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A Novel Face Detection Approach Using Local Binary Pattern Histogram and Support Vector Machine

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ABSTRACT

Biometrics plays a major role in the evolution of pattern recognition and security system throughout the entire world. In recent days, the most used sensor is either electrical or optical such as camera devices, including scanner to obtain images and recording of unique traits others measurements. This technology has made a major contribution to many fields like security, healthcare, biometric, identification, customs, prevention of cybercrime, and also for commercial organizations uses. In most of the recent technologies which incorporate biometric systems, only one biometric trait is used to ascertain the identity and it also has the same drawback such as noise in recorded data. These noises increase False Acceptance Rate (FAR) which in turn causes false recognition. Lesser the number of unique traits lower will be the Genuine Acceptance Rate (GAR).hence the security provided by the biometric diminishes its benefits. In this paper, we have come up with an idea of combining two biometrics of an individual to improve the security. It is a well-known fact that fingerprint and face recognition can make a decent combination that has been studied, applied, and proved in our project. The proposed method relies on feature extraction using fingerprint and face and key generation using result set analysis (RSR). The experiment has been evaluated in the MatLab 2013b and thus providing a result which increases security having GAR of 95.3%.

Keywords: *Biometrics, Fingerprint detection, Face detection, Multimodal, Matching, Machine learning algorithm, MatLab.*

1. Introduction

Image processing is one of the means of processing an image into its digital format thereby performing necessarily operation in it. And so on [1]. This will provide us an enhanced image which in turn can be used to extract information about an individual's unique traits from it. The Input image will be provided in the form of a video frame photograph which is like a quit signal dispensation. The output can be an image or maybe characteristic information related to that image. In image processing an image will be represented in the form of a two-dimensional signal, where the signal processing method can be easily applied to its [1].In recent days, image processing technology is a well-known and rapidly improving technology which provides various contribution to various fields.

It includes generally 3 steps they are,

1. Importing the image using Sensors/devices.

2. Analyzing and manipulating image which includes data compression and image enhancement. Thereby spotting patterns that are not visible to human eyes.

3. The output will be generated in this stage [1].

Computer vision is a method of computer imaging where the method doesn't require the physical presence of a human being in the loop [12]-[14]. The problem in the vision is solved by a First image analysis which is the examination of data. The process of feature extraction which is used to obtain information like color & shape and pattern classification which is used to identify the objects in the image is done in the second image analysis [10]-[11]. These methods are reliable for being utilized in e-passports [6]. Digital image processing isn't only confined to capturing images & increasing brightness rather much more than that. An image is represented as a 2-dimensional function such as F (x, y), where X and Y are spatial coordinates and F(x, y) is termed as the

intensity of the image. For an image to be digital, the coordinates x and y have to finite [2]-[3].computers are employed in the process of the manipulation of digital images using digital image processing [10]. Every data should undergo these three general phases such as pre-processing, enhancement, and display, information extraction [6]-[7].

2. Related Work

Multimodal biometrics advantages have been shown in various studies in the literature. For the fusion of face and voice biometrics, Brunelli and Falavigna [16] utilized average weighted geometric and normalization using hyperbolic tangent (tanh). They have also proposed a multimodal identification system through a graded combination scheme. Various fusion methods for the voice and face biometrics have been experimented by Kittler et al. [17], which includes the product, median, sum, maximum and minimum rules. It has been found that the sum rule has bettered the other rules. He also found that the sum rule is not disturbed by the probable estimation problems and this proves its supremacy. Identification system grounded on the fingerprint and face was proposed by Hong and Jain [18], the matching for fingerprint has been carried out after pruning the database through face matching. For voice and face biometrics, Ben-Yacoub et al. [19] proposed various fusion techniques like tree classifiers, multilayer perceptron's, and support vector machines. It has been found that the Bayes classifiers as the best method. A combination of fingerprint, face, and hand geometry biometrics with a decision tree, linear discriminant methods, and sum were proposed by Ross and Jain [20]. According to the reports by authors, the sum rule was high performed with others. The complexity of the apt system of fusion was affected by the number of samples per subject as noted by researchers in the databases. Additional samples might allow using knowledge-based techniques like perceptron which are complex.

