

# Multi-Biometric System for High Security Applications

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**Abstract:** Iris recognition and face recognition systems are thought of because of the most authentic and precise biometric systems accessible up to now. Some edges embody protection, speed, accuracy, quantifiability, and stability. This paper is concentrated on security in jammed places (like malls, airports, schools, colleges) and high-security places (like analysis centers, border security). This system uses a contactless system from a so much distance. Most of the current security systems are inaccurate and it takes an excessive amount of time for verification. It becomes harassing for the commoner to travel through such systems. The projected system is economical and efficient. The main beneficence of this combination is to make amends for errors in facial feature detection because of occlusions, cause, and illumination change, we have tendency to projected to extract HOG descriptors from an everyday grid. Other will be to establish the need for performing arts featuring choice to remove redundant and extraneous options to form the classification method less vulnerable to overfitting. Once an individual enters the zone, continuous snapshots will be taken with the help of camera associated sent to the code to be study and estimate with existing information of trustworthy folks.

**Index Terms:** Iris recognition, face recognition, biometric systems, HOG descriptors

## I. INTRODUCTION

Face recognition and iris recognition are considered the leading well-founded and accurate biometric authentication system out there. Some advantages embody protection, speed, accuracy, quantifiability, stability, and a few disadvantages are unit sightlessness, infection, and pricy instrumentality etc. Face recognition is one the foremost attention-grabbing and necessary analysis fields among the past twenty years because of its various applications in access management, enforcement, security, policework, automatic recognition. Recognition by face is known as a long-standing downside in computer vision [13,14]. Histograms of orienting Gradients (HOGs) and native Binary Patterns (LBP) have verified to be a good descriptor for seeing normally and face recognition

Personal identification plays a serious role in our lifestyle. whether or not we'd like to withdraw cash from our checking account or we'd like to access our social profile, email, and to use internet-banking and for the popularity method at airports in some countries so on [1].

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The extent of security decreases and dealings fraud will increase, the requirement for extremely secure identification and private verification technologies is additional.

We need a strong, systematic and optimal personal identification system. Biometrics will play a crucial role in personal identification. Biometric-based solutions offer confidential monetary transactions and private knowledge privacy. The term biometry consists of 2 words - Bio (Life) and Metrics (Measurements) [2]. biometry may be a technology that aims towards establishing one's identity supported personal traits. Biometry may be a technology want to establish, analyze, and live an individual's physical and other characteristics. every person is exclusive in terms of characteristics, that create him or her individual from all others. The physical attributes like finger prints, iris, hair color, hand arithmetic, and activity characteristics like voice and speech accent, signature etc., produce a private stand break away the rest [3]. A biometric system is usually a marking-recognition system that acknowledges a personal supported his or her picks. This recognition system usually operates altogether in two modes: identification and verification.

In enrollment module, everyone registers into the system info. Throughout the enrollment sections, a fingerprint device or CCD camera initial scans the individual's biometric characteristic to supply its digital illustration [4]. The system typically performs atop quality check to form positive that sequential stages will faithfully method the non-inheritable sample. To facilitate matching, a feature extract processes the input sample to come up with a compact however communicative illustration, known as a model.

In verification module, the system confirms a person's identity by examination the seize biometric characteristic with the individual's keeps biometric model. Verification is usually thought of to be "one-to-one" matching. One has tone compared to the sample model out of the many referencing templates [15]. The output of the verification systems may be a match or not matching call with in a second [16]. Biometric authentication is to stop multiple folks from exploitation a similar identity.

In an identification module, the system permits a person by looking at the complete example info for a match. This unique system will handle many comparisons to make associate an individual's identity [17]. There are two sorts of identification systems; one is positive and another one negative.

Biometrics is categorized based on characteristics. Physiological characteristics define the form of the body, includes veins on palm, face features, finger print, DNA,



print on the palm, hand pure mathematics, iris recognition, and membrane. Behavioral characteristics define the behavior of an individual, includes writing style, walk, and voice [5].

