https://www.ijsrtm.com
Vol.1 Issue 1 Dec 2021: 14-19
Published online 11 December 2021
E-ISSN: 2583-7141

International Journal of Scientific Research in Technology & Management

A Review on Implementation of Biometric Iris Recognition

Monika Singh
Dept. of Computer Sceience & Engineering
Oriental Institute of Science & Technology
Bhopal, Madhya Pradesh, India
monika1204singh@gmail.com

Sanjeev Kumar Sharma
Dept. of Computer Sceience & Engineering
Oriental Institute of Science & Technology
Bhopal, Madhya Pradesh, India
sanjeevsharma@oriental.ac.in

Abstract*— Biometric is considered as an authentic system to recognize a human with respect to their behavior and body features. Automatic verification of features like finger print, palm print, iris recognition is considered a proficient way to grant an access to any system. Among all those, iris is taken as one of the admired technique of recognition which needs precise recognition to execute the whole system. To extract those features which exists in the texture of eye and identify it with the existing database requires various methods to get performed like segmentation, preprocessing, normalization etc. For all those methods, various algorithms have been developed and their effectiveness varies according to the circumstances in which they have been applied. This paper proposes a review on various systems and their developed technique on which researchers have previously worked. Due to several issues, methods which have been developed, till now, can't consider for wide implementation. So, the system which has been proposed in this paper provides an iris recognition or authentication system using Savitzky-Golay filter for iris feature extraction. A Savitzky–Golay filter is a digital filter that can be applied to a set of digital data points for the purpose of smoothing or enhancing the data without distorting the information. The approach also proves that the symbolic representation effectively handles noise and degradations, including low resolution, specular reflection, and occlusion of eyelids present in the eye images and uses minimum number of features to represent iris image. This system can be implemented in various fields such as banking, security concern areas and many more. Major Canadian Airports have been using Iris recognition systems to expedite passengers through customs.

Keywords*— Biometric System, IRIS recognition, Savitzky-Golay Filter, Eye Lids, Feature Extraction.

I. INTRODUCTION

Iris recognition technique evolves various stages to get it precisely detected, which includes image acquisition in which wavelength of light, light reflected from the base of iris and some other factors are considered. Preprocessing is the next stage of recognition in which boundaries and other parts of an eye are taken into account with enhanced image quality. Image segmentation which includes the analysis of background texture, image normalization is used to change the intensity value of pixels obtained from an image. Feature extraction is considered as a crucial stage of recognition, as it extracts the vectors of those areas of an image which is taken under consideration. Final stage is matching where the acquired data in terms of coding from previous stage is compared with the existing information stored in the database to accomplish the recognition process. Various algorithms have been developed to execute those operations of localization, preprocessing, normalization, feature extraction and matching. Some of the known approaches are canny edge detector, Circular Hough transform, Daugman's Integro-differential operator, Gabor filter and many more. Several researches took place which extracts those approaches with some internal modification to develop an ideal system but for the implementation on wide applications, some flaws limit those systems.

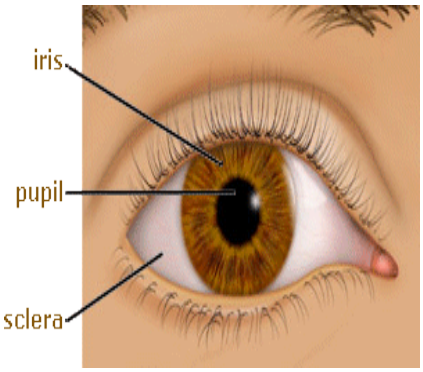


Fig. 1. Features of Eye [9]

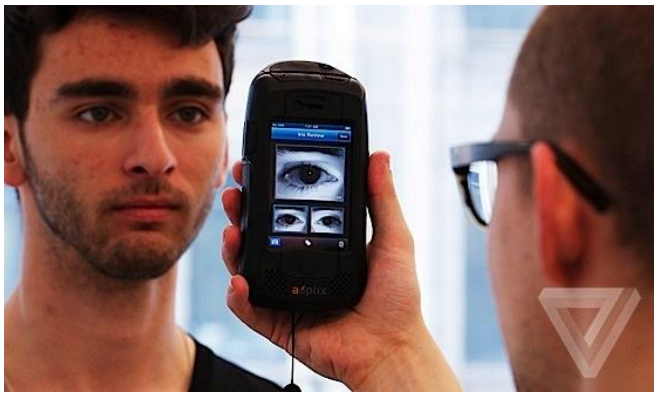


Fig. 2. Iris Biometric Authentication Application [13]

