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Biometric Identification Through Ear, Palm and Dorsal Vein Patterns

Hamsini A Kumar, Kavya M, Malavathi V
School of Computing and Information technology, REVA University, Bangalore-560064.

I. ABSTRACT- In the present days, security is the most important thing any person is looking for. But, single security system is not enough to provide secured authentication and it can be lost as well. So we turn towards Biometrics. Biometrics is the science for human identification and verification using human features. Biometric verification technique have had a history of over a 100 years. We go through many circumstances to find a person's identity using cards, badges, personal identity number, password, etc. Similarly, here we come across an aspect called Biometric Authentication System using ear, palm and dorsal. It has been proven to provide better authentication and security which is the need of the hour. The main aim of this paper is to develop efficient Biometric Authentication System using ear, veins of palm and dorsal.

II. KEYWORDS- Multimodal biometrics , ear, palm, dorsal, biometric fusion.

III. INTRODUCTION

In biometric applications, a relatively new technology is emerging viz., the superficial vein patterns of hand palm and hand dorsal. Using ear as biometrics is a novel topic in the field of Biometric Security. There are certain steps involved in human identification using the above three systems, that is, ear, palm and dorsal veins. A desired part of the image is placed on the identification system, then the image is captured by the camera, and is stored for further processes. As of now, biometrics have been known to be implemented with the features like iris, retina, face, fingerprints, voice, etc.

Initially the area containing ear, vein patterns of palm and dorsal are chosen. It finds the uniqueness from the image. But traditional systems were not that effective. So in order to make the system more accurate, to yield better performance and true output, our system uniquely combines these three human identification biometric traits.

IV. PROPOSED SYSTEM AND ARCHITECTURE

The decade has seen much advancements in terms of security. There has also been considerable increase in security attacks and hackers. Hence it is not sufficient to just make the system secure, but to also make it resilient.

Here we have employed multiple authentication techniques in a single system. This paper first takes you through a brief description of palm and dorsal part of the system and then to the ear recognition part of the system.

A. Image Acquisition System

The vein patterns can be caught on an optical
Medium being exposed to infrared radiations
.

Fig. 8 System architecture

The hardware setup consists of a dedicated NIR-lighting system built using IR-LEDs.

A camera is mounted on a stand over 4.5 cm from the baseboard along with two IR-LEDs arrays on either side of the camera. With the help of this acquisition system the images are captured (preferably 10 each) of the hand palm and hand dorsal.

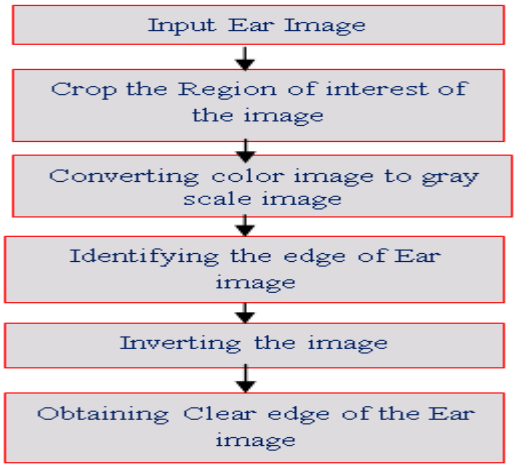

Fig. 2 System architecture

B. Pre-processing

The two main objectives include:

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- To extract the palm and dorsal area from the input images which constitutes the Region of Interest (ROI) for identification purposes.
- To remove the noise and enhance the contrast of the ROIs. ROIs are automatically extracted from the contour. Since the palm and dorsal are different in terms of visibility, structure and noise present in the acquired images, different techniques for reducing the noise and for the enhancement of the image is applied.

First step is to remove the speckle noise which is done by applying a median filter. Then to suppress the effect of high frequency 2-D noise, Wiener filter was applied, assuming that the Gaussian white noise is present in the images. To enhance the vein visibility limited adaptive histogram equalization is applied for improving the resulting image contrast.

C. Feature Extraction

Gabor filters are extensively used in most of the biometric systems (like iris, fingerprint and character recognition). Here too Gabor filters are employed to extract the identifying features.

A circular 2-D Gabor filter is defined as the product of sinusoidal wave with the Gaussian envelope. The Gabor filter is applied using the following formula:

$$G_{DC}=\mathrm{G[x,y},\theta,u,\sigma]-\frac{\sum_{i=-n}^{n}\sum_{j=-n}^{n}G[i,j,\theta,u,\sigma]}{(2n+1)^2}$$

Where $(2n+1)^2$ is the size of the filter.

σ = Standard Deviation

θ = Different Direction

Then, each Gabor filter is convolved with the vein images and for each filter direction two matrices are obtained, that is, for real and imaginary parts. The two matrices are converted into binary form by the following inequalities:

$$bit_{real}=\begin{cases}1, & if\ real\geq 0,\\ 0, & if\ real<0,\end{cases}$$

$$bit_{imaginary}=\begin{cases}1, & if\ imaginary\geq 0,\\ 0, & if\ imaginary<0,\end{cases}$$

The resulting binary matrices are used in matching process.