### A. Iris Recognition

Iris recognition could be a method used for distinguishing persons by seizing and examine the typical patterns of the iris within the persons eye [6]. This biometric system provides robotic verification individual's distinctive feature. not like different biometry, the distinct side of iris comes from at random distributed options[18]. Iris recognition is that the most real and correct biometric authentication system out there. The applications of iris recognition area unit machine (ATM), trailing captive Movement, National Border management, Ticketless air and Premises access management [7]. Finally, some benefits embody protection, speed, accuracy, measurability and stability, and a few disadvantages area unit visual defect, infection, and big-ticket instrumentality etc. finally, it provides associate degree correct and secure methodology of authenticating users onto company systems.

### B. Face Recognition

Face recognition is known as the foremost fascinating and vital analysis fields for the last twenty years attributable to its various applications in access management, enforcement, security, police investigation, automatic recognition [8,19]. However, this recognition of face is a long-standing drawback in laptop vision. Histograms of orientating Gradients (HOGs) [9] and native Binary Patterns (LBPs) have established to be a good descriptor for seeing normally and face recognition. The main benefactions of this work are 1st, to atone for errors in facial feature detection [10] because of occlusions, cause, and illumination changes, we tend to withdraw HOG figures from an everyday grid. Second, we have a tend to establish the need to play acting feature choice to get rid of redundant and immaterial options to form the classification method less at risk of overfitting. The importance lies in overlapping cells, from wherever HOG options are extracted. This method has of 2 parts: computer code and hardware part. The computer code half consists of face-detection and face-recognition algorithms computer code, whereas the hardware half consists of a camera. once someone enters to the zone, a series of snapshots are taken by the came and sent to the computer code to be analysed and compared with an existing info of trustworthy folks.

## II. PROPOSED TECHNIQUES

The system through a series of process is shown in figure 1.

### A. Working of Iris Technology

The steps in identifying and recognizing people using the IRIS go through the following steps: Iris image Acquisition, Pre-Processing, Segmentation, Normalization, Feature Extraction, and Pattern Matching. The steps in distinctive and recognizing individual's exploitation, the iris will undergo into following steps: Iris image Acquisition, Pre-Processing, Segmentation, Normalization, and other which be explained below. Iris recognition system performs segmentation system

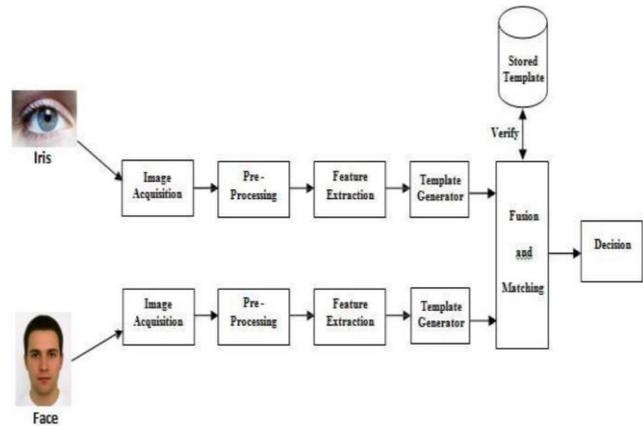


Fig. 1 Block Diagram of Proposed System which will base on circular Hough rework and might localize the iris and region of pupil, eyelids and eyelashes, and reflections. The obtained extracted iris region will be normalized into fixed dimensions of rectangular block.

At the end, the info from Log-Gabor filters was extracted and measure to four levels to inscribe the distinctive pattern of the iris into a bit-wise model. For classification of iris templates acting distance methodology was utilized, and 2 templates were found to match if a check of applied mathematics independence was unsuccessful. Thus, the system performed with perfect recognition on a set of 224 eye images. The working of iris technology can be seen in the figure 2.