The process of iris recognition involves several crucial stages of image processing that transform a raw image into meaningful data used for biometric authentication. The first and most fundamental step is image acquisition**,** where frames are captured to extract digital information from the iris region. Without accurate acquisition, subsequent steps cannot be performed effectively. Once an image is obtained, the next stage is image pre-processing**,** which aims to enhance the quality of the image by removing noise, correcting distortions, and improving features that are significant for further analysis. Pre-processing ensures that the image is in an optimal form for the following steps.

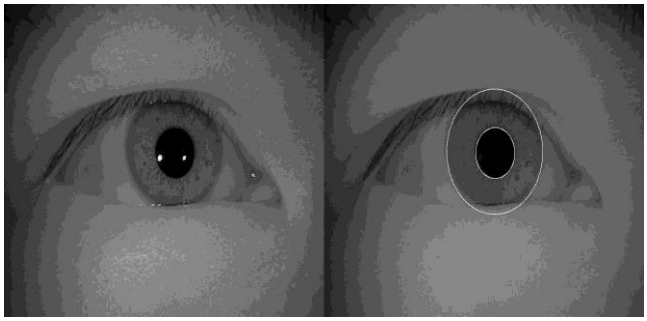


Fig. 3. Segmentation of Iris [10]

After pre-processing, the process advances to image segmentation, where the image is divided into multiple segments or sets of pixels, often referred to as super-pixels. This segmentation simplifies the image structure, making it easier to identify and isolate the region of interest, such as the iris, while excluding irrelevant areas like eyelids, eyelashes, or reflections. Segmentation thus provides a clearer, more meaningful representation of the iris pattern. To standardize the data further, normalization is applied, which adjusts the range of pixel intensity values to achieve consistency across different iris images. This process, sometimes called contrast or histogram stretching, ensures that variations in illumination or image capture do not affect the recognition accuracy. By normalizing the image, the system enhances uniformity, making the extracted features more reliable. The most critical stage is iris feature extraction, where the normalized iris image is transformed into a set of mathematical parameters. The iris is rich in unique textures, including stripes, rings, freckles, coronas, crypts, radial furrows, zigzag collarettes, and other intricate patterns. These distinctive characteristics are encoded into feature vectors, which serve as a unique representation of each individual's iris. The extraction process ensures that even small details are captured for accurate comparison. Finally, the system proceeds to classification, the concluding stage of the biometric recognition process. Here, the extracted iris features are compared with templates already stored in the database. This comparison determines whether the input image matches an existing template, thereby confirming or rejecting the individual's identity. Classification ensures that the biometric system can perform secure and reliable authentication, making iris recognition one of the most accurate forms of biometric identification.

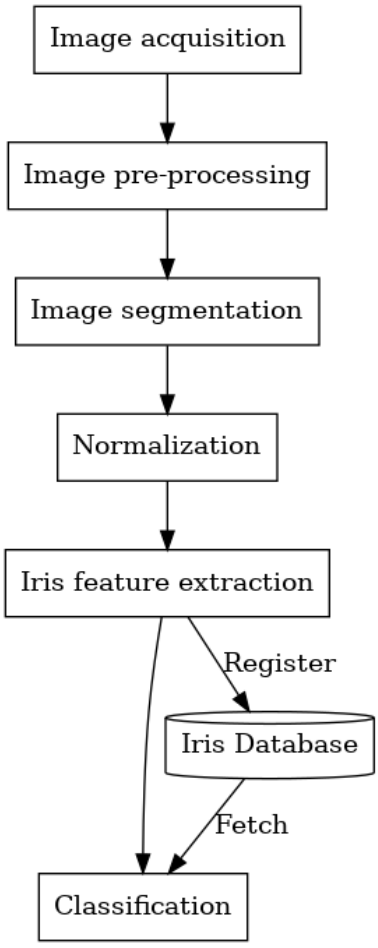


Fig. 4. Typical Iris Recognition Process [12]

