A Robust Hybrid Approach for Biometric Identification

Madhuri K.Pote[1],Arvind Shaligram[2],Umesh N. Hivarkar[3]

[1]*Department of Electronic Science, MAEER's Arts, Commerce & Science College, Pune, India*
[2]*Department of Electronic Science, SavitribaiPhule Pune University, Pune, India*
[3]*Post Graduate Research Centre, Department of Electronic Science, Modern College, Pune, India*

e-mail : [1]madhuripote09@gmail.com
e-mail : [2]adshaligram@gmail.com
e-mail : [3]umeshnh@gmail.com

Abstract

Identification of a person in real time has become a crucial issue now a day. There are multiple ways of biometric identification. There are limitations using individual biometric system. Potential approach to overcome some of these limitations of individual solutions could be Vision & speech based hybrid biometric identification.

Vision processing typically includes face recognition, and speech processing includes voice characterization along with gender identification. The work presented here provides the system design for such hybrid approach. Functional components involved, scope of the solution, and problems of individual biometric identification approaches are explained.

Key words: - *Biometric Identification, Hybrid Approach, Vision processing, Speech processing*

I. Introduction

Biometric Identification

- One of the advanced methods for uniquely distinguishing individual persons
- Has large applications in day to day real time operations
- M as shown in Figure 1 the area where the hybrid system can be implemented.

1. Banking and security sectors
2. Aviation
3. Various attandence system
4. Transport system

Figure 1: Applications of Biometric Identification
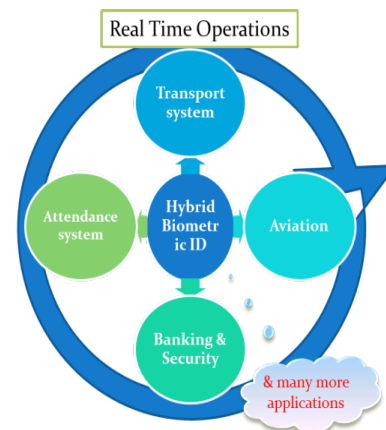
II. Limitations

There are various types of biometric identification, and there are many advantages as well as disadvantages with the single biometric system which are shown in figure 2. To overcome the limitations we can have a hybrid biometric identification system which will be more robust and element the problems. This paper highlights the need of hybrid biometric identification using vision of speech processing.
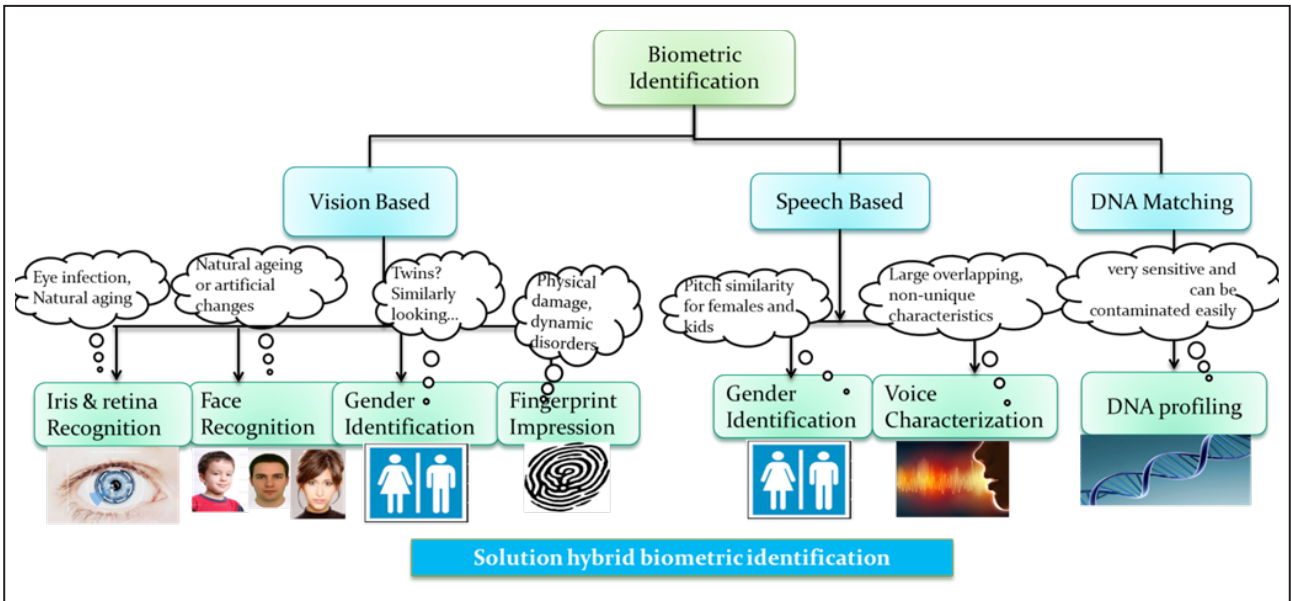
Figure 2 : Limitations of individual biometric system

The biometric identification can be separated in many types like Vision based, Speech based, & DNA matching.