3. Related Work

3.1 Face and Fingerprint Authentication

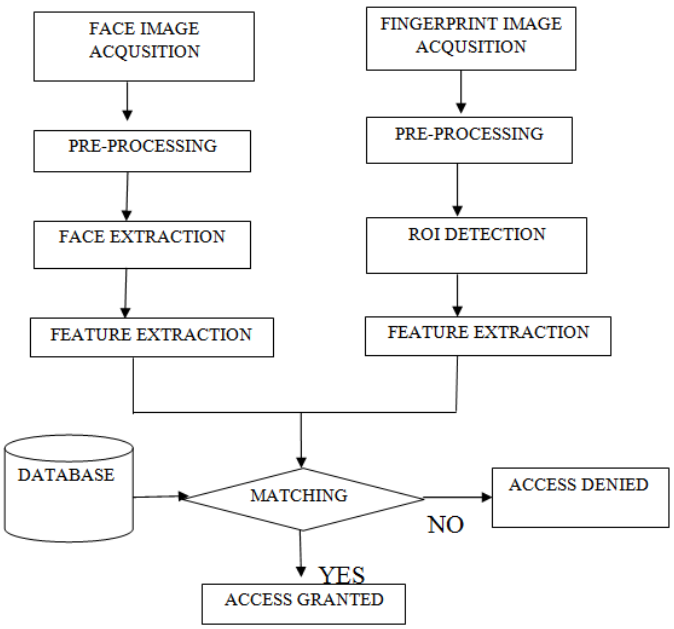


Fig.1 Block diagram

4. Methodology

4.1 Image Acquisition

Get the Input Image

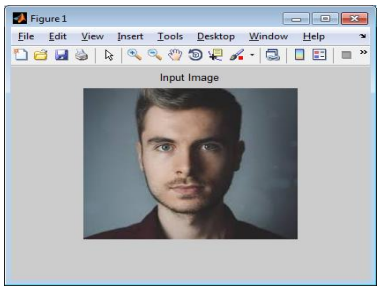


Fig.2 Face input image **Fig.3** Fingerprint input image

4.2 Preprocessing

For an ordinary image to be used in the face recognition module of biometric recognition, either the suppression of the undesired distribution needs to be done or Enhances some image features necessary to be processing the output. This is a level of abstraction and aim of image processing which does operations of image. It is a method that does not increase any content in the image rather capitalizing the unique and identical information in the image. Here every pixel checks its neighboring pixels with its value, whether it has similar brightness or it is identical. If there is a distorted pixel found, then it will be found in this process and it is taken out from the image. The removed pixel will be restored as the median of the pixel found as the neighbor to it [5].

Preprocessing is a process that indicates that identification information of an image has a precise scale of signal intensities which can also be applied for various images. Preprocessing is a process that consists of many of the required operations that have to be done before the basic image analysis (i.e.) data analysis and extraction of knowledge. This process is commonly termed as radiometric (or) geometric correction [3]. There are many preprocessing techniques available and some of them are studied and analyzed duration this section. Those techniques are content-based model, fiber tracking method, Fourier transforms techniques, wavelength, and wavelet pockets. The combination of these three modules such as histogram equalization, edge detection, and token matching builds up the image preprocessing.

4.3 Image Cropping

Initially the image is taken and it has been cropped. Then the unnecessary parts have been diluted. The scale of the image is also taken correctly with the provided information. We got an identical output image because of the ideal input class. Incorporation occurs when we resize a cluster of pixels blocks to a single one. Resizing of the image is utter important when we change the pixel number, where emending can occur in a single time when we are correcting for lens warping a picture. When we zoom, it refers to the extension of the number of pixels, and then we can see more detail.

4.4 Face Extraction

The Cascade object Detector is available in the Matlab. The Detector detects the objects using the Viola-Jones algorithm in the system of the image. The Detector is always ready to detect the image by comparing the body parts in the face like eyes, nose, ears mouth, etc., and these parts are called an input string model. This builds a system type object supported by Haar type features. The record got from the XML FILE record is the user classification model laid configuration. The train Cascade object Detector function helps to make the file.