The flowchart illustrates the complete workflow of an iris recognition system, beginning with image acquisition, where the iris image is captured for analysis. This is followed by image pre-processing, which enhances image quality by reducing noise and distortions, preparing it for the next stage of image segmentation, where the iris region is isolated from other parts such as the eyelids or eyelashes. Once segmented, normalization is applied to standardize the iris image and adjust intensity variations, ensuring consistency across samples. The process then moves to iris feature extraction, where unique iris patterns such as stripes, crypts, and furrows are converted into numerical features. These extracted features are either registered into the iris database for storage or later fetched for comparison during the classification stage, where the input features are matched

against stored templates to verify or identify an individual's identity.

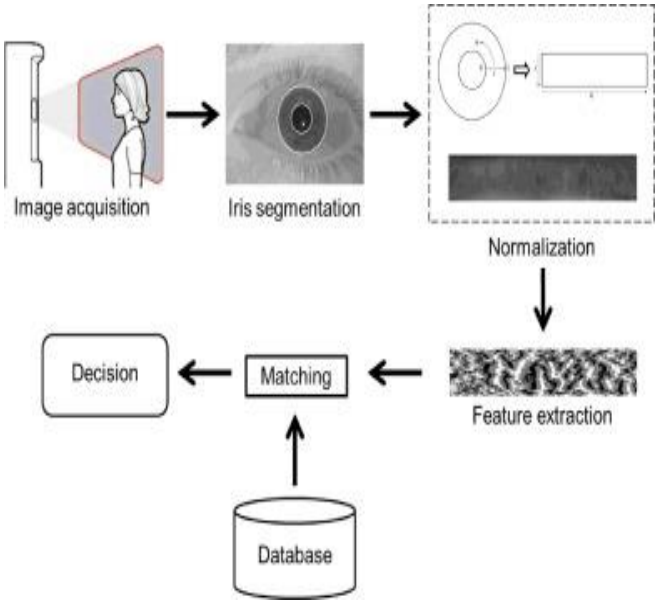


Fig. 5. Iris Recognition Process

II. Related Works

A. Related Works

Fabián Rolando et al. [1] developed a method for biometric iris recognition system which elaborates the segmentation and normalization process. Exploitation of these processes extracts the features of an eye. Implementation of segmentation algorithm took place by utilizing Gabor filters and Hough Transform. Gabor filter is a form of linear filter which is specifically used for the analysis of texture. Hough transform is a technique used to isolate the extracted features of an image. Accuracy of Hough transform relies on the number of accumulator cells, as the number of cells increases, accuracy will be enhance. Increment in number of cells will consume memory. The result shown in the paper which has been proposed stated that because of the variation in intensity between iris region and pupil, exploited algorithm for edge detection doesn't make proficient identification which increases the rate of error. Though the overall system is very comprehensive and not adequate for real time implementation as the result of implemented method may fluctuates.

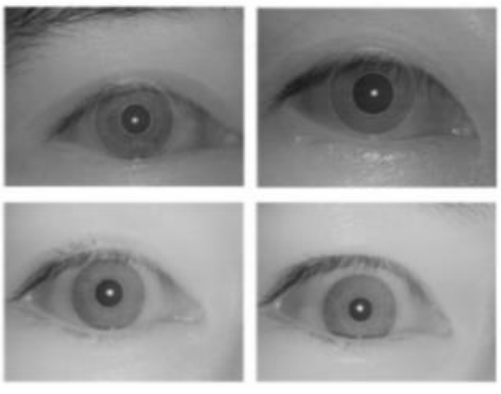


Fig. 6. Segmentation Procedure [1]

