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Iris Recognition using Feature Detection Techniques in Matlab Simulink Model Blockset

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Abstract: ***The biometric identification system is one of the technologies used in the recognition system. Iris recognition system is the most reliable system for an individual identification. Nowadays, many applications have been implemented with this feature such as the time attendance system for high security environment, hospitals, airports, government agencies, educational facilities, and etc. The conventional method applied on the security is not reliable such as the passwords may be forgotten or hacked and ID cards may be lost or forged. Iris-based biometric authentication is gaining importance in recent times. Iris biometric processing however, is a complex process and computationally very expensive. In the overall processing of iris biometric in an iris-based biometric authentication system, feature selection is an important task. This approach is based on the iris and the retina of the eye. The iris and retinal patterns are captured via a camera or video-based image acquisition system. The uniqueness of an individual's iris and retinal patterns helps in identifying and verifying the user. In Iris recognition authentication process, iris and retina are used as the previous inputs using to recognize the eye with different mechanisms like opening operation, edge detection, histogram equalization and median filter. In this paper, entirely biometric-based personal verification and identification methods have gained much interest with an increasing accent on safety. Iris recognition using feature detection techniques in Matlab simulink model blockset. The iris texture pattern has no links with the genetic structure of an individual and since it is generated by chaotic processes externally visible patterns imaged from a distance. Iris patterns possess a high degree of randomness and uniqueness. Video and Image Processing Blockset is a tool used for the rapid design, prototyping, graphical simulation, and efficient code generation of video and image processing algorithms. The developed process involves object feature identification, detection. In this paper present an approach to feature Detection Method.***

Keywords: ***Matlab Simulink Model, Opening operation, Histogram Equalization, Median Filter, Edge Detection, Iris Recognition, Feature Extraction, Video and Image processing.***

I. Introduction

This document aims features extraction for iris and retinal pattern using video and image processing Blockset in Simulink Environment of Matlab. The Video and Image Processing Blockset contains blocks that perform morphological operations (opening), edge detection, histogram equalization and median filter. The combination of these blocks is used to perform morphological image analysis. Morphology is the study of the shape and form of objects. Morphological image analysis can be used to perform image filtering, image segmentation, and measurement operations. A Simulink model has been developed using different image processing blocksets. The Median Filter block replaces the central value of an M-by-N neighbourhood with its median value. The Median Filter block can remove salt-and-pepper noise from an image without significantly reducing the sharpness of the image. The Histogram Equalization block enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram. The Edge Detection block finds the edges in an input image by approximating the gradient magnitude of the image. The block convolves the input matrix with the Sobel, Prewitt, or Roberts's kernel. The basic effect of an opening is somewhat like erosion in that it tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels. However it is less destructive than erosion in general. As with other morphological operators, the exact operation is determined by a structuring element.

The remainder of the paper is organized as follows. Section 2 briefly presents the related work. Section 3 briefly describes the experimental environment being used for this study. Section 4 presents the approach of extract features in the input iris image. Section 5 draws the conclusion.

Design framework of a biometric system:

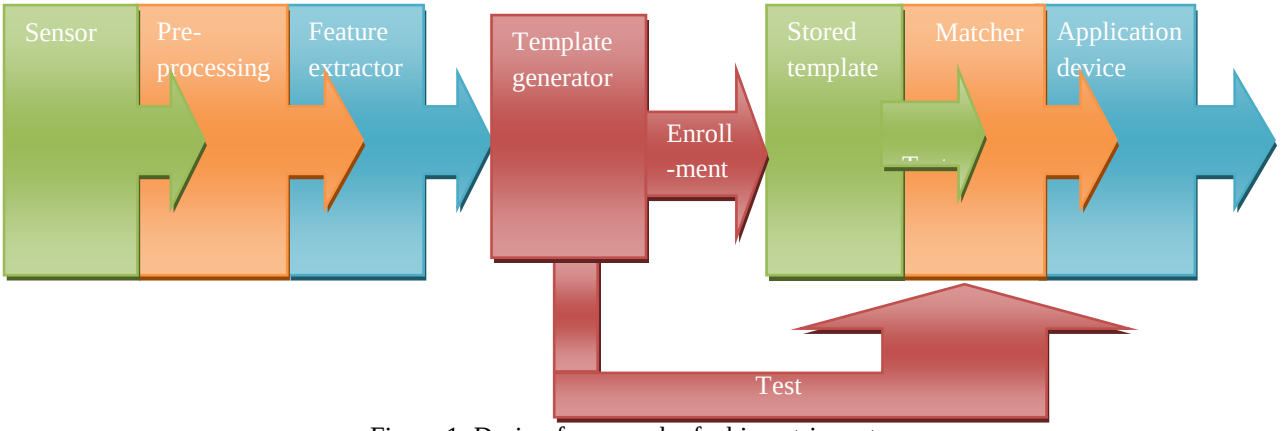

Figure 1: Design framework of a biometric system

Table 1: Description of steps in a biometric system based on the framework in figure 1

Step	Description
1. Capture biometric data	The biometric data is presented to the capturing device by the user.
2. Pre-processing stage	The biometric data is captured and pre-processed by enhancing the input from the sensor, removing any background noise or any piece of input that is not required. Normalization is done on the input stream to enhance quality and correct any deformity in the input stream in order to attain the desired format for efficient feature extraction.
3. Feature extraction	The pre-processed data is then further worked upon and features extracted in an optimal way as all the data captured is not necessarily essential for biometric evaluation.
4. Template creation	A template is created from all the relevant characteristics extracted from the user. Elements of the biometric data that are not required for the comparison algorithm are purged from the template to reduce file size and protect the identity of the user.
5. Storage of the template	The template is then stored in retrievable databases, which can be accessed while performing the matching process.
6. Matching/ test phase	This step involves using an algorithm to perform a comparison between the obtained biometric template and the stored template in the system to determine a match. The output of the comparison is then passed on to some application device.