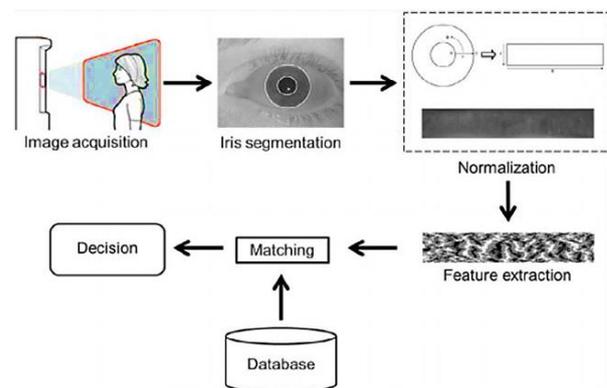


Fig. 2 Working of IRIS Technology

### B. Iris Image Acquisition

A typical iris system consists of optical lens, illuminator, image sensor and electronic control unit. Optical lens abides to the lens imaging geometry, the iris image focused on the image sensor through the lens. The field drop, field of view and focal length are critical to design a suitable lens for iris recognition system. The illumination is another important factor. Most of commercial products use near-infrared (NIR) LED as illuminator. It should note that the intensity should not exceed the safety limit of illumination - defined at about 10 mw/cm<sup>2</sup>.

**C. Pre-processing**

This iris recognition system works on gray scale pictures. So it had RGB or aside from gray scale iris image dataset. Or our image acquisition system provides you the image aside from gray scale pictures then we've got, to vary that image into gray scale image. The image was filtered mistreatment gaussian filter, that blurs the image and reduces effects thanks to noise. the quality deviation decides the degree of smoothening, s and it's taken to be two during this case. This Pre-processing module 1st transforms actuality color into intensity image.

So, the pre-processing consists of 2 steps: Iris Localization, Edge Detection. Before performing arts pattern matching, the boundaries of the iris ought to be settled. In alternative words, it needs to find the part of the image that extends from within the anatomical structure to the skin of the pupil. It ought to begin by determinative the outer reaches by 1st down sampling the pictures by an element of four then use the cagey operator with the default threshold price given by MATLAB, to obtain the image of gradient. By police work edges in a picture reduces the quantity data and filters out useless information, whereas protective the necessary structural properties in a picture.

The canny edge detection algorithmic rule is that the best optimum edge detector. List of support to increase current strategies of edge detection may be a low error rate. The other is that the sting points be localized that's the position among the sting pixels are launch by the detector and the real edge is at minimum. 3rd one is to own just one response to one edge.

**D. Segmentation**

The next stage in this system is to separate the region of iris from image of eye. The iris region could also be separated by two different circles, those are iris and the pupil boundaries. The Hough remodel may be a technique which might be wont to isolate options of a form at intervals a picture. because the desired options to be per some constant kind, the classical Hough remodel is most ordinarily used for the detection of standard curves like lines, circles, ellipses, etc.

**E. Image Normalization**

After segmentation, consequent stage is to normalize this half, to alter generation of the code and with their comparisons. The variations within the eye, like iris size, pupil position amendment person to person, it's needed to normalize the image of iris, so the illustration is common to any or all, with common dimensions. social control method involves in unwrapping the iris and changing it into its polar equivalent. It's done mistreatment rubber sheet model. The pupil inner point is taken to account because the reference and remapping formula is developed to change the points to other scale. Some necessary social control techniques are Daugman's rubber sheet model, Image registration, Virtual circles.

**F. Feature Extraction**

A Dennis Gabor filter as a linear filter in which impulse response is given by multiplying a harmonic operate with a Gaussian operate. a sign is rotten employing a combine of Dennis Gabor filters; with the important half given by modulating a cosine wave with Gaussian wave and therefore the imaginary part of a complex number given by modulating a undulation with Gaussian wave. Frequency of the

undulation or cos wave offers the middle frequency of the filter. Daugman used a 2nd version of Dennis Gabor filters to write the iris texture.

**G. Matching and Classification**

The example generated by the extraction of feature desires an identical metric to live the similarity between 2 iris templates. This metric offers one vary of values once templates generated from a similar eye (intra-class distribution) square measure compared and another vary of values once templates generated from completely different person eye's (inter-class distribution) square measure compared. These 2 distributions ought to provide distinct overacting distance values; in order that we will decide on whether the 2 templates belong to a similar or completely different persons.

**H. Working of Face Recognition Technology**

The process of distinguishing and recognizing folks using the biometric identification goes through the subsequent steps: formula advised for Face Detection, Face Segmentation, Face illustration using HOG, mRMR Feature choice, illustration and Matching.

This face recognition system reads a video from a camera connected to the pc running the software system, detects any face gift ahead of the camera, and so verify if this face is gift within the set of face pictures in an exceedingly information. The software system is split into: face detection and face recognition. The working of face recognition technology is shown in figure 3.