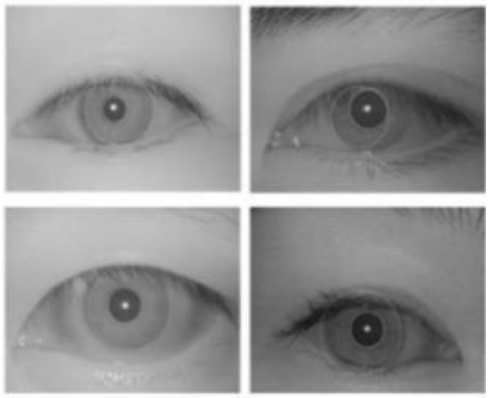


Fig. 7. Failed Segmentation to Correctly Locate Iris [1]

Arezou Banitalebi Dehkordi et al. [2] proposed a technique which uses multiple thresholding process for the identification of eyelids. Eyelash textures and light reflection and pupil pixels. Proposed work for Iris identification system depends on normalization and segmentation methods proposed by Daugman.

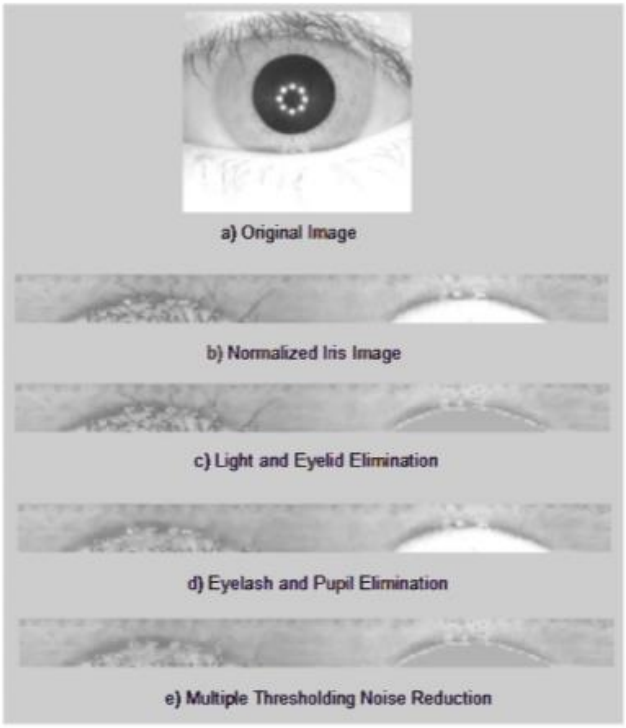


Fig. 8. Example of results of the proposed noise reduction method [2]

Evaluation of threshold values associated with those noises is acquired by the histogram of normalized iris image. Reduction of noise from the acquired image of iris took place in four distinct steps which includes: Preprocessing Stage, Segmentation Stage, Normalization and Noise Reduction Stage. Nevertheless the proposed method is able to efficiently reduce noise from images which contain normal eyelids shown in fig 8. But using this algorithm, such images that contain heavy eyelashes and obstruct the appearance of iris are not properly filtered shown in fig 9.

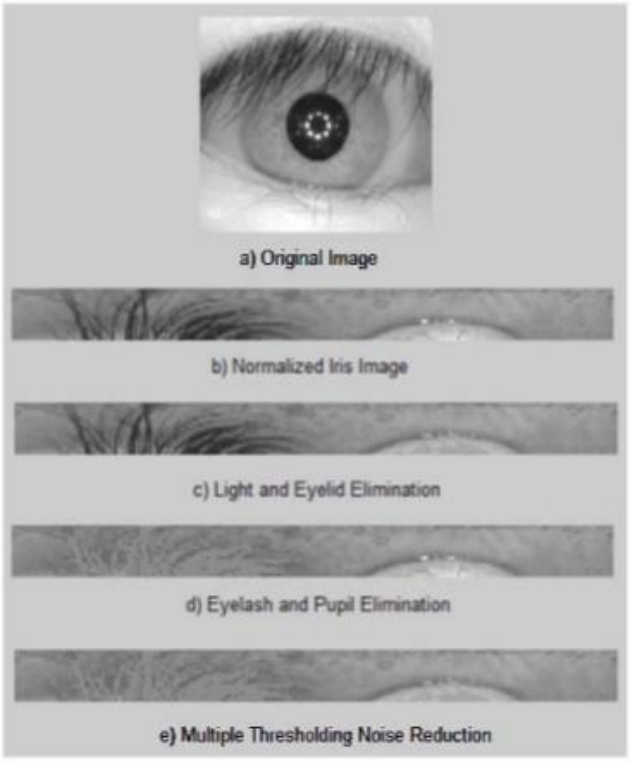
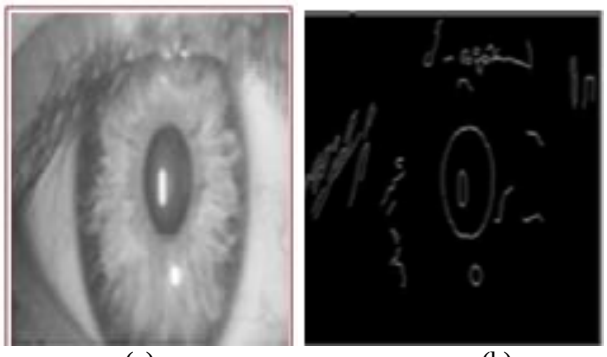