4.5 Face Feature Extraction

Each and every measurement obtained from an image is finite and all these measurements have some quantifiable property. All the unique measurements together make a function that is used to define the feature of the face recognition system. All these computed results evaluate some notable characteristics of the article. The various features which are currently used are,

General features: *Colour, shape, and texture are some of the most important and independent features of these systems. As per the abstraction level, it is further divided into 3 features they are:*

Pixel level features: *color, location... Etc. which is some of the features calculated at each pixel.*

Local features: *Edge deduction or picture segmentation over the parts of the image bond provides certain results sets and features are calculated from these result sets.*

Global features: *The result set generated over the entire image or a subarea of the picture is used to calculate these features.*

The following statements are used to resolve the problem regarding the selection of the feature from the extracted vector.

- Ample amount of information about the image should be provided by these features which are selected in order to help the user's extraction [6]-[14].
- Easy computation, rapid retrieval and easy processing of on oversized image collections should be facilitated for the user's feasibility.
- Since users are the ones who determine whether the picture retrieved is suitable or not. So they should provide results similar to human perceptual characteristics.

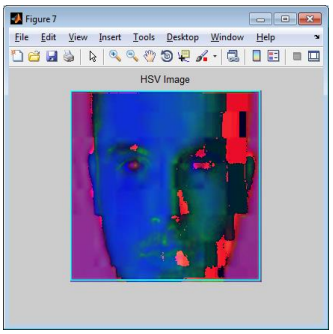
4.6 Chromatic Moment and Color Diversity Features

The recollected images are detected by discovering the chromatic degradation, on the other hand, spoof face detection effectiveness is strange. The color dispersal totally depends on illumination and camera deviation, we suggest planning invariant features in the spoof face to identify the uncharacteristic chromaticity. From the RGB space, the normalized facial images are converted into the HSV (Hue, Saturation, and Value) space then calculate the deviation, mean, and skewness of each channel by means of the chromatic feature.

Each channel, these three features such as deviation, mean, and skewness are similar to statistical moments, they are also stated by means of a chromatic moment features. Apart from these three features, In each channel the probabilities of pixels within the minimal and maximal histogram bins are used as two supplementary features. Initially, we performed color quantization with 32 steps within the red, green and blue channels, respectively. From the color scattering, we pooled two measurements

i) In normalized face image, the quantity of discrete color appearance.

ii) The Topmost hundred frequently appeared color in the histogram bin counts.



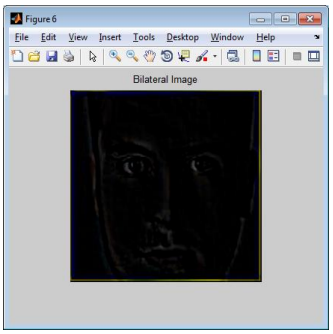


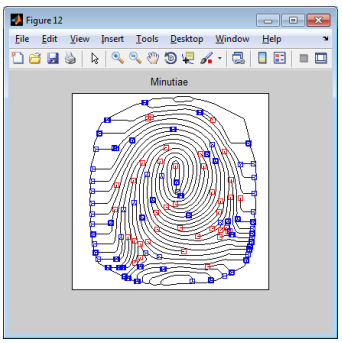
Fig.4 HSV image **Fig.5** Bilateral image

4.7 Fingerprint Feature Extraction

The last step in feature extraction is minute extraction. The Minute extraction process is accomplished and stored in database as a word image. In Thinned image operation, Minutiae extraction process is forthright to perceive and then the termination points of thin lines are found at the endings of the finger. The place in which the junction of three lines in the fingerprint is knowns as Bifurcation [4]. For each valid minutia found in fingerprint, the feature attributes are resolute.

These consist of: the (x, y) point position in fingerprint, the fingerprint ridge ending, and thus the bifurcation ending direction.

Feature attributes are determined for each valid minutia found. These consist of: ridge ending, the (x,y) location, and thus the direction of the ending bifurcation. Although minutia type is usually determined and stored, many fingerprint matching systems don't use this information because discrimination of 1 from the selection is usually difficult.



