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Enhanced Iris Recognition for Person Identification

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Abstract*— Iris recognition is a secure biometric for personal identification. Commonly used biometric are voice, face, fingerprint, iris etc. Among this iris recognition is considered as more accurate, because iris is externally visible and the texture patterns are unique and stable throughout a person's whole life. The main steps involved in iris recognition are pre-processing, feature extraction and feature matching. Unique preprocessing methods are mentioned in this work. The feature extraction phase is imperative in iris recognition task. Here in this work feature extraction utilizing Discrete Wavelet Transform (DWT) and matching of iris pictures utilizing Euclidean distance.

***Keywords*—unsharp mask, adaptive threshold, gradient magnitude, canny edge detection, DWT, Euclidean distance**

I. INTRODUCTION

Iris recognition is a reliable and more accurate biometric validation framework (Tisse, C.L.et al., 2002). It is applied for one kind of recognition of unique identity, air terminal security, crime control, border security etc. An Iris is a part of our eye culpable for controlling the light entering into our eye and specifies the color of eye. Iris has round shape and it is positioned behind the cornea (HH Patel.et al., 2018).

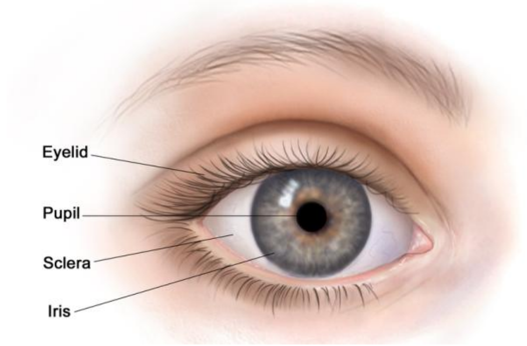

Figure 1: Human Eye

In modern world, Iris recognition is considered as appropriate way to deal with individual identification. From the review conducted it is evident that iris recognition has standout amongst the most reliable biometrics. The iris surfaces are obvious and exceptional to every individual. As contrasted from the different biometrics like face, voice, fingerprint etc. iris is more reliable and stable for personal authentication. Hence it has great importance in real time applications. Iris recognition is one of secure authentication yet despite everything it experiences a few issues. For example undesirable noise of surrounding environment (light reflection, eyelids, and eyelashes) which lessen the performance of iris recognition. Evaluation of nature of iris picture is presently a standout amongst the most vital research areas in biometric field.

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II. RELATED WORK

"Kumar D.et al have been proposed two novel methods to enhance the gradience between dark and bright pixels, contrast enhancement using top hat and bottom hat filters and to select salient features combination of DWT+DCT feature extraction is used. To select the feature a binary particle swarm optimization (BPSO) algorithm is used. In case of real-time applications, it is a time-consuming process (Kumar, D.et al., 2016).

Matin A.et al proposed a specified study of iris recognition technique. In this paper circular Hough transform method used to perform automatic segmentation. Dogman's rubber sheet method is used for normalization stage. To encode the exceptional quantization based 1D Gabor filters are utilized. To assess the global performance progressively unique datasets are required (Matin, A.et al., 2016).

Chen J.et al are proposed another methodology for automatic recognition and coordination of iris contents Multi scale content taken care of by segmentation algorithm. Earth Movers Distance (EMD) used for coordination purpose. Bad illumination and heavy occlusion have serious effect on this particular approach (Chen, J.et al., 2016).

Narmatha C. et al have been proposed an adapted contour segmentation for iris image segmentation. Canny method is used for edge detection. To discover the focal point of the pupil and its range Hough transform is used. Horizontal sobel filter is used to determine the outer boundary edge. At last hamming distance is utilized for matching the iris code. A major problem of iris recognition is that it is mostly secured by eyelids and eye lashes, so as to decrease the false reject risk in such cases, extra algorithm is required to recognize the position of eye lashes and the eyelids (Narmatha, C. et al., 2014). Kumar A.et al introduced a new approach for iris recognition, 2D discrete cosine transform (DCT) method used for feature extraction and recognition, circular Hough transform used for localizing the iris. Dogman's rubber sheet model is used for normalization stage.