Fig. 9. Example of application of the proposed method against an iris image corrupted with strong eyelash pixels [2]

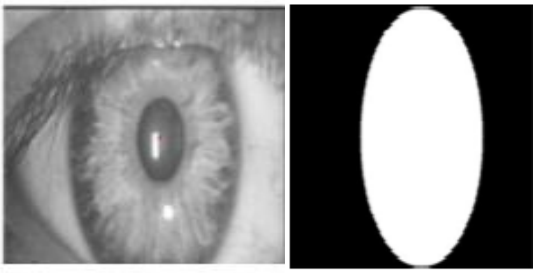
P.Thirumuruga et al. [3] proposed a system which developed a fusion technique of Canny Edge detection algorithm and Hough transform. Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. Moreover wavelet transformation technique is used to extract the cognitive patterns from the iris of an eye. Hamming distance method is used to compare two irises.



(a) (b)

Fig. 10. a) Input Image, b) Edge Detection [3]

Technique involved two different mechanisms i.e. prepositioning of image and matching which is further implemented on MATLAB. While considering usual image, Result showed an effective detection of the edges and removed background of the iris but noisy iris images may vary the result as the intensity contrast of eyelids can be less. Use of wavelet transform lessens the false rejection rate although the false acceptance rate is unchanged which can fails the whole system of recognition. The Hough transform is a technique which can be used to isolate features of a particular shape within an image. Because it requires that the desired features be specified in some parametric form, the classical Hough transform is most commonly used for the detection of regular curves such as lines, circles, ellipses, etc. A generalized Hough transform can be employed in applications where a simple analytic description of a feature(s) is not possible. Due to the computational complexity of the generalized Hough algorithm, we restrict the main focus of this discussion to the classical Hough transform.



(c) (d)

Fig. 11. c) Hough Circle, d) Background Removal [3]

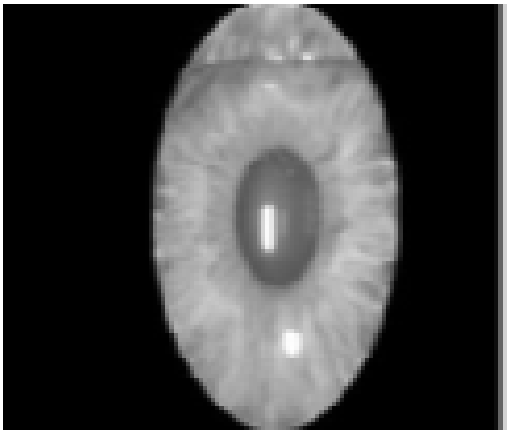


Fig. 12. Iris Detection [3]