➤ **Vision based :-**

Person identification using vision based can be done in various ways such as

• Iris and retina recognition
• Face recognition
• Gender identification
• Fingerprint impression

The list is quite exhaustive. Each has certain limitations. Iris and retina recognition– problem occurring due to eye infection, natural aging & it's one of the expensive method of identification, Face recognition - natural ageing or artificial changes, Gender identification - twins look similar, in fingerprint one can have physical changes, dynamic disorders[8].

➤ **Speech Based:-**

• Gender identification
• Voice characterization

Limitations are pitch similarity for females and kids, large overlapping, non-unique characteristics.

When hybrid system using vision and speech is used the limitation of single biometric will be eliminated and error free identification of a person will be done.

➤ **DNA matching**

This method is extremely intrusive, expensive, Privacy -some consider any request for a DNA sample to be a violation of an individual's right to privacy and a violation of their civil liberties.

III. Biometric Comparative study :

Table 1. Shows the comparison between various biometric identification systems, comparison is based on different parameters like technology, accuracy, error rate, stability, performance, user acceptance, cost and memory required. The performance is also based on whether conditions, age, natural occurring problems, data loss, etc. [8].

Parameter	RFID (1)	Signature (2)	Face recognition (3)	Voice recognition (4)
Technology	RF	Pattern Analysis	Image Analysis	Speech Analysis
Accuracy	High	Low	Medium	Medium
Error rate	High	High	Low	High
Long term stability	Low	Low	Low	Medium
Performance	High	High	High	Medium
User acceptance	High	High	Medium	High
Cost	Less	Less	Medium	Medium
Memory required	Low	------	More	Medium
System complexity	Less	-------	Medium	Medium
Reliability	Less	Less	Medium	Medium

Parameter	DNA analysis (5)	Finger print (6)	Iris scan (7)	Hybrid system (8)
Technology	Chemical Analysis	Image Analysis	Image Analysis	Vision & Speech
Accuracy	High	High	High	High
Error rate	Less	High	Medium	low
Long term stability	High	Medium	Medium	High
Performance	High	High	High	High
User acceptance	Low	High	Low	High
Cost	High	Low	High	Medium
Memory required	High	Low	Medium	medium
System complexity	High	Less	Medium	Less
Reliability	High	Medium	High	High

Table1. Biometric Comparison

IV. Design considerations

Looking at the above disadvantages of individual biometric system we can a hybrid biometric system using vision and speech processing which will eliminate the lacunas produced by individual system. The system will contain vision processing for face identification and speech processing for speaker recognition and gender identification. It will perform and operation which means the person will be identified only if he passes this identification system making it a robust system. The expected system will have the following functional blocks, which are shown in **Figure 3.**

When the person who is to be identified appears in front of the sensors his or her face image and voice sample will be automatically stored and processed and face, gender, speaker identification will be done and all this information when fused together using and logic, due to automated process the system will identify individual without error.
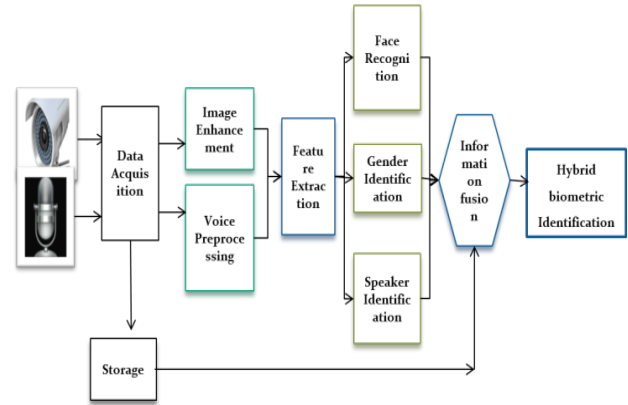

Figure 3. Functional Block Diagram

V. Methods Under Experimentation

Methods which can be considered are:

Methods for face feature extraction:

1. PCA(using eigen faces)
2. Line edge map
3. Wavelet extraction

Principal component analysis (PCA). Is the most used method for face recognition. The major advantage of PCA is using it in eigen face approach which helps in reducing the size of the database for recognition of a test images. The images are stored as their feature vectors in the database which are found out projecting each and every trained image to the set of Eigen faces obtained. PCA is applied on Eigen face approach to reduce the dimensionality of a large data set [1].

Methods for speaker recognition:

1. MFCC
2. GMM-UBM
3. SVM-GSV

MFCC is perhaps the best known and most popular. MFCC's are based on the known variation of the human ear's critical bandwidths with frequency.

Methods for gender Identification using Pitch feature extraction [2]

1. AM-FM formant model
2. Energy based speech frame extraction
3. Pre- emphasis and windowing
4. Formant estimation
5. Energy separation
6. Pitch period estimation
7. Working on speech analytics and characterization

For speech signal based gender identification, the most commonly used features are pitch period and Mel-Frequency Cepstral Coefficients (MFCC) [5].

VI. Summary

The paper basically highlights the drawback of individual biometric system, in a whole using a hybrid system it would be a better solution to overcome the current problems faced due to individual methods used for biometric identification in real time. Implementation of vision and speech based hybrid techniques will eliminate the lacunae produced by individual method which will use a and operation, a person will be identified only when both vision and speech based system scores get matched, identification problems like natural ageing, changes due to physical damage in fingers will not cause a major problem. The hybrid identification system can be a future solution for all real time biometric identification system.

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