II. Related Work

Jayachandra et al. [1] presented in this paper presented the basics of image processing. There are few biometric systems are available in world like finger prints, palm, signature, face, DNA, retina, ear and iris. Iris recognition is the process of recognizing a person by analyzing the random pattern of the iris images. Identity of verification and authentication of person is increasing rapidly for this iris recognition is the one of the best biometric system.

Saini et al. [2] presented in this paper Biometric Identification mode the system performs a one-to-many comparison against a biometric database in attempt to establish the identity of an unknown individual. So in electronic transactions biometric authentication is very much popular and secure. This must be encouraged and used in more and more systems. This technology is used by many countries, starting in 2005; US passports with Facial (image-based) biometric data were scheduled to be produced.

Garg et al. [3] discussed Iris-based biometric authentication is gaining importance in recent times. Iris biometric processing however, is a complex process and computationally very expensive. In the overall processing of iris biometric in an iris-based biometric authentication system, feature selection is an important task. In feature selection, we extract iris features, which are ultimately used in matching.

Pradeep Kumar [4] in this paper addressed the problems motivated by the existence of noise in the captured iris images and the correspondent increase of the error rates, with particular relevance to the false rejections, in the context of non cooperative iris recognition. Also fake identification is introduced for the lens images fixing over the iris portion.

Li Ma et al. [5] in this paper, we have presented an efficient algorithm for iris recognition which is invariant to translation, scale and rotation. This method regards the texture of the iris as a kind of transient
signals and uses the wavelet transform to process such signals. The local sharp variation points, good indicators of important image structures, are extracted from a set of intensity signals to form discriminating features.

Elsherief et al. [6] discussed in this paper Iris recognition, as an emerging biometric recognition approach is becoming a very active topic in both research and practical applications, Iris recognition is the process of recognizing a person by analyzing the apparent pattern of his or her iris. A typical iris recognition system includes iris imaging, iris detection,

feature extraction and recognition. In this work, we illustrate the existing techniques utilized at the different stages of the iris recognition process and evaluate their performance.

Yulin Si et al. [7] presented in this paper segmentation algorithms is the in efficiency of eyelash detection. Some real iris textures will be misclassified as eyelashes when there exists sharp contrast in the iris region. Based on directional filters, a new eyelash detection method is proposed with much fewer misclassifications. Second, in the iris feature extraction process, a multi-scale and multi-direction data fusion strategy is introduced in this work, and the combination of adaptive scale selection and improved matching criteria will better describe iris textures. Third, in order to speed up the response time for the 1: N search in a huge iris database, an iris indexing method based on corner detection is presented.

Costa et al. [8] discussed in this paper innovative methodology proposes the extraction of information about the way the human eye reacts to light, and to use such information for biometric recognition purposes. The results presented here demonstrated a minimum accuracy difference between the analyses performed with the full video versus the analysis with the reduced video, particularly in the evaluation by the Recall x Precision. Recognition methods that utilize static iris images provide a high accuracy rate. We did a fair accuracy comparison between a static method (Daugman) and our method using the ten best frames from each video. Considering our acquired images, the DFs presented an excellent performance.

Hsiung et al. [9] presented in this paper the best iris segmentation technique for iris recognition is Hough Transform. The results show that Hough Transform techniques capable to recognize the low resolution iris with the accuracy of 100% compared to the Daugman' s Integro Differential Operator with only 86.88%.

Arora et al. [10] presented in this paper there are several substances such as alcohol, LSD, MDMA, cocaine, and marijuana that affect iris property. Physiologically, these substances temporarily dilate or constrict pupil to a large extent. Iris recognition of a person under influence of these substances, therefore, can be viewed as a form of attack on the integrity of a biometric system. This paper shows that alcohol influence is a new covariate in iris recognition that affects the matching performance significantly. The experiments performed on the *IIITD Iris under Alcohol Influence* database suggest that after alcohol consumption, usable iris area changes due to deformation caused by dilation or constriction. This change is dynamic and varies from person to person.

III. Experimental Environment

A. Matlab

MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities. An additional package, Simulink, adds graphical multi domain simulation and Model-Based Design for dynamic and embedded systems.

B. Video and Image Processing

System objects are algorithms that provide stream processing, fixed-point modelling, and code generation capabilities for use in MATLAB programs. These new objects allow one to use video and image processing algorithms in MATLAB, providing the same parameters, numeric's and performance as corresponding Video and Image Processing Blockset blocks. System objects can also be used in Simulink models via the Embedded MATLAB Function block. Simulink environment provide platform for model-Based Design and code generation out of a user- Friendly block diagram environment. (Fig. 2 and Fig.3) Video and Image Processing Blockset blocks support floating-point, integer, and fixed-point data types. To use any data type other than double-precision and single-precision floating point, you must install Simulink
Fixed Point.

