Biometric Identification Using 3D Ear Recognition System

Pooja Bandal¹, Deepali Pawar², Ankita Shrishrimal², Priyanka Sonawane⁴, Dr. Prof. D.A. Godse⁵
UG Student¹, 2, 3, 4, HOD⁵
Department of Information Technology
BVCOEW, Pune, India

Abstract:
Biometric identification using 3D Ear recognition system is for authenticating the identity of an individual in information sensitive areas. It provides controlled access to the system using biometric 3D Ear template which is unique for each individual. This paper presents a system that provides a login screen to the user where the user has to enroll his 3D Ear template which is matched with the one present in the 3D Ear database. The proposed system includes the stages: Image Acquisition, Image Segmentation, Feature Extraction, Matching and decision making. Image Acquisition stage gives 3D Ear image as input to the system. Image segmentation divides the 3D Ear image into parts like hair, skin, ear pit etc. The segmentation process is based on the edges. Edge detection algorithm is used to separate various regions of the 3D Ear image. Feature extraction is the process of extracting the features of ear from the 3D image. Matching stage involves the matching of the 3D Ear template with the one present in the 3D Ear database and then the decision is taken whether the user is a valid user or not. If match is found then access is provided to the system. Otherwise, A notification containing a message that an unauthorised user is trying to access the system will be sent to unauthorised user.

Keywords: 3D Ear database, Authentication, Haar Cascade, ORB (Oriented FAST and Rotated BRIEF).

I. INTRODUCTION

Earlier research showed that human ear is one of the representative human biometrics with uniqueness and stability. Ear recognition has attracted much attention in recent years. Compared with other popular human features, ear has many advantages. For example, ear is rich in biological features, it is a stable structure which does not change with age, it doesn’t change its shape with facial expressions, cosmetics, hair styles and so on. Especially, when we can’t capture the well-posed face images, ear recognition techniques become more important. Much work has been done in this field and those approaches roughly can be classified into two categories: 2D based approaches and 3-D based approaches. Compared with the 2D-based approaches, the 3D based approaches are relatively insensitive to pose and lighting variations. So in recent years, more and more researchers began to pay more attention to the recognition approaches based on 3-D ear data. Relevant research activities have significantly increased, and much progress has been made in recent years. However, most current systems perform well only under constrained environments even requiring that the subjects to be highly cooperative [1].

Human ear is a perfect data for passive person identification, which can be applied to provide security in information sensitive areas. The ear has desirable properties such as universality; uniqueness and permanance. There are many human traits that can be used as a biometric like fingerprint, face, voice and iris. Despite extensive research many problems in 2D based approach such as lighting, shadows, scale, and translation remain largely unsolved. An alternative to this is 3D Ear biometrics [2]. It has been seen that finding two ears which are completely identical is almost impossible and ear does not change much with age, unlike face. Identification of an individual using 3D ear biometrics is promising because it is a passive identification method like face recognition. Biometric identification methods proved to be very efficient, more natural and easy for users than traditional methods of human identification. In fact, only biometric methods truly identify humans [3].

A side profile image of the subject is taken. A suitable image enhancement technique is applied to the captured 2D ear image to obtain a 3D Ear image that contains more distinct features as compared to 2D based authentication system. Automatic segmentation of the 3D ear image is performed to obtain the side profile image containing ear[4].

![System block diagram 3D Ear recognition system](http://ijesc.org/)

Fig. 1. System block diagram 3D Ear recognition system

Feature extraction is performed on the segmented ear image. In Image matching process matching of subject’s 3D Ear template with the one present in the 3D Ear database is performed. If user is valid, access will be granted to the application. However, if an unauthorised user tries to forge into the system then a notification will be sent to the authorised user [5].

II RELATED WORK AND CONTRIBUTIONS

A. RELATED WORK

Authentication of a person’s identity is a very challenging problem. There are three common ways which are used for authentication. First one is based on what a person has such as keys, identity cards etc. Second
mode of authentication is based on what a person knows or remembers such as passwords, PINs etc. Third way of authentication is based on what a person carries i.e. the characteristics of a human being [1]. There are chances that the items which are under possession may be lost. But this does not happen in case of Biometrics [2]. Limitations of the first two methods can be overcome if one makes use of particular characteristic of the body or habits as the mode of authentication because they are difficult to forget or stolen. This is the main driving force behind biometrics based recognition [3].

The human ear is a approach of relatively stable biometrics. Ear recognition is a new technique and future trend for personal identification. It is found that the structure of the ear does not change radically over time [4]. Ear biometric has a significant role in forensic science. Ear biometrics can be based on a 2D gray scale or colour image, 3D range image, or a combination of 2D and 3D images. Ear can be easily captured from a distance without any cooperation from user [5].

