(1)

Biometric authentication based on PCG and ECG signals: present status and future directions

M. Abo-Zahhad, Sabah M. Ahmed, Sherif N. Abbas

Abstract:

Due to the great advances in biomedical digital signal processing, new biometric traits have showed noticeable improvements in authentication systems. Recently, the ElectroCardioGram (ECG) and the PhonoCardioGraph (PCG) have been proposed as novel biometrics. This paper aims to review the previous studies related to the usage of the ECG and PCG signals in human recognition. In addition, we discuss briefly the most important techniques and methodologies used by researchers in the preprocessing, feature extraction and classification of the ECG and PCG signals. At the end, we introduce some future considerations that can be applied in this topic such as: the fusion between different techniques previously used, use both ECG and PCG signals in a multimodal biometric authentication system and building a prototype system for real-time authentication.

Keywords:

Review Biometric authentication Electrocardiography signals Phonocardiography signals

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(2)

PCG biometric identification system based on feature level fusion using canonical correlation analysis

M. Abo-Zahhad, Sabah M. Ahmed, Sherif N. Abbas

Abstract:

In this paper, a new technique for human identification task based on heart sound signals has been proposed. It utilizes a feature level fusion technique based on canonical correlation analysis. For this purpose a robust pre-processing scheme based on the wavelet analysis of the heart sounds is introduced. Then, three feature vectors are extracted depending on the cepstral coefficients of different frequency scale representation of the heart sound namely; the mel, bark, and linear scales. Among the investigated feature extraction methods, experimental results show that the mel-scale is the best with 94.4% correct identification rate. Using a hybrid technique combining MFCC and DWT, a new feature vector is extracted improving the system's performance up to 95.12%. Finally, canonical correlation analysis is applied for feature fusion. This improves the performance of the proposed system up to 99.5%. The experimental results show significant improvements in the performance of the proposed system over methods adopting single feature extraction.

Keywords:

Bark-frequency cepstral, Canonical correlation, Feature level fusion, Heart sounds, Linear frequency cepstral, Mel-frequency cepstral, PCG biometric authentication

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Electrical and Computer Engineering (CCECE), 2014 IEEE 27th Canadian Conference on , NULL , NULL

(3)

A Novel Biometric Approach for Human Identification and Verification Using Eye Blinking Signal

M. Abo-Zahhad, Sabah M. Ahmed, Sherif N. Abbas

Abstract:

In this letter, a novel technique is adopted for human recognition based on eye blinking waveform extracted from electro-oculogram signals. For this purpose, a database of 25 subjects is collected using Neurosky Mindwave headset. Then, the eye blinking signal is extracted and applied for identification and verification tasks. The pre-processing stage includes empirical mode decomposition to isolate electro-oculogram signal from brainwaves. Then, time delineation of the eye blinking waveform is utilized for feature extraction. Finally, linear discriminant analysis is adopted for classification. Based on the achieved results, the proposed system can identify subjects with best accuracy of 97.3% and verify them with an equal error rate of 3.7%. The obtained results in this letter confirm that eye blinking waveform carries discriminant information and is therefore appropriate as a basis for human recognition task.

Keywords:

Biometric authentication discriminant analysis electro-oculogram empirical mode decomposition eye blinking time delineation

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IEEE Signal Processing Letters , vol. 22, no. 7 , pp. 879-880

(4)

A New Biometric Modality for Human Authentication Using Eye Blinking

Mohammed Abo-Zahhad, Sabah M. Ahmed, and Sherif N. Abbas

Abstract:

This paper proposes a new biometric identifier for humans based on eye blinking waveform extracted from brain waves. Brain waves were recorded using Neurosky Mindwave headset from 25 volunteers. Two approaches are adopted for the pre-processing stage; the first approach uses empirical mode decomposition to isolate electro-oculogram signal from brain waves, then, extracts eye blinking signal. The second approach extracts eye blinking signal directly from brain waves. Features are extracted based on time delineation of the eye blinking waveform and classified using linear discriminant analysis. The best correct identification and equal error rates achieved are 98.51% and 2.5% for identification and verification modes respectively. The obtained results in this paper confirm that eye blinking waveform carries discriminant information and is therefore appropriate as a basis for human recognition task.

Keywords:

Biometric authentication Brain waves Discriminant analysis Electro-oculogram Empirical mode decomposition Eye blinking Time delineation

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Biomedical Engineering Conference (CIBEC), 2014 Cairo International , NULL , NULL

(5)

State-of-the-art methods and future perspectives for personal recognition based on electroencephalogram signals

Mohammed Abo-Zahhad, Sabah Mohammed Ahmed, Sherif Nagib Abbas

Abstract:

In the past decade, biomedical instrumentations have witnessed major developments and now it is very easy to measure human biomedical electrical signals. One of these signals is the brain waves, known as electroencephalogram (EEG) signals, which became very easy to be measured using portable devices and dry electrodes. This opens the way for the use of brain waves in different applications rather than the biomedical diagnosis. One of the most recent non-medical applications for brain waves is the biometric authentication. Brain waves have some advantages which are not present in the commonly used identifiers, such as face and fingerprints, making them robust to spoof attacks. However, brain waves still face many challenges with reference to permanence and uniqueness. In this study, the authors discuss the employment of brain signals for human recognition tasks and focus on the challenges facing these signals towards the deployment of a practical biometric system. This study, also, provides a comprehensive review of the proposed approaches developed in EEG-based biometric authentication systems.