CASIA V4 and IIITD database are used to testing the feature extraction abilities of DCT and for matching the iris templates, hamming distance is used. There are some issues in the proposed system that is, the feature extraction is done by using cooperative iris database. Iris at a distance and iris on the move are the other issues (Kumar, A.et al., 2016).

Zhang M.et al have been proposed a four-step method. Initially, normalized iris pictures are deteriorated into low pass and band pass sub bands by Non-Subsampled Contour let Transform (NSCT). Secondly, band pass sub bands are utilized to develop maxima pictures to extract key points. The areas of those points are utilized for adjusted Ordinal highlights extraction in low pass sub bands. Finally, the matching scores acquired by aligned local features and key point features are fused. The distorted iris pictures cannot be ultimately aligned. Meanwhile, occlusions of eyelid and eyelashes also make negative influence on the arrangement (Zhang, M.et al., 2013).

Mesecan I.et al have been introduced the utilization of Scale Invariant Feature Transform (SIFT) for iris recognition issue along with sub-sections. Here extracted sub-fragments from the iris pictures are utilized as opposed to utilizing the whole iris for classification. These sub-fragments were used individually for classification. Also, feature related fusion is applied using different sub-segments from the same iris. A pre-processing step for snipping the iris area from the image was label in this particular paper as well to improve performance of the system. Time consumption is a problem (Mesecan, I.et al 2013).

Alqahtani, A. has proposed an advanced method for iris recognition. In this paper the pictures in the databases were differentiated by utilization of Hamming Distance (HD) technique when noises were included to the picture. The outcomes acquired from this differentiation were the discover TPR qualities and FPR values that were then used to construct ROC bends. After that the resulting ROC bends used to assess the quality of the picture, caught from CASIA database. A significant challenge was faced throughout iris enlargement because a few of the pictures were dishonest and subsequently they couldn't work in the framework (Alqahtani, A., 2016).

Naguru, I have been introduced an iris recognition framework. In this proposed framework great quality with high goals eye pictures are caught from CASIA database for picture obtaining. During normalization organized Rubber sheet strategy is connected rather than polar change procedure for changing over the round iris locale into rectangular area. Gabor filter technique applied in highlight encoding. Hamming distance and Euclidian distance techniques are used in case of highlight matching (Naguru, I., 2017).

Li, Z has proposed an iris recognition system dependent on coarse and fine area. Calculus methods and Hough transformation used to get harsh area of the external and internal boundary of the iris. Canny edge detection and round Hough transformation are utilized to find the iris boundary precisely. Classifier design, most straightforward weighted Euclidian distance classifier is utilized in this experiment. It is simple and quick but consequence of this classifier is not worthy (Li, Z., 2017).

Akshay S. et al introduced a new algorithm with retinal photographs to recognizing the new vessels on the optic disc. The algorithm uses compressed images of retina as the input using FMM (Five Module Method). Canny detectors and watershed lines are utilized to discover candidate segment. For the candidate segments the features like location of the segment from the beginning, structure of the segment, intensity of the segment in the picture, positioning, line density, and divergence are extracted. Finally, SVM (support vector machine) classifier is used to classify the candidate segments as normal or abnormal (Akshay, S. et al., 2017).

Akshay S.et al introduced a gender identification criterion by using eye gaze information. An algorithm called Voronoi is used to create heat map related to the eye gaze information. In most of the case heat maps are utilized for recognizing the person‘s behavior, but it is just visualization. By using the Voronoi diagram it provides the user behavior correctly. Once the person’s viewing actions are known it may be utilized for application like gender recognition to seek out what may be the conceivable gender of the person (Akshay, S.et al., 2017)."

