Survey on Application of Face liveness detection in attendance system

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***Abstract*: Face recognition systems are user friendly and easy to use compared to other biometric methods. These systems are susceptible to spoof attacks. It is easy to spoof face recognition systems by using photographs. It is important to incorporate face liveness detection algorithms into these systems to make it more secure.**
There are various techniques for face liveness detection. Deciding on a specific method is often a difficult task because each method has its disadvantages. In this paper we present a survey on various face liveness detection techniques.

***Index Terms*—Biometrics, Liveness Detection, Spoofing**

I. INTRODUCTION

The attendance system used now requires lot of effort and is highly error prone. The current attendance systems in use are file based, biometric methods like fingerprints, iris scanning and face recognition. The present face recognition systems used in attendance systems are not resistant to spoof attacks. The proposed system uses face liveness detection algorithms for attendance systems to be error prone. The paper describes a survey on the present attendance systems and face liveness detection algorithms.

Face Liveness detection:

Solutions like face liveness detection can be studied with different points of view. The solution can be classified according to their fields of application, machine learning techniques used and information (features) extracted. We classify methods based on the information (features) extracted. There are 3 categories of face liveness detection algorithms on the basis of information (features) extracted.

- **Motion of face**: The main basis on which these methods work is that the movement of 2D objects is different from 3D objects. These methods require optical flow calculations between different frames in a video sequence. **Texture analysis**: The main basis on which these methods work is that portrait photographs can be distinguished from real faces by its texture patterns. These methods assume that fake faces are printed. The printing process produces texture patterns that do not exist in real faces.
- **Life sign detection**: The main basis on which these methods work is by detection of eye blinking, lip movement. These methods focus on movement of certain identified part of the face.

The proposed algorithm for liveness detection is based on the analysis of the eyes movement. The basic assumption is that because of blinking and unrestricted movement of the pupil's in human eyes, there should be big shape variations. This should be suitable for optical flow calculation. This algorithm is further presented in the following. First, the centre points of both eyes in the input image are detected. The above mentioned step must be precise, because it is the initial step and it has much effect on the performance. We have made use of the fact that the intensity of the eye region is respectively lower to detect the candidate face, a Gaussian filter is applied and then the intensities corresponding to local minimas are found using a gradient descent algorithm. The candidate regions of interest are classified using Viola-Jones algorithm is applied in the following step which involves Ada Boost classifier and as a result, invalid eyes are removed.

A normalization of the face region around the eyes is required after the centers of both eyes are found. Firstly, found regions are normalized to one size and a high pass filter (SQI-self quotient image is applied. The results are 20x20 pixels images based on the centres of eyes. Then using a threshold obtained from the mean pixel values of the eye region the regions are binarized. Eye regions from real faces have larger variations in Shapethan regions acquired from fake faces.
The next step is the calculation of liveness score, those scores were calculated using hamming distances. In their experiment 5 left and 5 right eyes have been compared. Liveness score (hamming distance) between two frames is the number of different pixels between both regions. After the calculation of 10 liveness scores of both eyes, the average of scores is taken. If this average liveness score is bigger than a threshold, then the input image is a live face, otherwise it is a fake.

Here, three scenic clues, which are non-rigid motion, face-background imaging banding effect and consistency, and to conduct an accurate and efficient face liveness detection. Non-rigid motion clue actually indicates the motions of the face that a real face can exhibit that are blinking and a low rank matrix decomposition based on image alignment approach is designed for the extraction of this non-rigid motion. Face-background consistency clue presumes that the face motion and the background has a high consistency and low consistency for fake facial photos and for genuine faces respectively, and this consistency could serve as an efficient liveness clue which is considered by GMM based motion detection method. The imaging quality defects is reflected by

image banding effect which is introduced in the prominent fake face reproduction, which is possibly detected by wavelet decomposition.