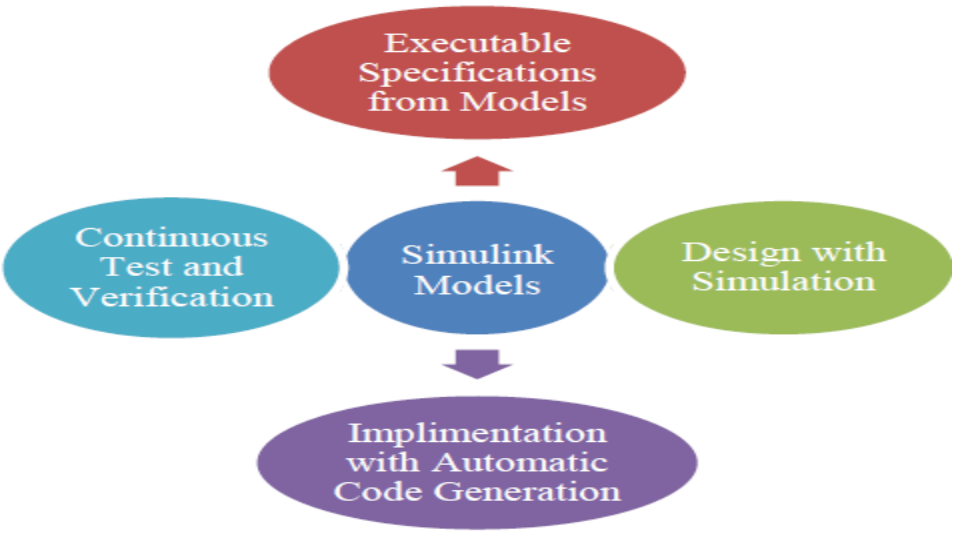

Figure 2: Simulink Model

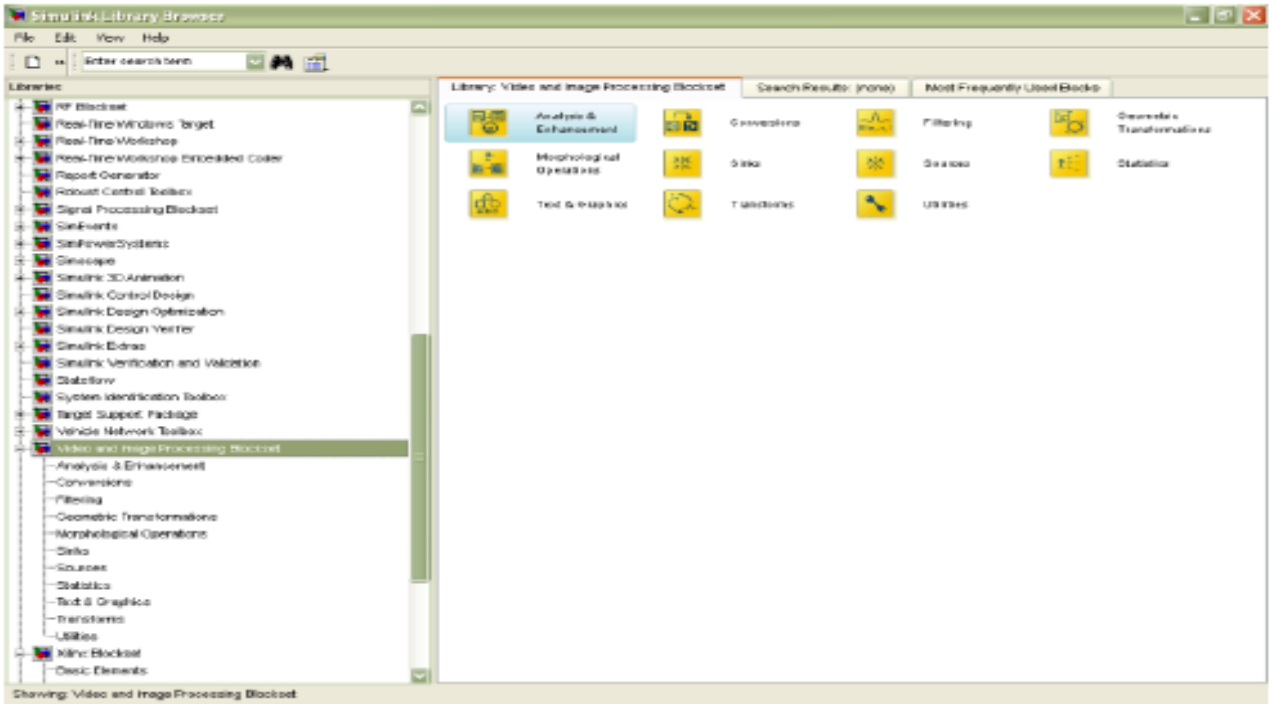

Figure 3: Video and Image Processing Library Browser

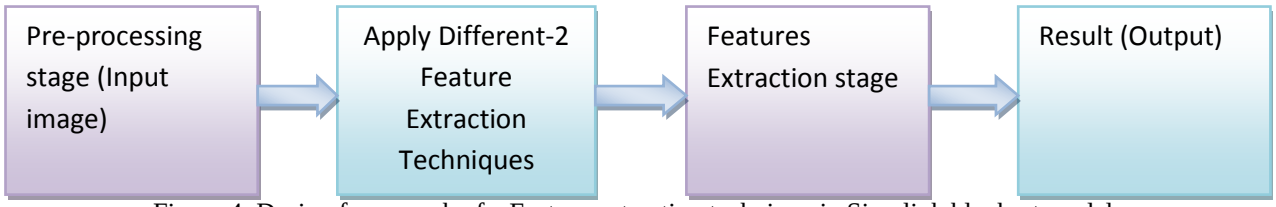

Figure 4: Design framework of a Feature extraction technique in Simulink blockset model

C. Parameters

Opening Operation: The basic effect of an opening is somewhat like erosion in that it tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels. However it is less destructive than erosion in general. As with other morphological operators, the exact operation is determined by a structuring element.