III. PROPOSED SYSTEM

DATASET

The proposed algorithm is evaluated by using UPOL (University of Palackeho and Olomouc) dataset. The pictures are collected through an optometric system (TOPCON TRC50IA) which is an optical gadget associated with SONY DXC-950P 3CCD Camera; the obtained pictures are of exceptionally high caliber and appropriate for the assessment of iris recognition in totally noise free conditions. The database contains 384 pictures in accordance with 64 subjects (3 pictures for every eye) (Parashar, R. et al., 2012).

The proposed system introduces a robust methodology for iris recognition system. The figure below (Figure 2) shows the architecture of proposed work.

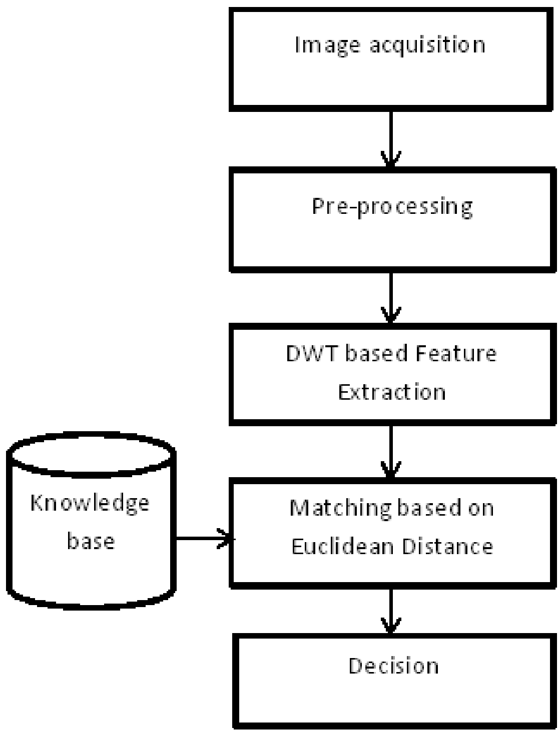

Figure 2: Architecture of proposed iris recognition system

A. **Image Acquisition**

This is our absolute initial step of the whole procedure. At the point when an individual want to be recognized by iris recognition framework, his/her eye is initially shot. This progression is confounded as a result of contrasts in size and shade of the iris starting with one individual then onto the next. The acquisition distance for normal catching is 2 to 3 feet and the normal time is 1 to 2 seconds. In some cases, the securing procedure produces diverse outcomes for a similar individual because of the distinctive natural conditions like lighting impact, situating and distinctive partition of separation. In this paper we used UPOL (University of Palackeho and Olomouc) dataset. The pictures are collected through an optometric system (TOPCON TRC50IA) which is an optical gadget associated with SONY DXC-950P 3CCD Camera; the obtained pictures are of exceptionally high caliber and appropriate for the assessment of iris recognition in totally noise free conditions. The database contains 384 pictures in accordance with 64 subjects (3 pictures for every eye).

B. **Pre-processing**

Pre-processing is essentially a readiness procedure which guarantees that the picture in the event is exposed to a change and yields an acceptable outcome. Image pre-processing has an important role in iris recognition system. It will increase the quality of the picture and make the iris picture to better feature extraction. In this paper the iris images are preprocessed by using following strategies for more enhancements.

1. Unsharp mask filtering

Unsharp mask sharpens an eye picture by expanding contrast along the edges in the picture. The Unsharp Mask does not distinguish edges in a picture. Rather, it finds pixels that contrast in an incentive from encompassing pixels by the limit you indicate. At that point it builds the difference of neighboring pixels by the sum we indicate. In this way, for neighboring pixels the lighter pixels get lighter and the darker pixels get darker. The fine details of eye image are enhanced by unsharp mask filtering (Deng, G., 2010).

2. Adaptive Thresholding

Picture thresholding segment an eye picture into a binary picture by setting all pixels whose power esteems are over a specific limit to "1" and all the rest of the pixels to "0". Adaptive thresholding changes the limit progressively over the picture and can adjust to brightening and contrast changes (Roy, P.et al., 2014).

