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Person Authentication using Ear Shape Detection

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Abstract

Person authentication /identification using biometrics have become much common in many contexts and also expected to grow a lot in the upcoming years. In the existing system, we conducted a set of experiments for assessing various biometric techniques as well as the advantage in their fusion to the security system's performance. In the proposed system, a new novel model is created using the face feature extraction technique which is the hybrid combination of existing Voila-Jones model and artificial neural network for feature detection model. The proposed technique focused on detecting the uniqueness present in the face reactions and the manipulation of ear piece. We implement this project using ***MATLAB****.*

Keywords- *Image Processing, Crack Detection, Internet of Things, Pothole detection, MATLAB*

1. Introduction

The Biometric authentication is a process that depends on the distinct genetic features of a person to verify his or her personal identity. Biometric authentication systems associate a biometric data captured on real-time with already stored and verified reliable data in a database. When the acquired data and the existing data is found to be matching, authentication is verified. Usually, biometric authentication is often used to manage physical access and digital access to buildings, computing devices and rooms.

Biometric based person authentication and identification is very common nowadays in many places and also expected to grow a lot in the upcoming years. In the existing system, we conducted a set of experiments for assessing various biometric techniques as well as the advantage in their fusion to the security system's performance. In the proposed system, a new novel model is created using the face feature extraction technique which is the hybrid combination of existing Voila-Jones model and artificial neural network for feature detection model. The proposed technique focused on detecting the uniqueness present in the face reactions and the manipulation of ear piece.

There are a variety of Biometric based Recognition systems and some of them are – Retinal tests are capable of reproducing the pattern of blood vessels inside the photo-sensitive layer overlaying the inner part of human eye in the form of an image.

Scanning of fingerprints are simply the digitized process of scanning normal fingerprints in paper and inking process. It works with paternal details of uplifted areas and divisions in a image of the human finger known as minutiae.

Finger vein ID is calculated by the distinct pattern of the blood vessels in a person's finger.

Faceprints consist of more than 80 nodal points on the human face. These faceprints are used by facial recognition systems for identification purposes. The shape of every individual's mouth and throat can be used as features in a security system based on voice identification.

This project uses Ear shape as a biometric using the face feature extraction technique since the ear shapes are found to have 99.6% accuracy and uniqueness over other commonly used biometrics.

2. Literature Survey

Andrea F. Abate , Michele Nappi and Stefano Ricciardi, [1] proposes a system that uses many biometric methods that enables authentication using smartphone's sensors. This system uses the smartphone's sensors and gets ear shape which is a physical biometric and arm's flex which is a

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behavioural biometric and combines it together. This paper proposes a system that uses both ear shape and arm gesture biometric data for authentication because when individually detected arm gesture has a EER of 0.13 but the fused data of ear shape and arm gesture biometric data has a 0.1 EER value. In this paper, Four experiments have been conducted for identifying Arm Gesture performance with respect to EER values achieved, for measuring individually the ear biometrics with a smartphone, combination of the two individual biometrics ear and arm gesture into a single biometric data using decision-level fusion schemes, and another experiment to assess the performance of the combined biometrics in terms of RR values. The overall maximum recognition rate achieved by this system is 80.5%. The recognition rate of Ear alone is 73% which is far better than the recognition rate of arm gesture alone at 58%. The noise in the data can be reduced by using appropriate filters such as Kalman Filter to improve verification accuracy.

Tapas Kumar Mohanta and Subrajeet Mohapatra, [2] proposes a multimodal biometric approach towards authentication and authorization. This system combines the functionality of both Ear based biometric and speech signals. This system uses ear segmentation technique that processes the captured image and segments it with respect to the centroid of the image. The image is usually converted into grayscale for easier processing. This system uses Discrete Wavelet Transform (DWT) and Gray-Level Co-Occurrence Matrix (GLCM) algorithms for detecting the ear shape. The ear shape biometric is then combined with another biometric value – Speech Recognition. This system uses Mel Frequency Cepstral Coefficient (MFCC) algorithm to detect and recognize human vocal pitch. This Speech Recognition involves 7 steps namely – Pre emphasis stage to emphasize frequencies, Framing to segment the speech samples, Hamming Windowing to integrate the closest frequency lines, Fast Fourier transform to obtain impulse response from the glottal pulse, Mel filter bank processing to scale and filter the obtained frequencies, Discrete cosine transform to convert the mel spectrum and finally fusing the obtained speech data with the Ear shape data to obtain a single biometric value.