Edge Detection: The Edge Detection block finds the edges in an input image by approximating the gradient magnitude of the image. The block convolves the input matrix with the Sobel, Prewitt, or Roberts's kernel.

Median Filter: In image processing, it is often desirable to be able to perform noise reduction in image or signal. Median filtering is very widely used in digital image processing because it preserves edges while removing noise. From the gray scale image remove the noise data like lightning, illusions, blurred data etc.

Histogram Equalization: The Histogram Equalization block enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram.

IV. Experiment and Results

An iris image is imported. Then, using the Opening, Edge Detection, Median Filter and Histogram Equalization Blocks, the features are extracted in the image.

1. Import an iris image from MATLAB using from multimedia file in video and image processing Blockset. (Fig. 5)

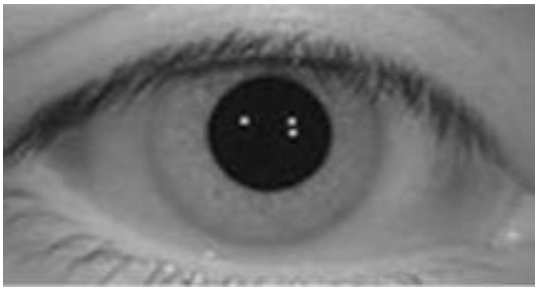

Figure 5: Iris Image

2. Create a new Simulink model, and click-and-drag the following blocks into it. (Table 2)
3. The unconnected blocks are arranged as shown in the figure. (Fig. 6)

Table 2: Blocks Quantity

Block	Library	Quantity
From Multimedia File	Video and Image Processing Blockset/Sources	1
Video Viewer	Video and Image Processing Blockset/Sinks	5
Opening	Video and Image Processing Blockset/Morphological Operations	1
Edge Detection	Video and Image Processing Blockset/Analysis and Enhancement	1
Median Filter	Video and Image Processing Blockset/Analysis and Enhancement	1
Histogram Equalization	Video and Image Processing Blockset/Analysis and Enhancement	1
2-D Histogram	Video and Image Processing Blockset /Function Block	2
Reshape	Simulink/Math Operations	2
In1 Block	Simulink/Source	2
Out1 Block	Simulink/Sinks	2
Matrix Concatenation	Simulink/Math Operations	1
Histogram	Video and Image Processing Blockset/Statistics	1