Navjot Kaur et al. [4] proposed a review on existing algorithms and different methods developed by various researchers used for iris recognition system. Further the author discussed the stages engaged in iris recognition. Steps required, recognizing an iris is shown in fig 12.There are different algorithm exists for the segmentation of image like Canny Edge detector, Circular Hough transform etc. Canny edge detector is used to find the edges of an iris whereas Hough transform is used to establish the boundary of an iris. Normalization is another step taken to create iris images with fixed dimension. After that image enhancement is used to improvise the quality and contrast of extracted image of an iris. Feature extraction places an important role in the recognition process which is used to extract features from noisy images. All these features have their own significance and criteria of usage in the system. Amena Khatun et al. [5] proposed a biometric based attendance system, which needs iris recognition to identify a student. System consists of both hardware and software execution. Implementation of proposed method took place by capturing images using webcam and processes it in MATLAB to extract their feature and further compare it with the existing

images stored in the database. The technique which has been used in the system has many flaws and limitations for practical implementation. Use of web cam in the system, which is just a VGA camera, is not capable to capture high definition images. Recognition of Iris needs high precision, so the extraction and comparison from noisy images is not precisely executed through the proposed system.

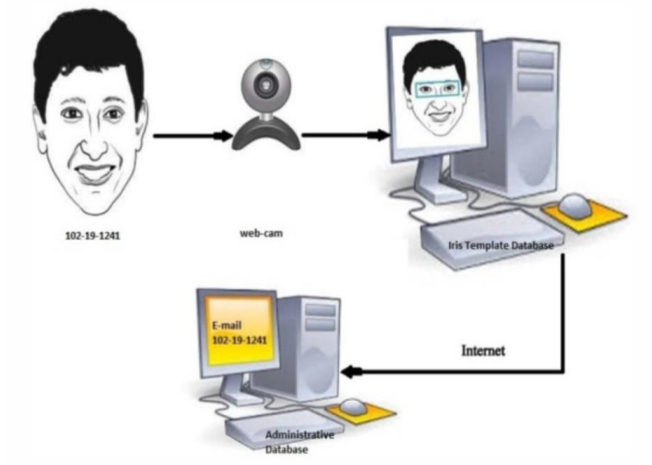


Fig. 13. Processing of Iris Recognition of Attendance Management System [5]

Mateusz Trokielewicz et al. [6] proposed a paper, which generated a database of iris images captured from mobile cameras in presence of proper lighting. Proposed paper shows the result obtained from the experiment taken place in existing iris recognition methods which are : IriCore, VeriEye, MIRLIN and OSIRIS. Observation took place in four different criteria taken into account. After preprocessing of acquired image, it has been observed that such images have fine appearance of iris texture. Second stage is an enrollment phase having independent data inputs. Third phase is for accurate matching with genuine match rates of 94.5%. At the end, trial reveals that segmentation of image should be proper; otherwise it may reduce the accuracy of recognition.

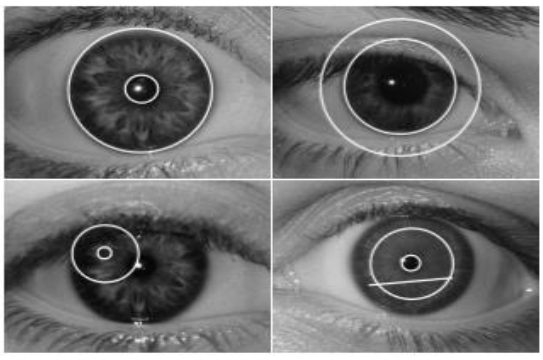


Fig. 14. Results of the Iris Localization performed by MIRLIN algorithm. Correctly localized iris is in 1st image. Other three images present irides that were incorrectly localized [6]

Sarika B Solanke et al. [7] proposed a system to summarize the prior work done on characteristics of Iris identification methods. This paper emphasized on segmentation process which is used to locate the area of iris and plays a vital role in the recognition process of iris. Various techniques have developed for the segmentation proposes, proposed paper assessed those methods. This paper reviewed different methods like cascaded classifiers, indexing algorithm, wavelength band selection, occlusion estimation methods etc and concluded by accepting an approach to simultaneously extract features of iris from both eyes and merge them to make it more proficient. Though the use of both irises for recognition increases the computational complexity and data storage which may alters the result. Jagadeesh N. et al. [8] proposed an algorithm of image processing for iris recognition system. Proposed work further processed the segmentation method by using GUI i.e. graphical user interface. System uses UPOL database for image acquisition process and access the images from that database to implement the proposed system. Recognition process took place in predefined format which uses Pre-Processing, Segmentation, Canny Edge Detection, Gaussian Filter, Finding the intensity gradient of the image, and others, till matching with the existing data in UPOL database and processed the algorithm in MATLAB. Since the proposed method uses predefined algorithm which limits the practical implementation of system as slight illumination can affect the accuracy of iris scanner and appearance of iris occluded by eyelashes may block the precise extraction.