Ali Fahmi Perwira Negara, Elyor Kodirov, Mohd Fikri Azli Abdullah , Deok-Jai Choi , Guee-Sang Lee and Shohel Sayeed, [3] proposes a system that uses the upper arm flex to augment its authentication system. This system enables the smartphone to improve its cognitive capability of understanding its user in a better way. This system puts in use a multi tri-axial accelerometer from its MPU-6000 processor. This system enables the smartphone to detect each individual user's arm flex pattern in picking up their phone from their pocket or from a table. This system uses vector form of data of the acceleration magnitude of the arm's flex of each user within a specified time frame. Similarity in the flexes are detected using Cosine Similarity and Euclidean Distance algorithm. This system is then evaluated using the amount of False Acceptance Rate (FAR) and False Rejection Rate (FRR). The system returned 87.8% accuracy when the phone is picked up from the table and resulted in 90% accuracy when the phone is picked up from the user's pocket. Although Arm's Flex based system cannot be used as well as a primary authentication algorithm, this system can be used as one of the sub authentication systems.

K. M. Brindha Shree, M. Rajalakshmi, [4] focuses on applying the biometric based Authentication and integrating the feature with existing web service applications to establish improved security systems. The pros of having biometric based authentications are also discussed. Some of the cons include the perks for users such as not having to remember the password or log in credentials and also eliminating the chances of misuse of passwords that can be eavesdropped by an intruder. The biometric systems incorporate authentications using any of the following - Online Signature, Voice System, Face System, Finger Print, Iris Scanner and Ear Shape recognition. The whole process is implemented in four steps namely- Data Preprocessing, Feature Extraction, Making the Decision, Integrating with Web Services. We can identify any fingerprint using the core point detection and then test it using a line based feature extraction algorithm which makes use of internal database and fingerprint verification competition (FVC). The oriented and non-oriented image of the prints are compared to verify the fingerprint. After extracting the feature it is compared with existing features (fingerprint) stored in the database and if the prints match, then authentication is allowed. The business logic of the web services can be implemented once the authentication succeeds. Once the verification is complete then it sends either a PASS or FAIL signal then it is authorized to access the web service.

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3. System Architecture

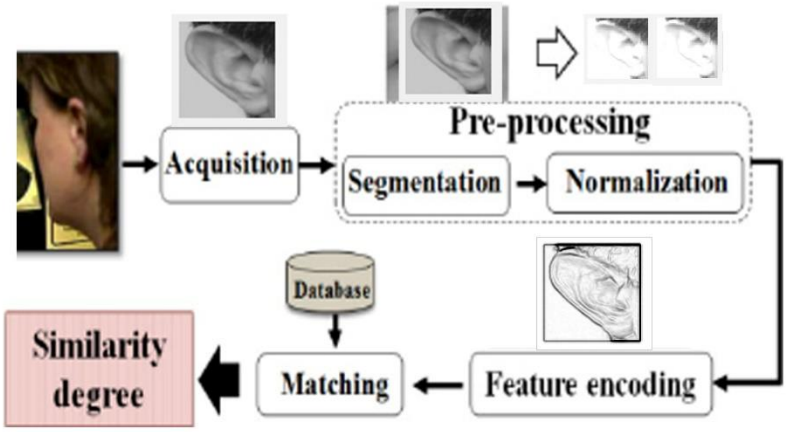
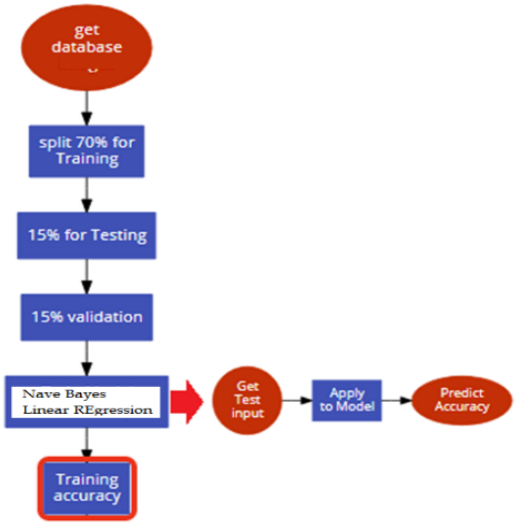