3. Gradient Magnitude

Picture Gradient is useful to extract information from pictures. Gradient pictures are produced using the original picture for this reason. In a provided direction every pixel of a gradient picture estimates the adaptation in intensity of that equivalent point in the original picture. To obtain the full extent of bearing, gradient pictures in the x and y directions are determined. Picture gradients are also useful for texture coordination.

4. Canny Edge Detection

The iris and pupil boundaries discovered from the caught picture by using canny edge detection technique. This edge detection provides the powerful edges of eye image (Vijayarani, S. et al., 2013).

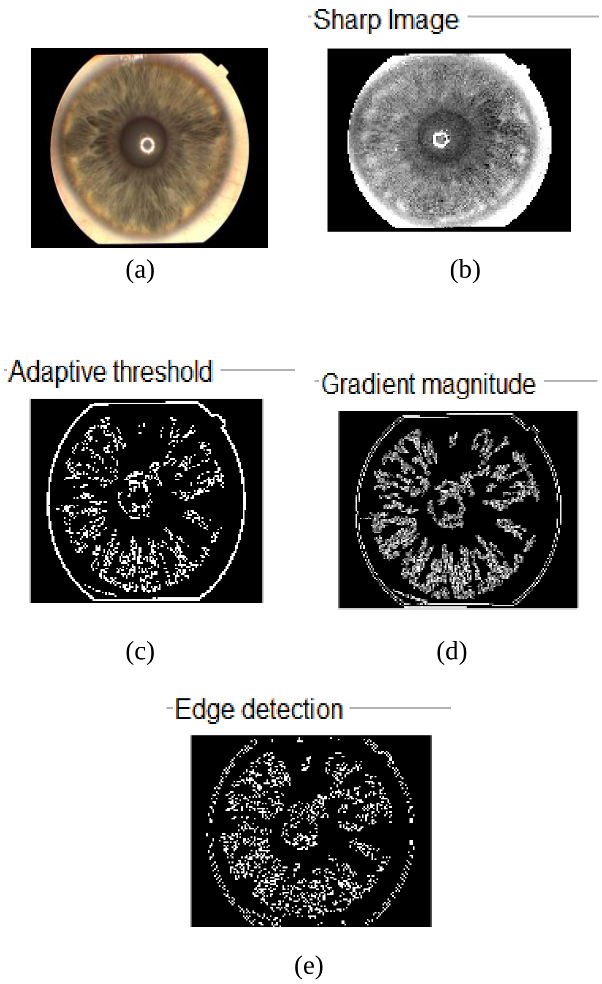

Figure 3: (a) input image (b) after applying unsharp mask filter, (c) after applying adaptive threshold, (d) gradient image (e) output of canny edge detection

C. **Feature Extraction**

After completing the preprocessing step, next step is to concentrate on feature extraction. In this work, the feature extraction is performed by using Discrete Wavelet Transform (DWT). The DWT relies upon sub-band coding, is among the most prominently wavelet transforms. The DWT gives data helpful to many image investigation errands, for example de-noising, division and feature extraction. The DWT is additionally simple to actualize and requires less calculation time. Image deterioration can be executed by using the 1D wavelet transform along the lines of the image initially, then along the sections. This procedure results four deteriorated sub-band pictures, for example low-low (LL), low-high (LH), high-low (HL), and high-high (HH) (shown in Figure 4)), which compare to estimate picture, distinctive data in flat, extraordinary data in vertical and diverse data in inclining separately. The low and high recurrence DWT coefficients are intertwined to produce successful iris features (Narote, S.P.et al., 2009, Elgamal, M. et al., 2013, Chen, P. et al., 2013).

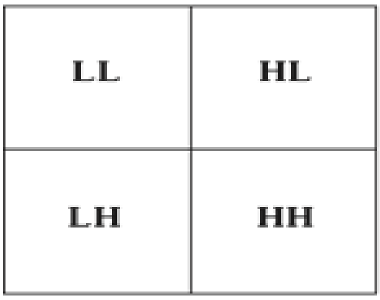

Figure 4: DWT divide's an image into 4 bands; LL, LH, HL and HH.

