



Geometric Ear Recognition System using LabVIEW

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Abstract—Biometric person identification is a common technological tool for identity verification and carries significant importance for national or international security. Fingerprint, palm print, face, iris, ear etc are some of the unique features in human being and are used for automate identity and authentication. Ear detection is a new class of relatively stable biometrics which is not affected by facial expressions, cosmetics, eye glasses and aging effects. It has been suggested by the researchers that the shape and features of ear are unique for each person and invariant with age. In this paper geometric based ear detection has been discussed, as simple geometric approach which is based on the concept of max line. In the proposed scheme the features from the ear image have been extracted by measuring geometrical relation between predetermined points .The proposed method is reliable and user friendly as it is developed in LabVIEW and it is simple as this method does not require the inner boundary of ear and this system is accurate.

Keywords--

I. INTRODUCTION

The potential of the human ear for personal identification was recognized and advocated as long ago as 1890 by the French criminologist Alphonse Bertillon[1]. In machine vision, ear biometrics has received scant attention compared to the more popular techniques such as automatic face, eye, and fingerprint recognition due to uniqueness. Ears have played a significant role in forensic science. An ear classification system based on manual measurements has been developed by Iannarelli, and has been in use for more than 40 years [1]. Ears have certain advantages over the more established biometrics such as facial recognition as Bertillon pointed out. The ear does not suffer from changes in facial expression and is firmly fixed in the middle of the side of the head so that the immediate background is predictable whereas face recognition usually requires the face to be captured against a controlled background.

II. EAR RECOGNITION HISTORY

First ever ear recognition systems is developed by A. Iannarelli in 1949 [2]. This is a manual system based upon 12 measurements ,he claim that ear is unique to each individual. In Iannarelli system ear is divide into eight parts and it is based on 12 measurements taken around the ear using mark. Measurement take through transparent compass on enlarge image of ear, basically it is manual method of taking measurement of geometry of ear.

First ever automated system were described by et al Moreno for ear recognition. They used multiple features and combined the results of several neural classifiers. Their feature vector included outer ear points, ear shape and wrinkles, as well as macro features extracted by a compression\ network [3]. To test that system, two sets of images were acquired. Later, this method is extended by Mu et al. They represented the ear feature vector as a combination of the outer ear shape and inner ear structure. Classification is done by neural network. This method can be considered as a simplified automation of the Iannarelli's system.

III. ANATOMY OF AN EAR

The ear can easily identify the person. The ear consists of several parts. Those are helix (Three parts i.e. H. superior, H. anterior, H. posterior), pliegue superior, Foseta, Coneha, Origen, Trago, Canal intertraguiano, pliegue inferior, Fose navicular, Antitrago, Lobule, Zone, Lobule etc as shown in Fig. 1. In the preprocessing step the ear image is resized into a fixed size. Then to distinguish the edges, threshold is applied [4].



Fig.1,The anatomy of the ear 1. Helix Rim 2. Lobule 3. Triangular Fossa 4. Cannal Intertraguiano 5. Concha 6. Crus of Helix 7. Tragus 8. Antihelix 9. Antritragus

IV. THE OVERALL SYSYTEM

The proposed system for person identification by ear biometric is done by. Initially image is acquired through digital camera or other means. The image is converted to gray scale. Then using threshold a binary image obtained. After that Region of Interest (ROI) is chosen which is the rectangular area containing the ear image. Masking is used to detect the edges of the ear image. Using labVIEW algorithm the features of the ear is extracted. The extracted features along with the subjects id is stored in the database for testing for a match [4].

The algorithm to extract the feature involves the following steps:

- Image Acquisition
- Image Preprocessing
- Thresholding
- Ear Feature Extraction

IMAGE ACQUISITION

Use the IMAQ Read File VI to open and read data from a file stored on your computer into the image reference. You can read from image files stored in a standard format (BMP, TIFF, JPEG, PNG, and AIPD) as shown in fig2. In all cases, the software automatically converts the pixels it reads into the type of image you pass in [5].