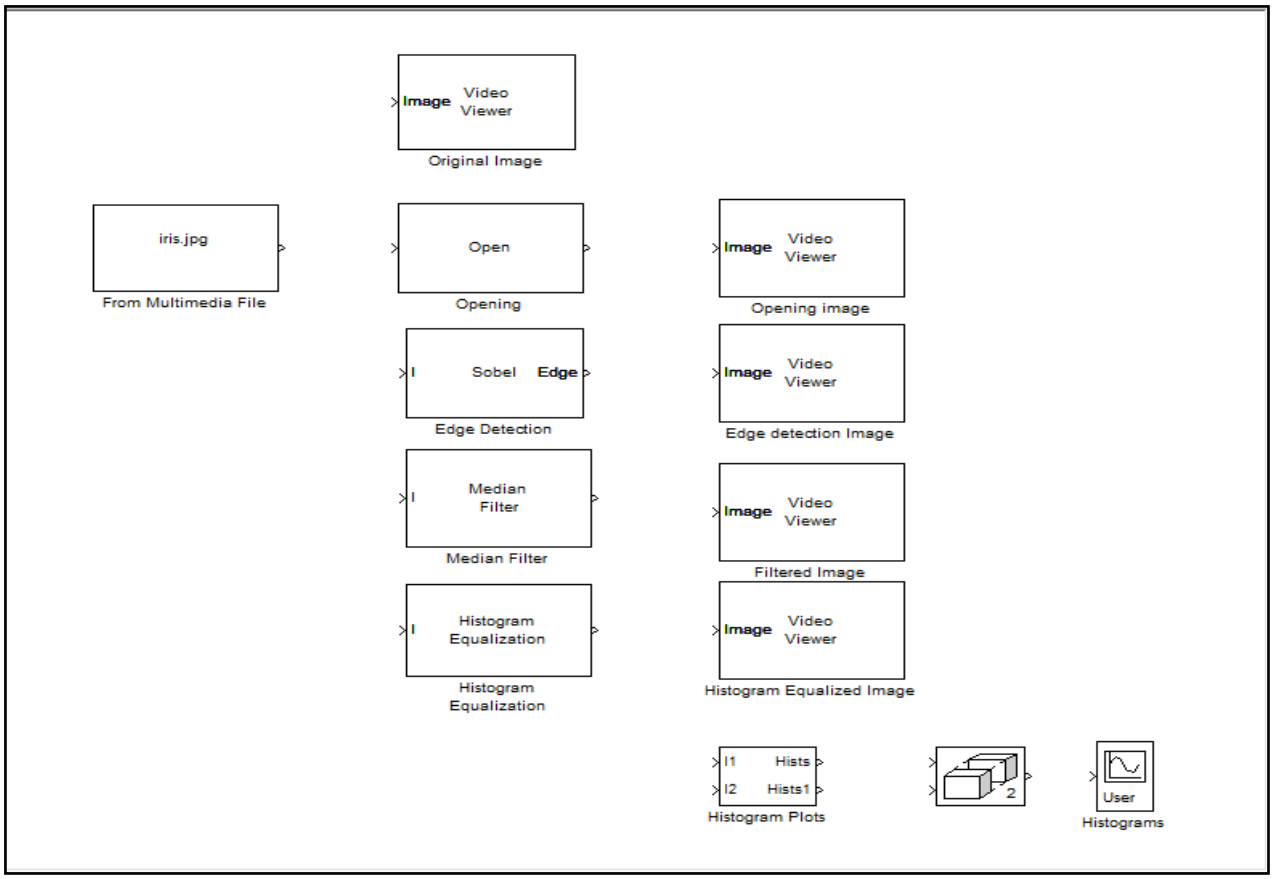

Figure 6: Unconnected Blocks

4. Perform morphological opening on an intensity or binary image. Use the Neighbourhood or structuring element parameter to define the neighbourhood or structuring element that the block applies to the image. Use the default Parameters.
5. Finds the edges in an input image using Sobel, Prewitt, Roberts, or Canny methods. The block outputs a binary image, a matrix of Boolean values, where pixel values equal to 1 correspond to edges. Use the default Parameters.
6. Performs Median filtering of input matrix I. Use the Neighbourhood size parameter to specify the size of the neighbourhood over which the block computes the median. Use the default Parameters.
7. Enhance the contrast of input image using histogram equalization. Use the default Parameters.
8. Matrix Concatenate input signals of the same data type to create a contiguous output signal. Select vector or multidimensional array mode. Use the default Parameters.
9. Histogram Display a vector or matrix of time-domain, frequency-domain, or user-specified data. Each column of a 2-D input matrix is plotted as a separate data channel. 1-D inputs are assumed to be a single data channel. Use the default Parameters.
10. Video Viewer block is used to view the results like Original image, Opening image, Edge detection image, Filtered image and Histogram Equalization image.