D. **Matching**

Matching of feature vector from trained database and feature vector of picture to be tested is finished utilizing Euclidean distance as appeared in equation 1 below

$$Edist = \sqrt{\sum_{i=1}^{n} (Xi - Yi)^2} \quad (1)$$

In the event that two vectors precisely match at that point the Euclidean separation between them will be zero (Sinwar, D. et al., 2014).

The figure below demonstrates a case of two points called x and y. Each point is depicted by five qualities. The spotted lines in the figure are the separations (x1-y1), (x2-y2), (x3-y3), (x4-y4) and (x5-y5) which are mentioned in the equation (1) above (Juri Ranieri., 2015)

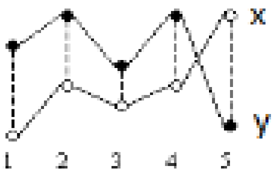

Figure 5: Demonstration of two points in case of Euclidean Distance.

IV. RESULT

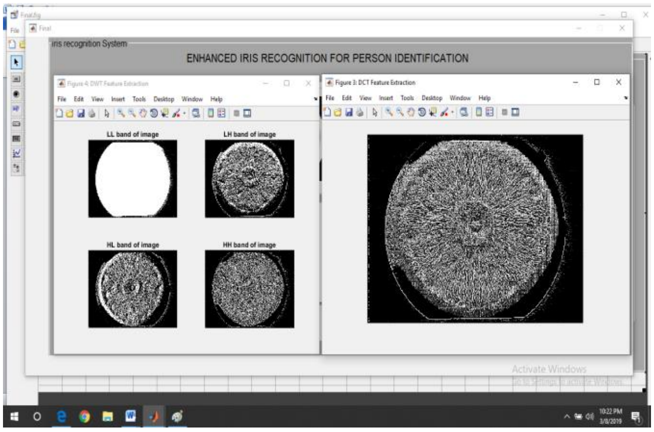

Figure 6: Feature extraction by using DWT.

1D wavelet transform results four deteriorated sub-band pictures, which are LL, HL, LH and HH. Here L represents low frequency coefficients and H represents high frequency coefficients. The low and high recurrence DWT coefficients are intertwined to produce successful iris features, shown in Figure 6.

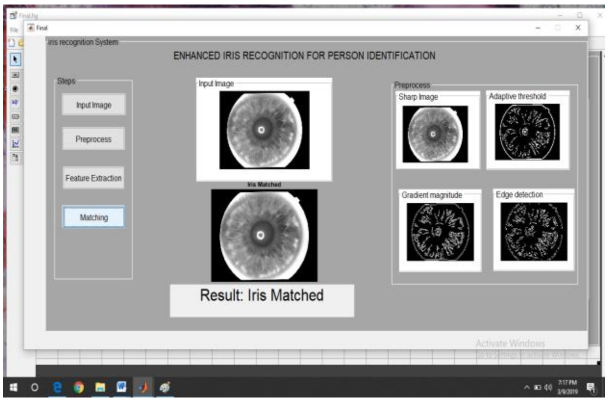

Figure 7: Input image/test image is matched with knowledge base (database).

After extracting DWT features of the iris pictures the salient features are stored as feature vectors in a knowledge base. At the time of testing, the test image will go through same procedure used to obtain feature vector. At last Euclidean distance method is used for matching with stored vectors. Whenever the features are matched (Euclidean distance is minimum) it will produce the result like the iris image matched, shown in Figure 7.

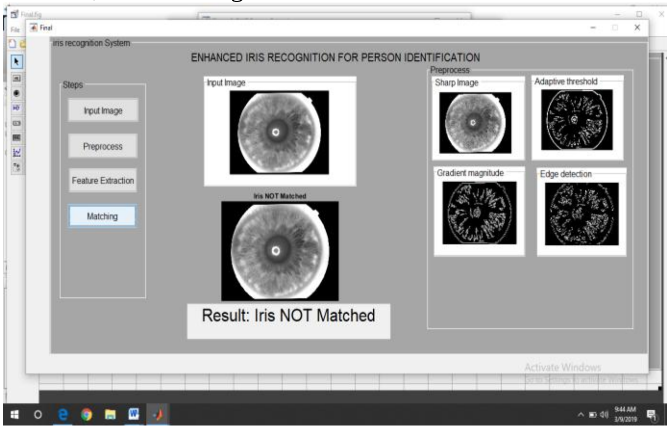

Fig 8: Input image/test image is mismatched with knowledge base (database)

Whenever the stored feature vectors and feature vector of test image are mismatched (Euclidean distance is maximum) it will produce the result like iris not matched, shown in Fig 8.