Figure 3.1 System Architecture

This system is a deep-learning based module that uses face feature extraction technique to extract the image of the ear and apply filters such as the Gabor filters and treats the ear shape as a biometric.

If the input images are color images then they are converted to gray scale from that color images. Then the binary conversion method is applied from the grayscale image. The median filter is used in order to remove the noise from the image. Figure 3.1 shows the Architecture diagram of the system.

Pre-Processing: If the input images are colored, then we convert them to gray scale images. Then the binary conversion method is applied from the grayscale image. The median filter is used to remove noise from the image. This is the first module of the system named **Preprocessing Module.**



Segmentation: The second module of the system – **Segmentation module** uses ROI segmentation. The ROI (Region of interest) segmentation algorithm is used in order to detect the particular part. A region of interest (ROI) is a specific part of an image to be filtered or to perform the operation.

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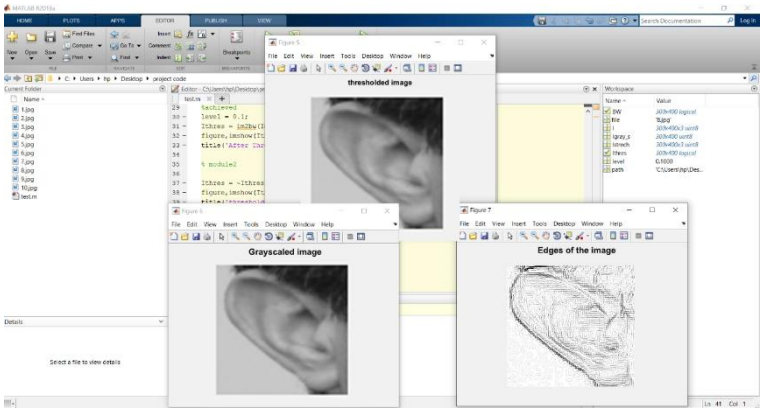

Classification: The third module is the **Classification Module.** This module is used to establish the neural network concept for training the image and testing the image with the help of weight estimating classifier. The result image will compared with the dataset images and it will display whether it is authorized or unauthorized person.

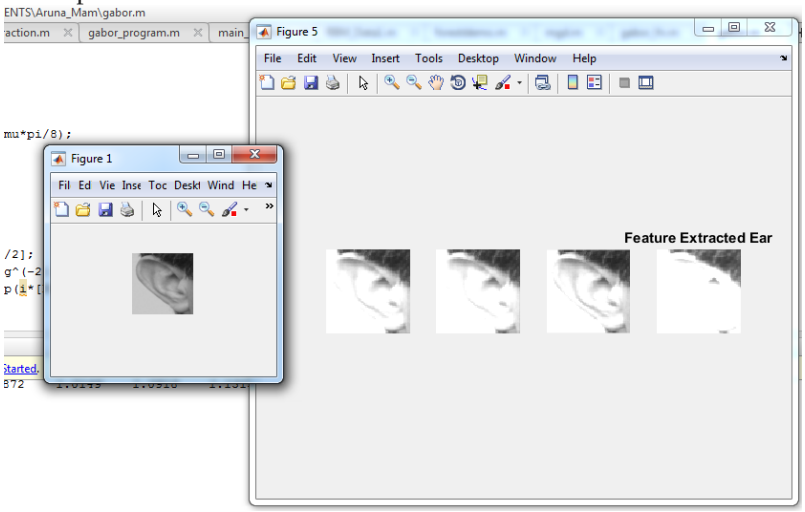

Figure 3.2 Feature Extraction

4. Implementation

A neural network is a layered structural model of data computing. It is similar to the connected structure of the neurons inside the human brain, with interconnected nodal layers. A neural network is capable of learning from data in such a way to be proficient to identify patterns, categorize data, and predict events in the future.