D. Matching

Matching procedure is based upon normalized hamming distance between binary feature matrices, which is applied to both the images. The normalized hamming distance (D0) can be defined for 2 binary feature matrices, A and B as:

$$D_0=\frac{\sum_{i=1}^{n}\sum_{j=1}^{n}[Re(A(i,j))\oplus Re(B(i,j))+Im(A(i,j))\oplus Im(B(i,j))]}{2N*N}$$

The normalized hamming distance takes value between 0 and 1, where 0 corresponds to a perfect match.

For the multimodal system, the outputs obtained from the normalized hamming distance for both the palm and the dorsal veins are fused at the score level and then are levelled to threshold , to determine whether the identification attempt is genuine or not.

$$\text{Score}=\frac{Score\_Dorsal+Score\_Palm}{2}$$

Where score_dorsal and score_palm are the normalized distance scores of the hand palm and dorsal veins respectively.

Finally this score is levelled to threshold to reach the multimodal system decision.

$$Decision=\begin{cases}accepted, & score\geq t,\\ rejected, & otherwise,\end{cases}$$

Where t= threshold.

Now, let us know about the ear recognition mechanism.

E. Image Compression Standards and Artefacts

We need to use three image compression algorithms viz.,

1) JPG: It is used to obtain desired bitrates and especially for block based artefacts, because it cannot recognise ring based facts.

2) J2K: It is used as a conversion medium which promotes explicit rate control and also generates ring based artefacts, masking JPG's disadvantage.

3) MJ2: Motion JPG encompasses the video footage, in which motion compensation prediction blocks is available with error protection.

F. Feature Extraction

We need to employ quality feature extractor, so that they could provide us with better description of the visual features of the contents of images. They describe the basic features like shape, colour, texture or motion(if any) of the contents of images.

1) Local Binary Pattern: we have to extract LBP features from n-8 neighbourhood in each pixel (i.e., (x+1,y),(x-1,y),(x,y+1),(x,y-1) and

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(x+1,y+1),(x+1,y-1),(x-1,y+1),(x-1,y-1)). It improves the performance with respect to detection when combined with HOG(histogram of oriented gradients) descriptor. Here the image is divided into 10X10 pixels and LBP histograms are concatenated with each grid cell.

2) Local Phase Quantisation: It is applied for blur-insensitive image analysis. Here the image is extracted from 11X11 pixels and LPQ histograms are then concatenated within each grid cell to obtain global feature vector.

3) Histogram of Oriented Gradients: It is a feature detector used for the purpose of detection of object. For our system, we may use a patch size of 8X8 pixels with nine different orientations.

The captured image is resized to the same size as that of the original image. In order to smoothen the captured image using Gaussian filter the formula goes:

$$G(x,y)=(1/2\pi\sigma^2)e^{-(x^2+y^2)/2\sigma^2}$$

Where x and y are the image pixels coordinate,

σ =standard deviation

On seeing the results of both hand palm, hand dorsal as well as ear, we AND (logical AND-&&) them.

If the resultant is binary 1, then verification attempt is successful, rejected otherwise.

Hence the data is verified /authenticated biometrically.

V. APPLICATIONS

*The ear samples as biometrics are extensively used in forensic areas.

*The ear biometrics are used in compression network (for satellite broadcasting).

*The vein pattern of the hand palm and hand dorsal can be seen being applicable at the banks in the near future.

VI. ADVANTAGES

°The image of the ear can be easily captured from a distance for the verification details.

°The structure of ear does not change much with the age, facial expression and emotions.

°Identical twins have different and distinct vein patterns.

VII.WHY ARE THE OTHER BIOMETRIC SYSTEMS FAULTY?

1). *Face Biometrics*: As in case of plastic/cosmetic surgery the face morphology changes which is proved faulty.

2). *Signature Biometrics*: In the present scenario its not a big deal to duplicate/forge the signature.

3). *Voice Biometrics*: The voice is easily prone to mimicry.

4). *Iris and Retina Biometrics*: It will damage the eye in the long run and people fear to undergo the scan.

5).*Fingerprint*: The factors like dryness, dirt of the finger skin as well as age adds up to the disadvantages of the oldest biometrics.

VIII. LIMITATIONS

1) In case of loss of hand or fingers due to accidents, the security verification fails miserably.

2) During crime scenes the surveillance cameras sometimes miss to capture the individual's ear which is masked by hair or cloth.

IX. CONCLUSION AND FUTURE TRENDS

It is worth noting that this multi-modal system yields better performance in terms of privacy security, authentication and renders true output. The importance of biometrics in day to day life has been increasing exponentially, ranging from a security lock to a smart phone to the Amazon database security system!!

The limitation of this system can be rectified and improvised to encounter spoof attacks against biometrics. The system can employ further more biometric authentication systems to ensure even higher security.

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