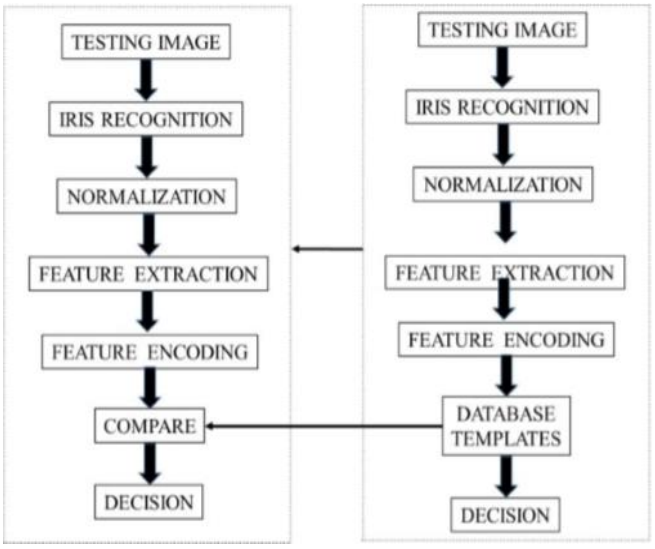


Fig. 15. Flow of Proposed Method of Iris Detection [8]

III. Conclusion & Future Scope

As per the survey takes place on various researches made in the field of Iris Recognition system, there are different available methods implemented by the researchers with certain modification to create an authentic recognition of iris. Most of the techniques used basic algorithms available for the operations needs to take place for the recognition of Iris. Typical operations performed to recognize an iris are segmentation, normalization, feature extraction and matching. Canny Edge detection, Hough Transform, Gabor Filter, Daugman's operator are some frequently used

technique in the proposed systems. Though the techniques which have been proposed having few limitations as complex computational approach, lack of accuracy for complex noisy image, obstructions due to lens, eye lashes and reflection. So, a system is required which can efficiently recognize the Iris with zero false rates and secure the crucial applications.

REFERENCES

[1] López, F. R. J., et al. (2013). Biometric iris recognition using Hough transform. IEEE.

[2] Dehkordi, A. B., et al. (2013). Noise reduction in iris recognition using multiple thresholding. International Conference on Signal and Image Processing Applications. IEEE.

[3] Thirumurugan, P., et al. (2014). Iris recognition using wavelet transformation techniques. International Journal of Computer Science and Mobile Computing, 3(1).

[4] Kaur, N., & Juneja, M. (2014). A review on iris recognition. IEEE.

[5] Khatun, A., Haque, A. K. M. F., et al. (2015). Design and implementation of iris recognition-based attendance management system. IEEE.

[6] Trokielewicz, M., et al. (2016). Iris recognition with a database of iris images obtained in visible light using smartphone camera. IEEE.

[7] Solanke, S. B., et al. (2016). Biometrics: Iris recognition system, a study of promising approaches for secure authentication. IEEE.

[8] Jagadeesh, N., et al. (2017). Iris recognition system development using MATLAB. International Conference on Computing Methodologies and Communication. IEEE.

[9] Montgomery, T. (n.d.). The eye – iris. Retrieved from http://www.tedmontgomery.com/the_eye/iris.html

[10] Ghazi94. (n.d.). Iris segmentation. GitHub repository. Retrieved from https://github.com/ghazi94/IRIS-Segmentation

[11] Jillela, R. R., et al. (2014). Segmenting iris images in the visible spectrum with applications in mobile biometrics. Pattern Recognition Letters, ScienceDirect.

[12] Mattoo, I. A., & Agarwal, P. (2017). Iris biometric modality: A review. Oriental Journal of Computer Science and Technology (OJCST).

[13] Geektimes. (2016). How iris recognition works. Retrieved from https://geektimes.ru/post/247634/