A neural network converts the input into abstract layers. It can be trained over many examples to identify patterns consisted in speeches or pictures, in a way similar to the human brain. The connection weights and strengths of its elements or nodes determines the behavior of the whole neural network. These weights adjust themselves during training process based on a previously specified learning rule repetitively till the network is capable of delivering the anticipated output by performing the tasks.

Neural networks are especially well suited to carry pattern recognition processes to identify and classify objects or signals in speech, vision and control systems.

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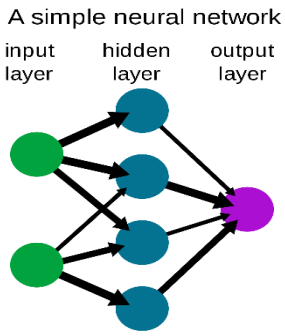

A neural network joins together a number of processing layers using nodes parallel and very similar to anatomical nervous systems in a human body. The neural network has layers namely for input and output and one or more hidden layers. The layers are connected through nodes, such that every layer uses the previous layer's output as its input.

MATLAB has a Deep Learning toolbox that can be used for this system. This toolbox consists of codeblocks to build small neural networks inside Simulink software. These blocks are categorized into four libraries.

- Transfer functions takes input vectors and generates output vectors.
- Input functions are used to calculate weighted input and output vectors and bias vectors. The return of this function is an input vector.
- Weight functions transfer a neuron or a node's weight to obtain a weighted input value.
- Data preprocessing functions are used in mapping data into suitable ranges for direct handling purposes.

The MATLAB Environment also has SIMULINK which provides simulation environment for training of the neural networks. This also can pictorially represent the networks in a graphic output.

5. Statistical Analysis

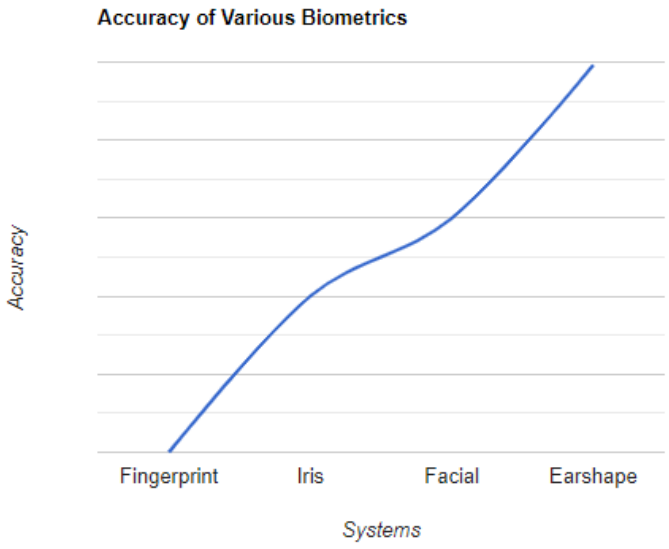

Figure 5.1

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A report is generated on the existing biometric system's Equal Error Rate (EER) and the number of filters used to extract features from the input images. Figure 5.1 depicts the recent researches on comparing the various biometric systems and Ear Shape Recognition is said to have a 99.6% accuracy based on a research conducted by the University of Southampton. A conceptual design for the architecture of the system is devised. The system modules can be implemented in smartphones or other biometric systems.

6. Conclusion and Future works

In An overview of the various technologies that are used for detection and classification of authentication methods using sensors are presented in this paper. The different methodologies using Fingerprint, FaceID, IRIS, Arm gesture and ear shape are analysed in order to implement a complete Ear shape Biometric Authentication system.

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