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A small look at the ear recognition process using a hybrid approach

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ABSTRACT

The purpose of this document is to offer a combined approach in biometric analysis field, integrating some of the most known techniques using ears to recognize people. This study uses Hausdorff distance as a pre-processing stage adding sturdiness to increase the performance filtering for the subjects to use it in the testing process. Also includes the Image Ray Transform (IRT) and the Haar based classifier for the detection step. Then, the system computes Speeded Up Robust Features (SURF) and Linear Discriminant Analysis (LDA) as an input of two neural networks to recognize a person by the patterns of its ear. To show the applied theory experimental results, the above algorithms have been implemented using Microsoft C#. The investigation results showed robustness improving the ear recognition process.

1. Introduction

The ears do not have a completely random structure. They have standard part as other biometric traits like the face. A recognition system based on images of the ears is very similar to a typical face recognition system, however, the ear has some advantages over the face, for example, their appearance does not change due to expression and is little affected by the ageing process, its color is usually uniform and the background is predictable.

Although the use of information from ear identification of individuals has been studied, it is still debatable whether or not the ear can be considered unique or unique enough to be used as a biometric. However, any physical or behavioral trait can be used as biometric identification mechanism if it is universal, that every human being possesses an identifier, being distinctive and unique to each individual, invariant in time, and measurable automatically or manually; the ear accomplishes all these characteristics.

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2. Brief review of the literature

Significant progress has been made in the past few years in ear biometrics field. One of the most important techniques which are known to detect the ears is raised by Burge and Burger [6] who have made the process of detection using deformable contours with the observation that initialization contour requires user interaction. Therefore, the location of the ear is not fully automatic. Meanwhile Hurley et al. [11] used the technique of force field, this process ensures that it is not required to know the location of the ear to perform recognition. However, only applies when the technique has the specific image of the ear out of noise. In [22], Yan and Bowyer have used manual technique based on two previous lines for detection, where takes a line along the border between the ear and face while another line crosses up and down the ear.

Ansari and Gupta [1] presented a process based on the outer ear helices edges, they use 700 samples collected at IIT Kanpur, the strategy only relies on the outer helix curves. Yuan and Mu [23] have proposed a skin-color and contour information technique, they perform the ear detection considering ear shape elliptical and fitting an ellipse to the edges to get the accurate ear position. Attarchi et al. [2] have shown an ear detection process based on the edge map. It relies on the hypothesis that the longest path in edge image is the ear outer boundary. It works well only when there is not noisy background present around the ear and fails if ear detection is carried out in whole profile face image; they use two databases, USTB and Carreira-Perpinan with 308 and 102 images [20] with an accuracy of 98.05% and 97.05% respectively.

A. Cummings et al. [9] show a strategy using the image ray transform which is capable of highlighting the ear tubular structures. The technique exploits the helix elliptical shape to calculate the localization. Kumar et al. [14], have introduced a proposal where uses skin segmentation and edge map detection to find the ear, once they find the ear region apply an active contour technique [17] to get the exact location of ear contours. In the context of 3D images, Zhou et al. [24] presented a novel shape based feature set, called Histograms of Categorized Shapes (HCS), for robust 3D ear detection, using a sliding window approach and linear Support Vector Machine (SVM).

In other terms a biometric recognition system requires the discovery of unique features that can be measured and compared in order to correctly identify subjects. There are some known techniques for ear recognition specially in 2D and 3D images, as the strategies based on appearance, force transformation, geometrical features, and the use of neural networks.

The most used technique for face recognition principal component analysis (PCA) was applied for ear recognition by Victor et al. [3]. They used PCA to perform an comparative analysis between face and ear, concluding that the face performs better than the ear. However, Chang et al. [16] also have accomplished a comparison using PCA and found that ears provided similar performance, concluded that ears are essentially just as good as faces for biometric recognition. There are many proposals to solve the problem, in this paper only has done a small review from some of them, the next section introduce an intent to solve the problem of ear recognition using a practical way, applying some interesting concepts for 2D images and real time video.

3. Ear recognition system

Recognition systems traditionally follow a set of standards, such as, acquiring images, pre-processing, feature extraction, and the classification and/or recognition of the respective object. All of these tasks will be described in upcoming sections connecting important algorithms in order to complete its goal. Nevertheless, it is important to notice that the process that we are about to describe is based in the combination of some existing methods in order to build a robust system, allowing to perform, detection, tracking, and recognition in a real time video using identification through the ear.

In this way, the system combines a series of algorithms that give significant results individually, and when they are combined, achieve a higher degree of robustness with significant improving in problems such as