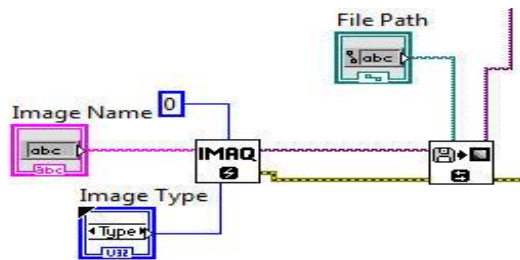


Fig. 2. Block diagram for acquisition of image

IMAGE PROCESSING..

Images with ear rings, other artifacts and occluded with hairs have not been processed in this research work. Each image shown in fig 3 is gone through the following steps before feature extraction.

- Ear image is *cropped manually* from the complete head image.
- Cropped ear image is resized.
- Colored image is converted to grayscale image.



Fig. 3. Original image.

Manual cropping has been done in the work . The sizes of cropped ear image are different. In order to find same number of features from each ear image shown in Fig 4, resizing the images to unique fixed size of pixels is made. Each image was converted from RGB to grayscale (if not in grayscale). Then it was sent to feature extraction module.



Fig. 4. Resizing the images to unique fixed size of pixels

THRESHOLDING

Thresholding is the simplest method of image segmentation from a grayscale image, it can be used to create binary images. Clustering-based methods, where the gray-level samples are clustered in two parts as background and foreground (object), or alternately are modeled as a mixture of two Gaussians. The threshold operation sets the background pixels to 0 in the binary image, while setting the object pixels to a non-zero value. Object pixels have a value of 1 by default, but you can set the object pixels to have any value you choose [6].

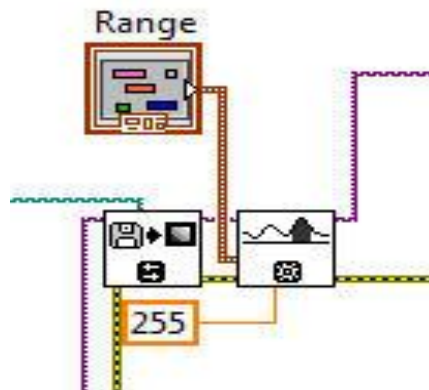


Fig. 5. Block diagram for thresholding.



Fig. 6. Threshold image of ear.

You can use different techniques to threshold your image. If all the objects of interest in your grayscale image fall within a continuous range of intensities and you can specify this threshold range manually, use the IMAQ Threshold VI to threshold your image shown in fig 5. If all the objects in your grayscale image are either brighter or darker than your background, you can use one of the automatic thresholding techniques in IMAQ Vision resultant is shown in fig 6.

EAR FEATURE EXTRACTION..

The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the object in image. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to [7].

- discontinuities in depth,
- discontinuities in surface orientation,
- changes in material properties

In this approach after thresholding of grey scale image we set image by calibration tool to default size. We find first feature that is outer shape or edge of ear, second feature is to find out the Euclidean distance, by finding out the max top point and bottom point of ear, the max line has both its end points on the outer edge of the ear as approach is based on the max line it should be found very carefully with minimum error. The Euclidean distance is the straight-line distance between two pixels [5].

In this approach shown in block diagram in fig 7, we convert image in array of pixels. Now image is form where only black and white pixels are there, now search for an element in a 1D array starting at start index. Because the search is linear, need not sort the array before calling this function. It stops searching as soon as the element is found. Either its black pixel or white pixel, scanning starts from 0 to max value it find first white pixel which consider as a top point on edge of ear, now reverse image an scan again to find out bottom point, by using caliper tool we find Euclidean distance between them. Now we can find midpoint of max line from where scanning starts again in straight line from left to right, now where we get first black pixel that is side boundary point now we have three point of ear shown in Fig 8, find out distance between them and area of ear.

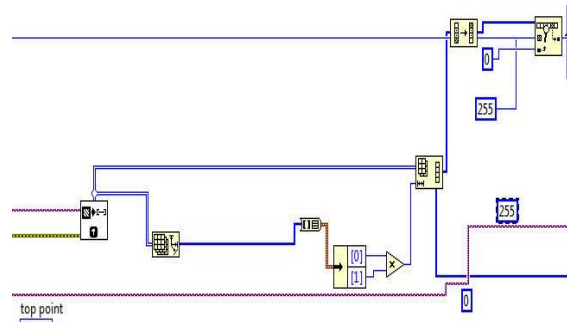


Fig. 7. Block diagram for convert image into array of pixel and scanning.