Keywords:

NULL

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(6)

A New EEG Acquisition Protocol for Biometric Identification Using Eye Blinking Signals

M. Abo-Zahhad, Sabah M. Ahmed, Sherif N. Abbas

Abstract:

In this paper, a new acquisition protocol is adopted for identifying individuals from electroencephalogram signals based on eye blinking waveforms. For this purpose, a database of 10 subjects is collected using Neurosky Mindwave headset. Then, the eye blinking signal is extracted from brain wave recordings and used for the identification task. The feature extraction stage includes fitting the extracted eye blinks to auto-regressive model. Two algorithms are implemented for auto-regressive modeling namely; Levinson-Durbin and Burg algorithms. Then, discriminant analysis is adopted for classification scheme. Linear and quadratic discriminant functions are tested and compared in this paper. Using Burg algorithm with linear discriminant analysis, the proposed system can identify subjects with best accuracy of 99.8%. The obtained results in this paper confirm that eye blinking waveform carries discriminant information and is therefore appropriate as a basis for person identification methods.

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(7)

A comparative approach between cepstral features for human authentication using heart sounds

M. Abo-Zahhad, Mohammed Farrag, Sherif N. Abbas, and Sabah M. Ahmed

Abstract:

The main objective of this paper is to provide a comparative study between different cepstral features for the application of human recognition using heart sounds. In the past 10 years, heart sound, which is known as phonocardiogram, has been adopted for human biometric authentication tasks. Most of the previously proposed systems have adopted mel-frequency and linear frequency cepstral coefficients as features for heart sounds. In this paper, two more cepstral features are proposed. The first one is based on wavelet packet decomposition where a new filter bank structure is designed to select the appropriate bases for extracting discriminant features from heart sounds. The other is based on nonlinear modification for mel-scaled cepstral features. The four cepstral features are tested and compared on two databases: One consists of 21 subjects, and the other consists of 206 subjects. Based on the achieved results over the two databases, the two proposed cepstral features achieved higher correct recognition rates and lower error rates in identification and verification modes, respectively.

Keywords:

Heart sounds; PCG biometric authentication; Wavelet denoising; Cepstral features; Wavelet packet decomposition; Linear discriminant analysis.

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Signal, Image and Video Processing , NULL , NULL

(8)

A new multi-level approach to EEG based human authentication using eye blinking

M. Abo-Zahhad, Sabah M. Ahmed, and Sherif N. Abbas

Abstract:

This letter proposes a new multi-level approach for human biometric authentication using Electro-Encephalo-Gram (EEG) signals (brain waves) and eye blinking Electro-Oculo-Gram (EOG) signals. The main objective of this letter is to improve the performance of the EEG based biometric authentication using eye blinking EOG signals which are considered as source of artifacts for EEG. Feature and score level fusion approaches are tested for the proposed multi-level system. Density based and canonical correlation analysis strategies are applied for the score and feature level fusions, respectively. Autoregressive modeling of EEG signals (during relaxation or visual stimulation) and time delineation of the eye blinking waveform are adopted for the feature extraction stage. Finally, the classification stage is performed using linear discriminant analysis. For evaluation, a database of 31 subjects performing three different tasks of relaxation, visual stimulation, and eye blinking was collected using Neursky Mindwave headset. Using eye blinking features, a significant improvement is achieved, in terms of correct recognition and equal error rates, for the proposed multi-level EEG biometric system over single level system using EEG only.

Keywords:

Multi-level biometric authentication; Electro-encephalogram; Electro-oculogram; Eye blinking; Feature level fusion; Score level fusion.

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Pattern Recognition Letters , NULL , NULL

(9)

A new biometric authentication system using heart sounds based on wavelet packet features

M. Abo-Zahhad, Sabah M. Ahmed, Sherif N. Abbas

Abstract:

In this paper, a new approach for human recognition using heart sounds is proposed. The new approach is based mainly on extracting features from heart sounds using wavelet packet decomposition. Different linear and non-linear filter banks at different decomposition levels are designed using wavelet packet decomposition to select the appropriate bases for extracting discriminant features. Automatic wavelet de-noising and linear discriminant analysis are adopted for pre-processing and classification stages, respectively. The proposed system is tested using an open database for heart sounds known as HSCT-11 which contains data collected from 206 subjects. Based on the achieved results, the proposed system can identify subjects with best accuracy of 91.05% and verify them with an equal error rate of 3.2%. The obtained results in this paper show that wavelet packet based features are appropriate for human recognition task using heart sounds.

Keywords:

Biometric authentication Cepstral analysis Heart sounds Wavelet packet decomposition

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(10)

Heart-ID: Human identity recognition using heart sounds based on modifying mel-frequency cepstral features

Abbas, Sherif N.; Abo-Zahhad, Mohammed; Ahmed, Sabah M.; Farrag, Mohammed

Abstract:

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Keywords:

NULL

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(11)

Biometrics from heart sounds: Evaluation of a new approach based on wavelet packet cepstral features using HSCT-11 database

Abo-Zahhad, M.; Ahmed, Sabah M.; Abbas, Sherif N.

Abstract:

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Keywords:

NULL

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