Frequency-based feature extraction:
In frequency based feature extraction given facial image is transformed into frequency domain using 2D discrete Fourier transform. Transformed result is then going to be divided into several groups in the form of concentric rings. Each ring represents a corresponding region in the frequency band. 1D feature vector could possibly be acquired by concatenating the average energy values of all the concentric rings. [1]

Texture-based feature extraction:
Texture characteristics of the images taken from faces that are live and the masks are analysed using Local Binary Pattern (LBP). It assigns a code for each pixel by considering the relative differences in intensity between the pixels and its neighbours.[1]

Face Liveness Detection For Combating The Spoofing Attack In Face Recognition

Fourier transform is applied as the core in our proposed method. The Fourier transform decomposes an image into its sine and cosine components. After performing Fourier transform, an image in spatial domain is turned into that infrequency domain, and thus a lot of unrevealed information is disclosed. The Fourier transform outputs an array of complete numbers which can be depicted either with the real part and imaginary part or with magnitude and phase. In image processing, we usually focus on the magnitude rather than the phase because it contains more information of the geometric structure of the spatial domain image. Fourier spectrum is a common way to intuitively illustrate the magnitudes of frequencies for an image in frequency domain. [2]

Under Bad Illumination Conditions
Improvisation of liveness detection can be done without extra devices or user involvement is to recognise when the image comes from the laptop or cell phone screen instead of a real human.
The image of a photograph taken from a camera shown on screen is image of a real face, but passes through camera system twice and the projection display once. It is a recaptured image and it shows less borders than their real counterparts. Image is analysed and using a Difference of Gaussian (DoG) filter, a bandpass filter which uses two Gaussian filters with different standard deviation as limits. [3]

Eye and Mouth movement:
Haar classifier devised by Viola and Jones are used for detecting the faces and facial features. Challenges are given to the system in terms of their eye and movement of the mouth (openness/closeness) in a sequence. The movement is calculated in the designed system by measuring the teeth HSV (Hue Saturation Value).
Responses are calculated by counting the movements. Eye openness and closeness is going to be calculated by searching the eye in those regions where eye should exist if found then it is open else eye is close. Similarly mouth openness and closeness is calculated. Number of challenges thrown by the system acted as the threshold, then the system will recognize the person as live else not.
Disadvantages in this method are that the camera resolutions should be good. Five types of attacks are observed in this method
Photo imposter attack
Eye imposter attack
Mouth imposter attack
The eye and Mouth imposter attack
Video imposter attack. [4]

Fusion based feature extraction:
Support Vector Machine classifier is used to learn liveness detectors with the feature vectors created by power spectrum-based and LBP-based methods. Feature vector is extracted by fusion-based method by adding the decision value of SVM classifier trained by one of the power spectrum based feature vectors, and that of SVM classifier trained by LBP-based feature vectors. [5]

Optical flow method:
The method based on optical flow field was introduced by Bao et al. This will examine the differences and also the properties of optical flow which is generated from 3D objects and 2D planes. The motion of this field is a combination of the four basic movement types: Translation, rotation, moving and swing.
It is found that the first three basic types are generating the quite similar optical flow fields for both 2D and for 3D pictures. The fourth type creates the actual differences in optical flow field. Their approach is basically based on the fact that the optical flow field for 2D objects which also can be represented as a projection transformation. The optical flow, it allows to find the reference field, thus allows to determine if whether the test region is planar or not. For that record, the difference among the optical flow fields is going to be calculated. To decide whether a face is a real or not, this difference is actually being noted as a threshold. [6]

3D Face shape analysis

Most face recognition systems use visible or infrared light on 2D images .Here the movement of the face is detected. In order to detect real expressions or natural involuntary movements it is done holistically or through the extraction and tracking of facial features. Optoelectronic 3D scanning is presented. It has the advantage of using full 3D face information, 3D model is acquired in few milliseconds minimising the user involvement.

This method has several advantages over other liveness detection techniques:

Active interaction with the subject nor smiling, speaking or responding to any external prompt.