Fig. 8. Result image after scanning.

Next step is to locate the centroid of image to find out more point or edges to be safe detection. Centroid will calculate the center of energy of either a specific region or entire image. Image Mask is an 8-bit image specifying the region in the image to use for the calculation. Only those pixels in the original image that correspond to an equivalent non-zero pixel in the mask image are used for the calculation shown in Fig 9 [5].

x centroid is the x coordinate of the point.

y centroid is the y coordinate of the point.



Fig. 9. Centroid of ear.

Use the Edge Tool to find edges or sharp transitions in the pixels values along a given line or ROI profile. Edge locations can determine the dimensions of an object in a gauging application [8]. The connected source image must have been created with a border capable of supporting the size of the processing matrix. Use the Threshold Parameters to determine whether a change in the pixel values is considered an edge. The main criterion is a Threshold Level on the pixel values. This threshold value will be absolute, its value is based directly on the pixel grayscale intensity. It can compute the location of the edges with sub pixel accuracy, it calculate best edges shown in Fig. 10.

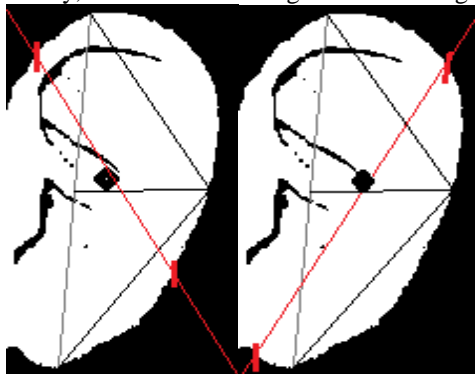


Fig. 10. Edge detection of ear.

V. RESULTS

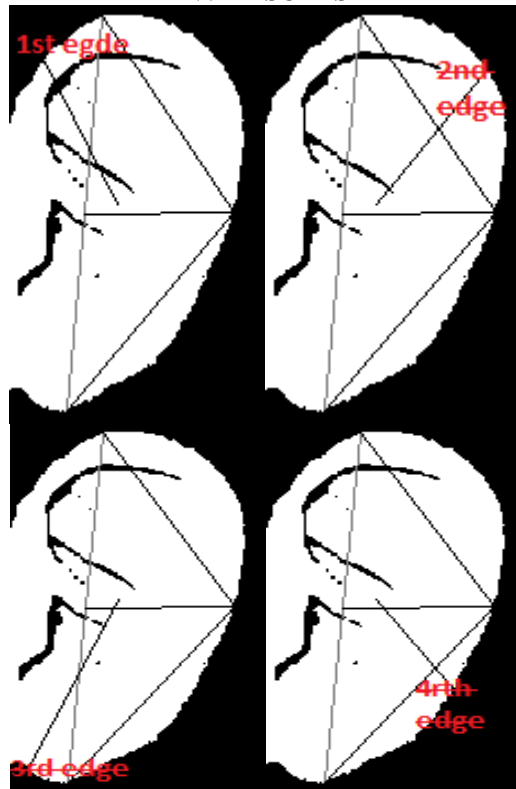


Fig. 11. Results of geometry of ear.

results shown in fig 11, we have top point or max point of threshold image of ear and bottom point, midpoint and extreme side point, X Y coordinates of centroid and coordinate of all above edges, now with caliper tool we find the pixel distance between them [5].

xy centroid to xy 1st edge = (83)

xy centroid to xy 2nd edge = (78)

xy centroid to xy 3rd edge = (61)

xy centroid to xy 4th edge = (104)

euclidean distance from top to bottom=(198)

these all factors are more than sufficient to make a template of ear, now next step is features extracted in the previous stage have to be compared against those stored in the database in order to establish the identity of the input ear. In its simplest form, matching involves the generation of a match score by comparing the feature sets pertaining to two ear images. The match score indicates the similarity between two ear images [4].

VI. CONCLUSION

The match score(s) generated in the matching module are used to render a final decision. In the verification mode of operation, the output is a “yes” or a “no”, with the former indicating a genuine match and the latter indicating an impostor. In the identification mode of operation, the output is a list of potential matching identities sorted in terms of their match score

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