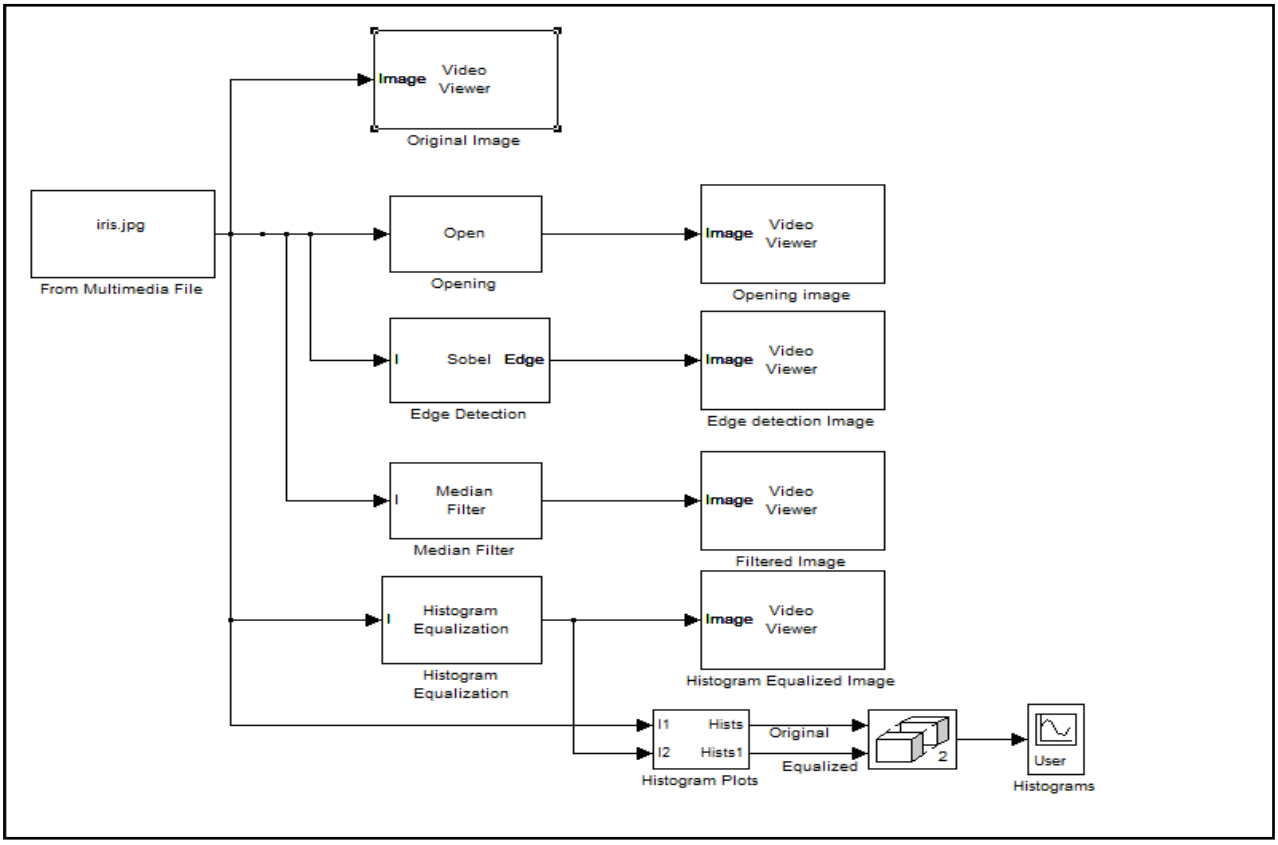

Figure 7: Feature Extraction Techniques

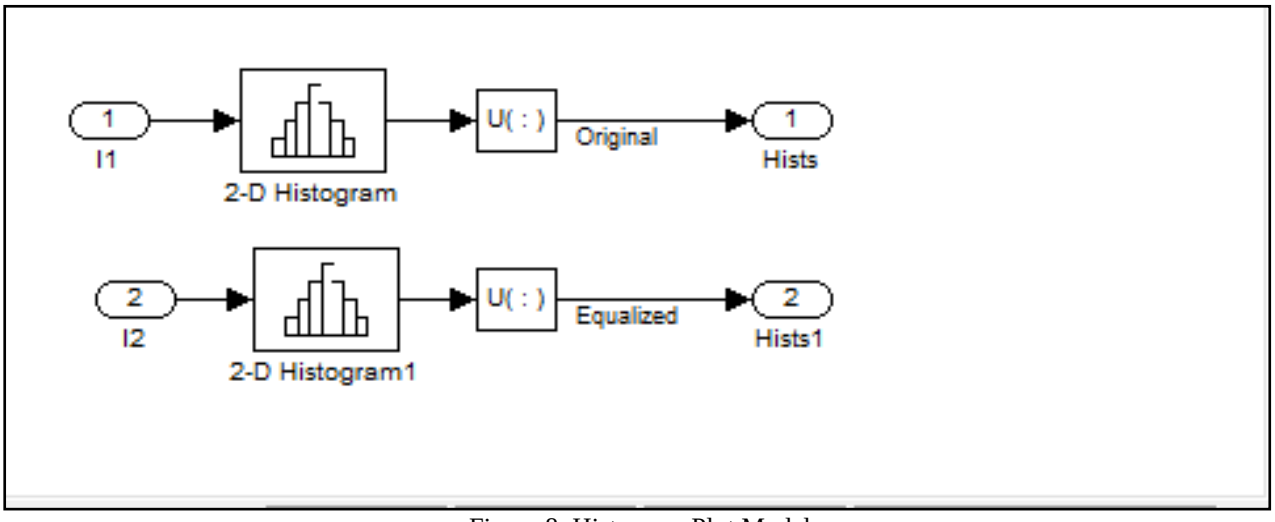

Figure 8: Histogram Plot Model

Results:

