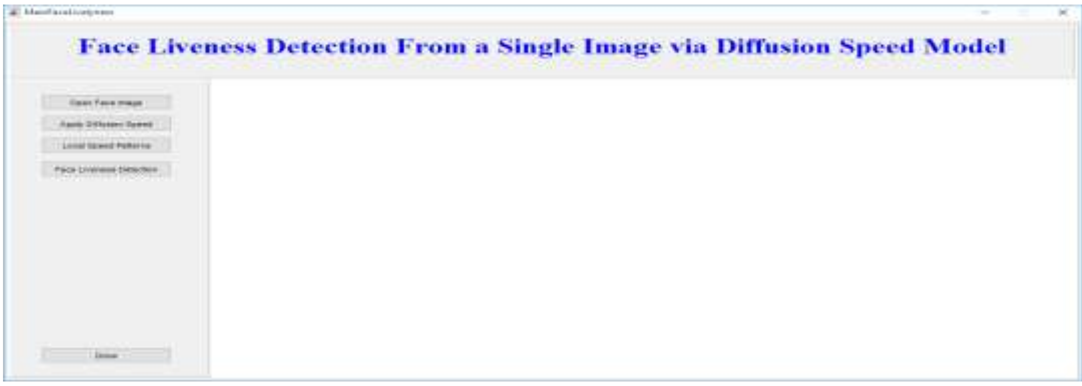
In order to show the performance according to the parameters of our diffusion speed model, we conducted experiments in which the size of the time step and the iteration numbers were varied, as shown in TableI. It should be noted that we use the image block B of 32 × 32 pixels in our implementation and thus the dimension of the feature vector is 59 × 9 = 531 and 59 × 49 = 2, 891 for the NUAA datasets, respectively. These features are input into the linear SVM classifier [11] for training and testing. In all experiments, we fixed C = 100 for SVM, which was shown to give good results when validating the proposed method on a subset of the training set. In Table I, we can see that four iterations are sufficient to yield reliable results for NUAA datasets because of the AOS scheme employed in the proposed method.

TABLE I

PERFORMANCE VARIATION ACCORDING TO PARAMETER SETTINGS ON NUAA

	τ	alpha	accuracy
NUAA	10	0.5	87.03%
	50	0.5	89.05%
	100	0.5	91.23%
	200	0.5	95.56%

B. Output




Face Liveness Detection From a Single Image via Diffusion Speed Model


Face Liveness Detection From a Single Image via Diffusion Speed Model


Face Liveness Detection From a Single Image via Diffusion Speed Model


Face Liveness Detection From a Single Image via Diffusion Speed Model

IV. Conclusion

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).

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