Use of additional hardware is not required. [7]

Learning Multispectral Reflectance Distributions

In this method, a novel liveness detection method of multiple spectral lighting is used. The

Analysis is started by distinguishing fake faces multi spectrally which is based on Lambertian

Model when the user-system distance is unlimited and also variable. Then albedo curves of different the materials after measured (skin and non-skin), two discriminative wavelengths are selected. A device is built to get multi-spectral data of the face to be recognized and a classifier is trained with the multi-distance reflectance data set to the final liveness detection.

Compared to previous works, the advantages of this methods are obvious. Firstly, our method requires no user cooperation, and therefore is user-friendly and fast. Secondly,

This multispectral method takes user-system distance factor into consideration. [8]

Focusing On Frontal Faces And
Image Backgrounds

In this method countermeasure to defence against the video replay anti-spoofing attacks

Is proposed. Two photos are taken by focusing on the nose and ear. The degree of lure ness measured by the Sum-Modified-Laplacian (SML) of two photos is calculated. As the object is fake sample shown by the photograph of a video, the degree of blur should be similar. Otherwise, the degree is different due to the 3Dshape of the face. This method is simple and does not require an additional device. However, locating the ear and nose may not be accurate in some situation, e.g. the Hai covers the ears. Moreover, the distance between nose and ear is not long enough to cause the major difference in the degree of blurriness. In this paper, we present a revised method based on the Kim's model. We consider the degree of blurriness of the face and the background in order to increase the difference of two photos. Moreover, the accuracy of locating the background should be more accurate than an ear. As a result, the background information should sufficiently increase the robustness of the face liveness detection.[9]

Face Liveness Detection By Variable Focusing

In this method a novel method from infringing face identification systems with forged 2D photos is defined. This method uses variable focusing which is camera feature. For instance, any image taken from a high end camera has both focused and out focused areas. The focus area can be controlled by users from foreground to background during a shot, though there is a limitation due to the unique effective focal length of each lens. Difference in focus values in real and fake images can be found. This is possible by collecting two sequential images assuming there is no big movement. Defocusing is used to estimate the depth information in practice. It becomes a good feature to identify live faces. Real faces are solid, but images which are targeted as spoofed faces are flat. This feature makes our system be able to discriminate which face is real or not. [10]

Face Liveness Detection Using Analysis Of Fourier spectra
Based On Hair

This method is based on the difference of hair texture with and without flash light two photos including with and without flashlight are taken from the object. The reason we consider the hair as subject of interest is because the change of hair under different illumination are more obvious than other parts. The high frequency component (HFD) is calculated for the hair region. The two values of HFDs of the pair of images are applied to classify the input images [11]

Dataset

In order to develop and test a face liveness detection solution, an informative and diverse

Data set that imitate the expected application scenarios is needed. The application scenario and expected spoof attacks are linked with the developed solutions through the type of information extracted from the images and used for liveness detection (liveness indicators).

The PRINT-ATTACK database[n] consists of 200 videos of printed face photo attacks and

200 videos of real access attempts. The videos were collected from 50 different persons under different lightning conditions. Videos are captured by having a real person or a printed photo trying to access a laptop through a webcam. The colour videos sequences where at least 9 seconds each and were taken under two illumination scenarios, a controlled scenario and a diverse scenario with more complex background and natural light.

Conclusion:

This work has provided an overview of several different approaches of face liveness detection. It presented a classification which depends on the different techniques used and various methods of liveness indicator/clue applied for face liveness detection which

helps understanding various type of spoof attack scenarios and its relationship to the developed solutions. A review of most interesting and effective approaches for liveness facial detection was presented. The most common issue that have been faced during various liveness detection techniques are the effects of change in illumination, effects of amplified noise on images which damages the texture information. For eye blinking and eye movement based liveness detection methods, eyes glasses which causes reflection should be considered for future development of liveness detection solutions. Furthermore, the datasets, which play a very significant part in the performance of liveness detection methods, must be informative and diverse that copies the expected application scenarios in real world. Non-interactive video sequences should include interactive sequences where the users will perform some specific tasks. Future attack datasets should consider attacks like 3D sculpture faces and improved texture information. Our main objective is to provide a clear pathway for future development of more secured, user friendly and also more effective approaches for face liveness detection.

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