Available online at www.sciencedirect.com
ScienceDirect
Procedia Computer Science 78 (2016) 241 – 247
Procedia
Computer Science

International Conference on Information Security & Privacy (ICISP2015), 11-12 December 2015, Nagpur, INDIA

Developing a Novel Technique for Face Liveness Detection

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Abstract

Face recognition is an important tool in identifying a person. Due to existence of non-real faces, Spoofing attack weakens the Face Recognition process, which can be overcome byLiveness Detection. There are three approaches to perform liveness detection: by challenge and response based liveness detection technique, by face texture liveness detection and by joining two or more biometrics liveness detection. The existing techniques fail to give good results for Face Liveness Detection under unconstrained environment. Hence we have proposed Face Liveness Detection based on Image Quality Assessment (IQA) parameters. The proposed system is validated on a database having 70 images which are taken under unconstrained environment.

Peer-review under responsibility of organizing committee of the ICISP2015

Keywords: Face recognition; Spoofing attack; Liveness detection; Image Quality Assessment.

1. Introduction

In biometric authentication face recognition technology plays an important role to identify the person identity, but spoofing is a major cause for the failure if various face recognition systems[1]. By insertion of a photo/video/mask of an registeredindividual in front of the camera spoofing attack is performed during face recognition process [2-4].

To overcome this problem liveness detection is performed before face recognition [5-7]. The liveness detection module adds an additional layer of security, it uses macro features of face mainly eye and mouth actions. The consistency of liveness module is tested by using photo/video/mask of aregisteredindividual.

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Peer-review under responsibility of organizing committee of the ICISP2015
doi:10.1016/j.procs.2016.02.039

There are three approaches to perform liveness detection: By utilizing challenge and response based liveness detection technique, by using face texture liveness detection and by joining two or more biometrics liveness detection. Based on the three approaches there are three existing methods which have been derived to perform liveness detection they are: Multispectral method, Client Identity Information Method, Single Image via Diffusion Speed Model.

2. Related work

Traditional method to perform liveness detection involves: Training process and Calculation of Mean, Covariance. Eigenvectors, Eigen face. Δ=P∗Q image is considered for training process, which is kept in a training database, where there are P number ofindividuals and eachindividual has Q images. Mean is calculated, Covariance is calculated to know the relationship between each features. Principal component such as Eigenvectors and Eigen face are calculated. This traditional approach was not found to be suitable to detect liveness in images under varying poses, hence three new methods been derived to perform liveness detection they are: Multispectral method, Client definite method, Single image via Diffusion speed model.

Authors in [1] present Multispectral method for livenessdetection; here a monochrome camera captures the ambient light and an image. Xenon lamp illuminates the scene. In order to provide required energy at various spectrums we use full-spectrum active light.

$$I_i^P = t\int_{\lambda^i_{min}}^{\lambda^i_{max}} L^P(\lambda)R^P(\lambda)T_i(\lambda)C(\lambda)d\lambda \quad (1)$$

The Table 1 shows True Positive Rate (TPR) and True Negative Rate (TNR) obtained using Multispectral method for liveness detection. Two orientations are considered: fontal face, 45° profile face. Among the two orientations 45°profile gives better results because in 45° viewpoint uniform hair styles are observed but in the front portion of face a change of hair styles consequence in numerous spatial scatterings of gradient values hence reducing the performance.

Table 1.Performance of Multispectral Method for Liveness Detection in Frontal and 45°Profile Face.

Orientations	TPR (%)	TNR (%)
Frontal face	94.3	98
45°profile face	100	99

Authors in [2] present Client-independent and Client-definite and methods for liveness detection. Client-definite method uses Probabilistic Graphical Model framework for anti-spoofing. Enrollment of samples for each of the clientsaremajor requirements of client definite anti-spoofing system. This information is utilized to create client definite model and train client-definite classifiers. Using enrollment samples a client-definite Support Vector Machine classifier is developed. Two protocols are used for testing: intra-protocol and cross- protocol, intra-protocol algorithm is trained and tested using same protocol but in cross-protocol algorithm is trained using one protocol and tested on another protocol.

Authors in [3] presentsingle Image through diffusion model of speed which uses Logarithmic Total Variation (LTV) model. LTV model differ from previous Total Variation (TV) model. In LTV the diffusion speed of the local pattern also named as Local Speed Pattern (LSP)is given as input into to linear Support Vector Machine classifier which determines if the given face image is fake. This method works well illumination invariant face images. The performance of diffusion speed model was found to be reliable under varying lighting conditions in different indoor and outdoor environments. Table 3 compares the Human-targeted Translation Error Rate (HTER) value of Local Binary Pattern (LPB), Local Binary Patter + Local Discriminant Analysis (LBP+LDA), Local Binary Patter + Support Vector Machine (LBP+SVM) and Local Speed Pattern (LSP). From table 2 we find that HTER value for LSP is the minimum when compared to other techniques.