Performance Analysis

The UPOL database is used for the performance analysis. The database contains 384 images of 64 subjects. To calculate the FRR, FAR and EER, 20 subjects with 6 sample images per subject are used to make database. One image per subject is utilized for testing purpose.

FRR (False Rejection Rate): The FRR will quantify the likelihood of a selected individual not being recognized by the system.

FAR (False Acceptance Rate): The FAR will quantify the likelihood of an individual being falsely recognized as another individual.

EER (Equal Error Rate): EER is where FRR and FAR are equivalent.

The value of EER in this case is 8.61 that is the value of FAR and FRR are equal at threshold 1.9, shown in Fig 9.

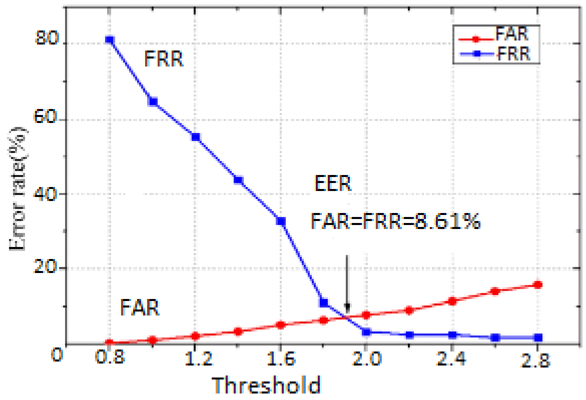

Fig 9: FRR and FAR variations using Euclidean distance.

V. CONCLUSION

A new algorithm for iris recognition is introduced by proposed system. Here in this work, preprocessing includes the unique methods for more enhancements. MATLAB is used for implementing the system. The preprocessing methods used are unsharp mask filtering, adaptive thresholding, gradient magnitude and canny edge detection. The input image is sharpened by using unsharp mask filter. After that adaptive thresholding used to segment an eye picture into a binary picture then gradient image produced by using gradient magnitude. At last iris boundaries are detected by using canny edge detection. After completing the preprocessing step DWT based feature extraction is used to extract the salient features of iris. Finally, matching is done by using Euclidean distance and 91% of accuracy is gained by proposed system.