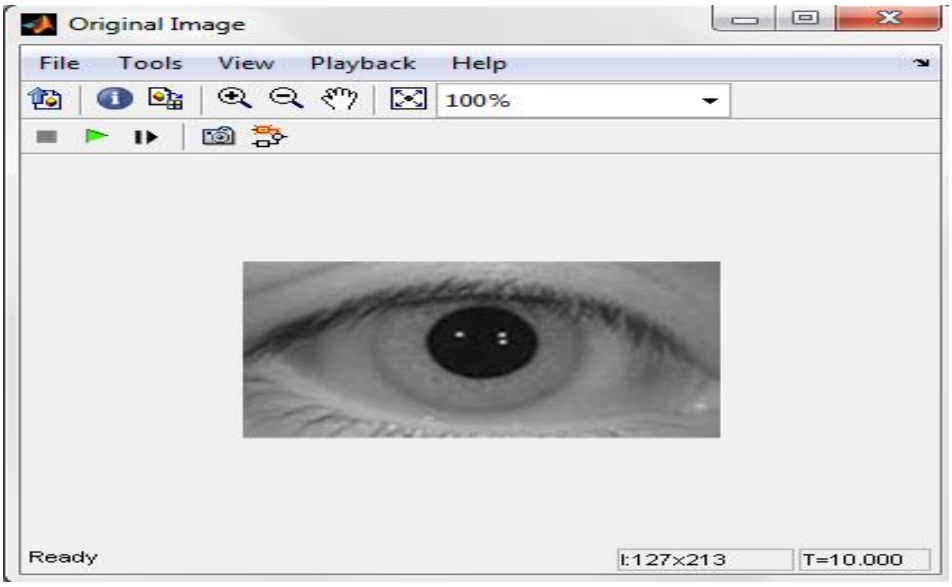

Figure 9: Original Image

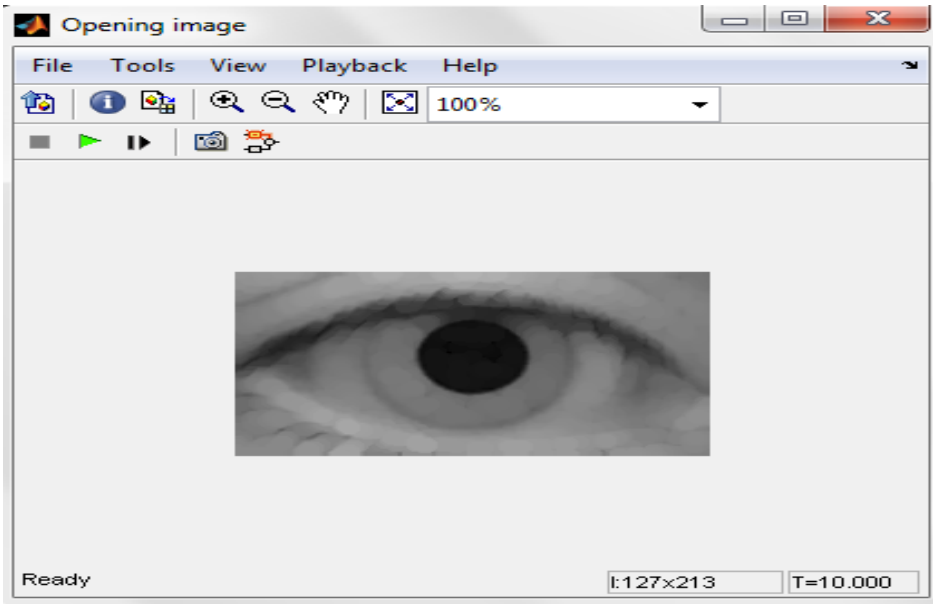

Figure 10: Opening Image

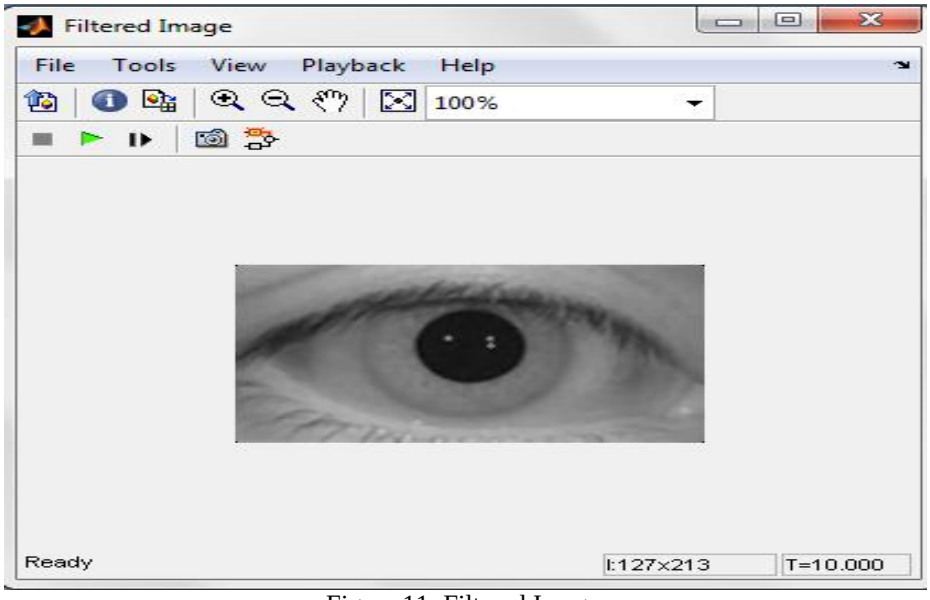

Figure 11: Filtered Image

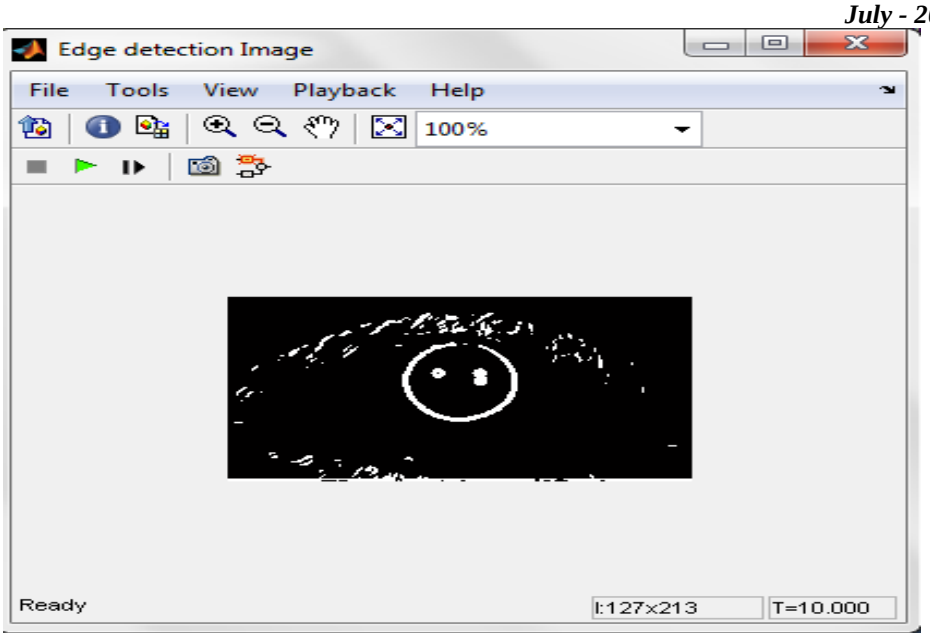

Figure 12: Edge Detection Image

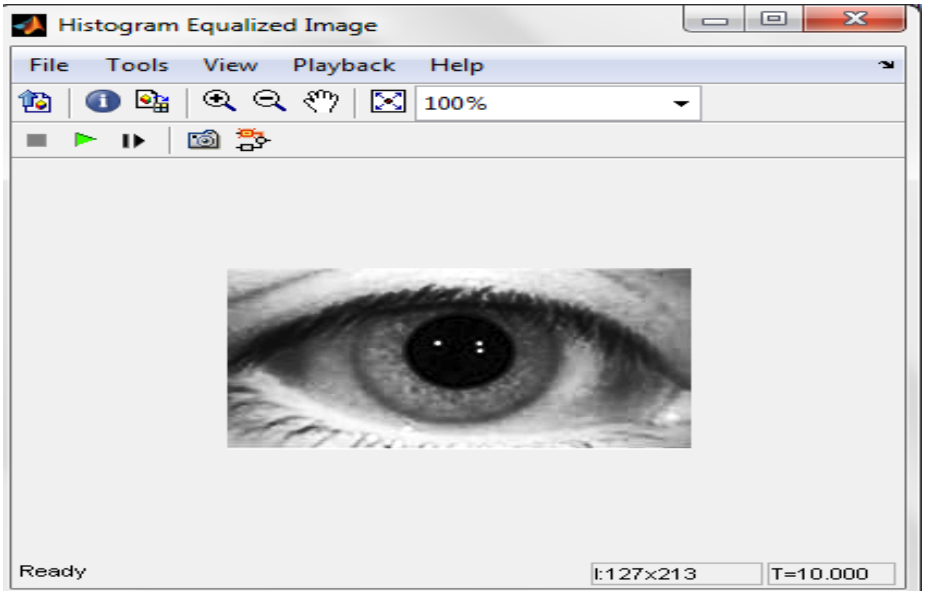

Figure 13: Histogram Equalized Image

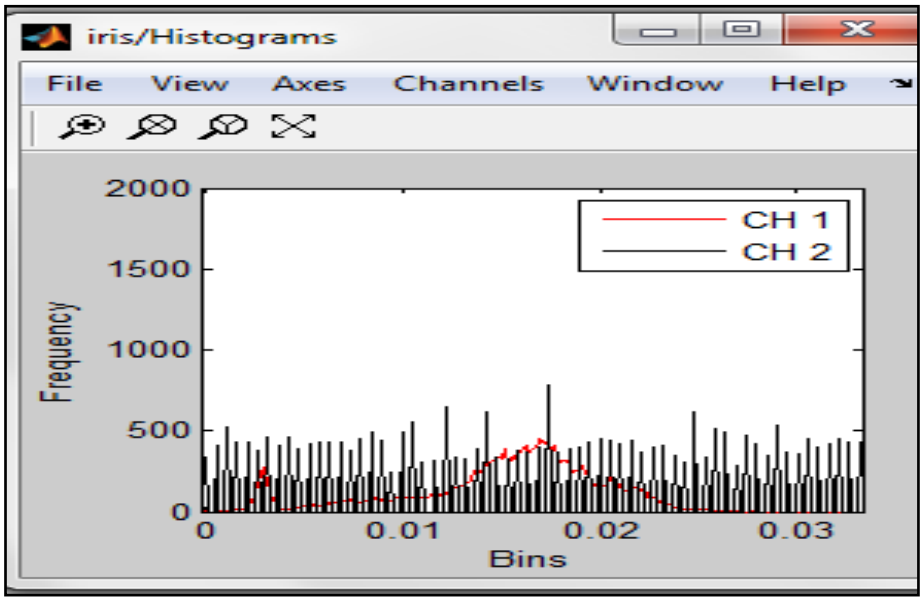

Figure 14: Histogram Plot (Here CH1 Original image and CH2 Equalized image)

V. Conclusion

In this paper, a video and image processing algorithm suitable for iris recognition has been suggested and analyzed. The developed Simulink model is reliable and can perform extract features. This Simulink model will be useful to detect the features in any iris image. Hence, the suggested technique proves to be an efficient solution for detect features. This approach is based on Sobel edge detection, Opening operation, Histogram equalization and Median filter. It guarantees the effective pupil detection to get accurate iris identification. We described a method for the feature extraction that takes into account the typical characteristics of the images, namely their noise regions determined by the imaging environment. This document stress that this approach is compatible with different imaging environments, since each recognition system will select a proper sub set of features that are further taken into account in the recognition process, through the comparison with the correspondent enrolled features. Biometrics is typically defined as the study of methods of making measurements of physical, biological or behavioural attributes that can be used to identify a person. Within the field of biometrics, fingerprint, face and iris are often thought of as the current major general purpose methods. This perception is reinforced by the fact that the Unique ID, or "Aadhaar", project currently in progress in India aims to acquire face, fingerprint and both irises for all of the approximately 1.2 billion residents of India.

Advantages and drawbacks of various biometric systems:

Biometric system	Advantages	Drawbacks
Finger print verification-based recognition	This approach is a proven and highly accurate one. Hence it is used widely and has the ability to enrol multiple fingers. The system comes with a wide range of deployment environments.	The verification system reminds one of law enforcement in the minds of the users. Impaired or damaged fingerprints can be difficult to verify. Standards for interoperability need to be established.
Iris and retinal scanning-based recognition	Operations are highly reliable and hands free and the characteristic remain stable over a lifetime.	This is a highly sophisticated technology that needs proper training. Sometimes glasses with strong lenses can impact the performance of the system.
Hand geometry-based recognition	This can operate in challenging environments. It is perceived as a non-intrusive and highly-established technology.	Complications might arise when used with certain populations. There can be a perception of bio-hazard due to potential spread of germs. Possible changes to the shape of the hand can lead to failed authentication.
Facial recognition	This can operate without user compliance, work from a distance, and leverage existing image databases to establish identity.	The system is susceptible on error. Non-matching depends on factors such as lighting, camera angle and facial alterations caused by surgery, accidents and the like.

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