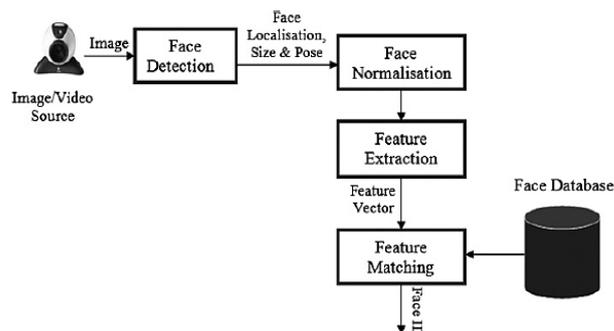


Fig. 3 Working of Face Recognition Technology

**I. Algorithm Suggested for Face Detection**

First, the image is distributed as associate degree input into the software package. This program will convert color mode (RGB) into grayscale then resizes it. a footing detection operation is then performed by scheming the image gradient. The gradient of a picture is found by the Sobel operator, that will generate a mask by employing a threshold price. Then the edge price is got by the mean of all gray values within the image. subsequent step is dilation operation that makes the borderlines thicker, followed by a filling technique to fill the opening within the face. once filling, holes erosions followed by dilations square measure applied to urge eliminate the opposite smaller objects within the image and maintain the region of interest intact. Finally, the image is resized to its original size.



The whole process is shown in figure 4.

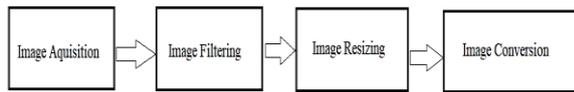


Fig. 4 Algorithmic flow of Face Recognition System

#### b) Face Segmentation

The main aim of image process is to retrieve needed info from the given image during a manner that it'll not effect on the opposite options of that image. De-noising of a picture by using filter is the most valued step need to satisfy the necessity. The segmentation will divide a picture into many non-overlapping regions. That provide same characteristics as gray level, color, tone, texture celebrated techniques of image segmentation that area unit still being employed by the researcher area unit Edge Detection, Threshold, Histogram, Region primarily based strategies, and Watershed Transformation.

#### J. Face Representation Using HOG

The algorithmic program for extracting HOGs counts occurrences of edge orientations in an exceedingly native neighborhood of a picture. In our case, the image is initial divided into tiny connected regions, known as cells, and for every cell a bar chart of edge orientation is computed. The bar chart channels area unit equally touch 0-180° or 0-360°, counting on whether the gradient is 'unsigned' or 'signed'. The bar chart counts area unit normalized to complete illumination. this could be done by accumulating a live of native bar chart energy over the somewhat larger connected regions and mistreatment the results to normalize all cells inside the block. Then that mixture of those histograms represents the ultimate HOG descriptor. Invariableness to scale and rotation can be achieved by taking descriptors from solely salient points within the scale area of the image rotation standardization. The steps concerned are: Scale-space detection, Orientation assignment, Descriptor extraction.

#### K. mRMR Feature Selection

To select the candidate feature set, we compute the cross-validation classification error for many features and find a relatively stable range of small error. This range is called  $\Omega$ . The optimal number of features of the candidate set is determined within  $\Omega$ .

#### L. Representation

The system interprets the facial knowledge into a novel code. This cryptography method permits for easier comparison of the recently nonheritable facial knowledge to hold on facial knowledge.

#### M. Matching

The freshly noninheritable facial information is compared with the keep information and joined to a minimum of one keep facial illustration. The system maps the face and creates a brand-new face print, a novel numerical code for that face. Once the system has stored a face print, it can compare it to the thousands or millions of face prints stored in a database. Each face copy is stored as an 84-byte file.

### III. RESULTS AND DISCUSSION

#### A. Results for Iris Recognition

Stage 1: In initial stage human face is detected from original image and it is cropped from the original image this is shown in figure 5.



Fig. 5 Original and cropped image

Stage 2: From the face detected image, eyes are detected and cropped shown in figure 6 (from the original image).



Fig. 6 Cropped eye image

Stage 3: Right eye is detected from the eye image and cropped from it. Then RGB image is converted to grey scale image shown in figure 7.