REFERENCES

1. Tisse, C.L., Martin, L., Torres, L. and Robert, M., 2002, May. Person identification technique using human iris recognition. In Proc. Vision Interface (Vol. 294, No. 299, pp. 294-299).
2. HH Patel, M.Pharm, Susha cheriyedath,M.Sc, Sep 26, 2018. Human Eye Diagram. [Online], Available: <https://www.news-medical.net/health/Anatomy-of-the-Human-Eye.aspx>.
3. Kumar, D., Sastry, M. and Manikantan, K., 2016, February. Iris recognition using contrast enhancement and spectrum-based feature extraction. In 2016 International Conference on Emerging Trends in Engineering, Technology and Science (ICETETS) (pp. 1-7). IEEE.
4. Matin, A., Mahmud, F., Zuhori, S.T. and Sen, B., 2016, December. Human iris as a biometric for identity verification. In 2016 2nd International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE) (pp. 1-4). IEEE.
5. Chen, J., Shen, F., Chen, D.Z. and Flynn, P.J., 2016. Iris recognition based on human-interpretable features. *IEEE* Transactions on Information Forensics and Security, 11(7), pp.1476-1485.
6. Narmatha, C. and Manimurugan, S., 2014, March. A new approach for iris image identification using modified contour segmentation. In *2014* International Conference on Green Computing Communication and Electrical Engineering *(ICGCCEE)* (pp. 1-7). IEEE.
7. Kumar, A., Potnis, A. and Singh, A., 2016. Iris recognition and feature extraction in iris recognition system by employing 2D DCT. IRJET International Research in Computer Science and Software Engineering, and Technology, *3*(12), pp.503-510.
8. Zhang, M., Sun, Z. and Tan, T., 2013, June. Deformed iris recognition using bandpass geometric features and lowpass ordinal features. In 2013 International Conference on Biometrics *(ICB)* (pp. 1-6). IEEE.
9. Mesecan, I., Eleyan, A. and Karlik, B., 2013, May. Sift-based iris recognition using sub-segments. In 2013 The International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE) (pp. 350-353). IEEE..
10. Alqahtani, A., 2016, December. Evaluation of the reliability of iris recognition biometric authentication systems. In 2016 International Conference on Computational Science and Computational Intelligence (CSCI) (pp. 781-785). IEEE.
11. Naguru, I., 2017. Feature Matching in Iris Recognition System using MATLAB. International Journal on Advanced Science, Engineering and Information Technology, 7(5), pp.1748-1757.
12. Li, Z., 2017, March. An Iris recognition algorithm based on coarse and fine location. In 2017 IEEE 2nd International Conference on Big Data Analysis (ICBDA)((pp. 744-747). IEEE.
13. Akshay, S. and Apoorva, P., 2017, April. Segmentation and classification of FMM compressed retinal images using watershed and canny segmentation and support vector machine. In 2017 International Conference on Communication and Signal Processing (ICCSP) (pp. 1035-1039). IEEE.
14. Akshay, S., Lakshmipriya, V.P. and Sikha, S., 2017, June. Analysis of spatial eye gaze data for aiding gender identification. In 2017 International Conference on Intelligent Computing and Control (I2C2) (pp. 1-5). IEEE.
15. Parashar, R. and Joshi, S., 2012. Comparative study of iris databases and ubiris database for iris recognition methods for non-cooperative environment. International Journal of Engineering Research & Technology *(IJERT)*, *1*(5).
16. Deng, G., 2010. A generalized unsharp masking algorithm. IEEE transactions on Image Processing, *20*(5), pp.1249-1261.
17. Roy, P., Dutta, S., Dey, N., Dey, G., Chakraborty, S. and Ray, R., 2014, July. Adaptive thresholding: a comparative study. In 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT)(pp. 1182-1186). IEEE.
18. Vijayarani, S. and Vinupriya, M., 2013. Performance analysis of canny and sobel edge detection algorithms in image mining. International Journal of Innovative Research in Computer and Communication Engineering, 1(8), pp.1760-1767..
19. Narote, S.P., Narote, A.S. and Waghmare, L.M., 2009. Iris based recognition system using wavelet transform. IJCSNS International Journal of Computer Science and Network Security, 9(11), pp.101-104..
20. Elgamal, M. and Al-Biqami, N., 2013. An efficient feature extraction method for iris recognition based on wavelet transformation. Int. J. Comput. Inf. Technol, 2(03), pp.521-527.
21. Chen, P. and Chang, J.Y., 2013. An adaptive quantization scheme for 2-D DWT coefficients. International Journal of Applied Science and Engineering, 11(1), pp.85-100.[Online],Available:<https://www.cyut.edu.tw/~ijase/2013/11(1)/8_023005.pdf>
22. Sinwar, D. and Kaushik, R., 2014. Study of Euclidean and Manhattan distance metrics using simple k-means clustering. International Journal for Research in Applied Science and Engineering Technology (IJRASET), *2*(5), pp.270-274.
23. Juri Ranieri, Published on Nov 17, 2015. Euclidean Distance Matices: A short walk through theory, algorithms and applications. [Online], Available: <https://www.slideshare.net/JuriRanieri/euclidean-distance-matrices-a-short-walk-through-theory-algorithms-and-applications>