The best known work on using the ear for identification is that of Iannarelli [1], who developed a manual technique. In his work, over 10,000 ears were examined and no indistinguishable ears were found [6]. The results of this work suggest that the ear may be uniquely distinguish depend on a limited number of features or characteristics [6]. Earlier work had shown that the ear is a promising candidate for biometric identification. The pre-processing of ear images has manual steps and algorithms have not necessarily handled problems occurred by hair and earrings. We present a complete system for ear data, including automated segmentation of the ear in a profile image and 3D shape matching for recognition [7].

B. Contribution
1. Automatic Selection of Suitable Image Enhancement Technique: In the ear recognition technique proposed, three enhancement techniques have been applied in parallel to overcome the problems of contrast, illumination and noise and also three classifiers have been used for classification.

2. Issue of Occlusion: Occlusion is a common problem in ear biometrics, which is caused due to hair, jewellery, headphones, acute pose variations etc. There is a need to extensively study the effect of such occlusions on the performance of ear detection and recognition process.

3. Symmetry between Left and Right Ear Images: Though there are few attempts in the literature to understand the symmetry between left and right ears of the human, it is not yet well understood. There is further scope of investigation on this issue.

4. Behaviour of the Ear with Respect to Age: Ear is believed to be invariant to aging process for most part of our life. However, there is no database available having ear samples of subjects at different ages.

Conclusion:
In this paper, the system designed is very useful, reliable and user friendly. Physical presence of human being makes biometrics based authentication more secure. The idea behind the development of this system is that each person can be physiologically characterized by a set of unique internal as well as external ear characteristics extracted from the 3D ear image. There is no need for remembering information like passwords, pin. Moreover there is less possibility of biometric identity to be faked, forged and fooled. The proposed system is insensitive to illumination and poses variance as compared to 2D Ear recognition system. System gives slightly higher performance as it contains surface shape information related to anatomical structure of the ear. The main advantage of proposed system is it is able to deal with the hair occlusion. However; the proposed system is inefficient to remove occlusion due to scarf.

Software Requirements:
1. Front end: Java
2. Back end: My SQL Database
3. Operating System: Windows XP/Vista/7

Hardware Requirements:
1. Web-camera
2. Minimum 512 MB RAM
3. Screen with minimum 1280 X 1024 Resolution

ORB (Oriented FAST and Rotated BRIEF):
The most important thing about the ORB is that it comes from “OpenCV Labs”. This algorithm was brought up by Ethan Rublee, Vincent Rabaud, Kurt Konolige and Gary R. Bradski. It is a good alternative to SIFT and SURF in computation cost, matching performance and mainly the patents.

ORB is basically a fusion of FAST keypoint detector and BRIEF descriptor with many modifications to enhance the performance.

First it uses FAST to find keypoints. It then applies Harris corner measure to find top N points among them. It also uses pyramid to produce multiscale-features. It computes the intensity weighted centroid of the patch with located corner at center. The direction of the vector from this corner point to centroid gives the orientation.

Descriptors: ORB use BRIEF descriptors. But seen that BRIEF performs poorly with rotation. So what ORB does is to “steer” BRIEF according to the orientation of keypoints.

Haar Cascade:
Haar cascade is used for object recognition. Object recognition deals with identifying a particular object in an image or video sequence. Haar cascade recognizes an object in an image very easily, inspite of the fact that the image containing the object may vary by certain amount in different sizes and scales or even if they are translated or rotated. The main advantage of using Haar Cascade is that it can recognized an object even if it partially obstructed from view. Object recognition based on the calculation of pixel entities is computationally expensive. Viola and Jones [13] used Haar wavelets and developed the Haar-like features. A Haar-like feature considers adjacent rectangular regions at a specific location in an object detection window.
Haar–like features are:

1. Edge features
   (a) (b) (c) (d)

2. Line features
   (a) (b) (c) (d) (e) (f) (g) (h)

3. Center-surround features
   (a) (b)

After a classifier is trained, it can be applied to a region of interest (of the same size as used during the training) in an input image. The classifier outputs a “1” if the region is likely to show the object (i.e., face), and “0” otherwise. To search for the object in the whole image one can move the search window across the image and check every location using the classifier. The classifier is designed so that it can be easily “resized” in order to be able to find the objects of interest at different sizes, which is more efficient than resizing the image itself. So, to find an object of an unknown size in the image the scan procedure should be done several times at different scales.

II. REFERENCES


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