Fig.7 Conversion of RGB Image to Gray image/ Cropping Single Eye image

Stage 4: Median filtration is done after conversion of gray scale to remove noise as shown in figure 8.



Fig.8 Filtration of Cropped Image

Stage 5: Deletion of extra portion from the cropped eye image as shown in figure 9.

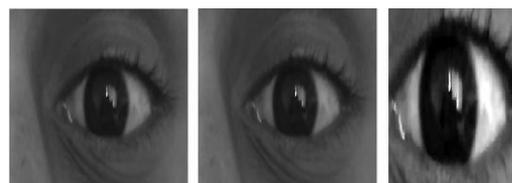


Fig.9 Deleting extra portion image

Stage 6: Extracting the pupil and the iris from the eye image, marking with red and blue respectively as shown in figure 10.

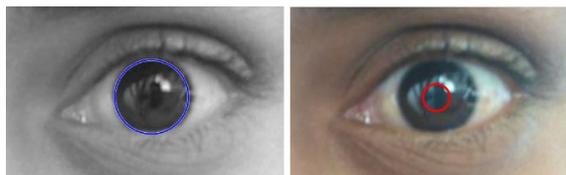


Fig.10 Iris & pupil extraction image

Stage 7: Smoothing of image for proper normalization and applying the rubber sheet model on the extracted iris region as shown in figure 11.



Fig.11 Smoothed and rubbersheet normalization image

Stage 8: Applying Gabor filter on the normalized extracted iris region and performing wavelet Encoding as shown in figure 12.

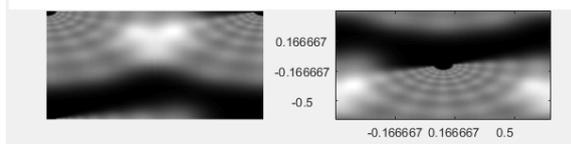


Fig. 12 Combined Frequency Response of the Bank & Zero Frequency Shifted to Center image

**B. Results for Facial Recognition**

Stage 1: Collecting images from the database and showing in montage format as shown in figures 13.



Fig. 13 Images in the database 1&2



Fig. 14 Images in the database 3&4



Fig. 15 Image in the database 5

Stage 2: Extracting HOG feature from the given input face as shown in figure 16.



Fig. 16 Extracted HOG Feature

Stage 3: Matching with the database and showing the query image and matched image side by side as shown in figures 17 to 20.

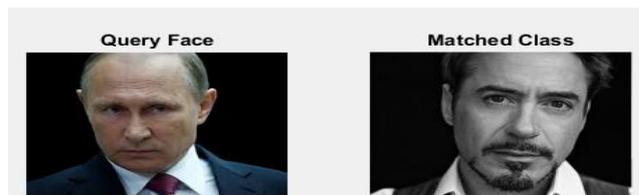


Fig.17 Query face & matched class image for database 1



Fig.18 Query face & matched class image for database 2

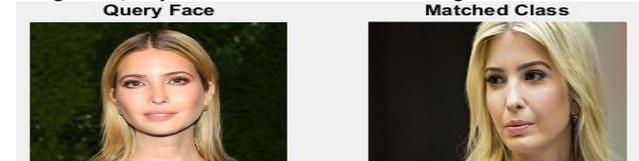


Fig.19 Query face & matched class image for database 3



Fig.20 Query face & matched class image for database 5

#### IV. CONCLUSION

The demand of Multi Biometric technology is growing speedily. This can be true in security applications, like those which is used at some airports and government places. To method massive a lot of numbers of people, a biometry answer should be quick and non-intrusive. Multi- Biometric permits the verification up to thirty folks per minute from many feet. The scanned people haven't any needn't to prevent. Compare this with associate degree expected through out of ten to fifteen folks per minute with high-end hand or fingerprint scanners. This multi- biometric system uses 2 or a lot of form characteristics which ends during a abundant higher security and authentication level. Face and iris verification are simple and most generally enforced safety measures. completely different biometric techniques area unit compared to depict that Face and iris recognition systems have lower error rates. Also, these 2 techniques combination will result the final word biometric authentication system with high accuracy rates.

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