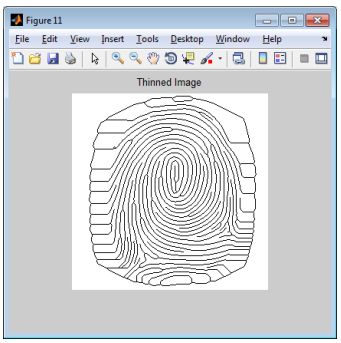


Fig.6 Minutia **Fig.7** Thinned image

4.8 Matching

The measure of similarity is purposed to match the two sets of numbers (i.e. vectors) and to evaluate its similarity by computing it to one number. Many of the measures were created within the perspective of comparing variables in pairs (like attitude or income to abortion) across cases like respondents during surveys [4]. Euclidean distance is the measure of dissimilarity and similarity [4]-[5]. The definition of space between the X and Y vectors are given below.

$$d(x,y)=\sqrt{\sum_{i}^{n}\left(x_i-y_i\right)^2} \quad (1)$$

In other terms, the sum of the squared difference between the components of the resultant of the two vectors is called the Euclidean distance. It is also noted that the formula considers the X and Y values seriously; hence no adjustment is created for the scale difference. It has been found Euclidean distance is apt for measuring data on an identical scale [13]. It has been observed that the correlation is inversely proportional to the Euclidean distance on the correlation section.

Table 1. In a multimodal Biometric Authentication system, FRR vs FAR table

False Accept Rate (FAR)	**False Rejection Rate**		
	Fingerprint	**Face**	**Multimodal (Face & Fingerprint)**
0.001%	15.2%	66.46%	10.33%
0.01%	9.4%	62.7%	4.30%
0.1%	6.9%	41.32%	6.6%
1%	3.6%	14.45%	1.53%

The above table 1 displays the single biometric attributes outcome and then the combination of those single multiple biometric attributes. The single biometric feature has a high False Rejection Rate (FRR) according to the data shown while the combination of fingerprint and face has low False Rejection Rate (FRR) for the identical FAR. The performance is enhanced by the multimodal of the biometric trait.

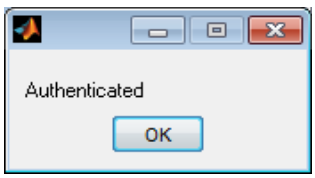


Fig.8 Result Output

5. Conclusion

The features of individual biometric samples are extracted from their preprocessed images which they're compared with the stored template to urge matching scores. This paper describes an honest and efficient

face and fingerprint multimodal biometric system that has appealingly low complexity and specializing in diverse and complementary features. During this paper face features are extracted supported image distortion analysis, and fingerprint minutiae-based features are taken. The importance of the authentication mechanism can alright be understood for at this point networked world and thus the pc program (smartphone) available with us.

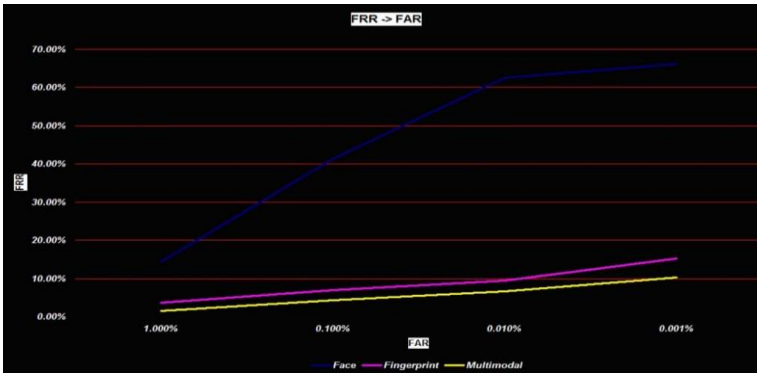


Fig.9 Face**,** Fingerprint, and Multimodal biometric FAR vs FRR comparison graph

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional and personal interests.

Consent for publication

We declare that we consented for the publication of this research work.

Code availability

The programming code that we have used for this research is available and authors are willing to share when it is required.

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