ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

IRIS RECOGNITION USING GRAY LEVEL RUN LENGTH MATRIX AND KNN CLASSIFIER

Ruchi Luhadiya*, Prof. Dr. Anagha Khedkar
Department of E&TC, R. H. Sapat College of Engineering, Nasik, Maharashtra, India

DOI: 10.5281/zenodo.203815

ABSTRACT
Biometric devices are great tools for the security. Iris is a very unique identifying characteristic amongst all human biometric traits. In the proposed system, the biometric authentication system using iris recognition is presented. In this iris image is preprocessed then image localized with the Hough transform, normalized using Daugman's rubbersheet model finally image sharpening is used with the morphological toggle filter. Feature extraction is done using Gray Level Run Length Matrix (GLRLM) technique with 0 directions and classification is done using multiclass KNN. This system is evaluated on CASIA database and it gives 92.66% accuracy.

KEYWORDS: Iris recognition, Feature extraction, GLRLM (gray level run length matrix), KNN (K-nearest neighbor)

INTRODUCTION
In the last decade, the field of information and technology grows exponentially. It is good for society, but there is an increase in the frauds with greater proportion. Therefore, there is a need of robust, effective security system which is not susceptible to the hackers.

Numbers of authentication systems are proposed by different researchers which are based on card, password. PIN. These traditional authentication systems are not that safe because card or pin can be stolen by anyone or these can be used by unauthenticated person too. The biometric systems overcome the disadvantage of the traditional system. Biometric authentication system is the only robust, accurate solution for person identification system.

Biometric systems are divided into physiological and behavioral characteristic for person identification. The biometric systems consist of various traits like Face, fingerprint, palm print, vein pattern, retina, iris, Gait, Voice etc. Among all biometric systems, Iris based biometric system is the most secure system because the iris pattern of each person are unique, even though the iris pattern of the twins doesn't match.

In this system, Iris based person identification system is proposed. The system comprises of image acquisition, preprocessing, binarization, morphological filter operations, feature extraction and classification.

The paper is organized as, in the second section the previous techniques to recognize the iris has been present. The proposed methodology to detect the iris by machine learning algorithm has been present in the third section. Results in quantitative and qualitative ways are presented in Fourth section. In the last section, the proposed system is concluded.

LITERATURE REVIEW
Biometric system is growing research topic from the last decade, so there is a number of papers were presented by different researchers. Some of them are reviewed in this section.

The first successful method for iris segmentation iris proposed by the Daugman's and named as Daugman's Algorithm in 1993. [1]

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Yulin Si et al. [2], present eyelash detection algorithm based on the directional filter bank and multiscale and multidirectional data fusion method. This system achieves a low error rate. The performance evaluations are carried out on two popular iris databases, CASIA and IITD.

Seyed Mehendi et al. [3], present a person identification system using biometric graph matching technique. This system uses 60% images from the VARIA database. The images were enhanced using histogram equalization, matched filter and morphological filters. SVM classifier is used to classify the iris features.

Kishori B. Jagtap et al. [4], proposed a person identification system by considering iris features. The system has passed through five main steps, i.e. Pupil detection, ring detection & noise removal, feature extraction and classification. The edges of the pupil and iris are extracted by the canny edge detection as it finds out the strong edges. The noise due to eyelid and eyelashes are removed in thresholding process. The binary image is then transformed into wavelets by 1D and 2D DWT. PCA is used to extract the features and SVM and KNN is used to classify the different persons. SVM gives around 80% accuracy on CASIA database.

Upasana Tiwari et al. [5], uses CASIA and MMU database for person identification system using iris. In this system the features are extracted using Gabor filter and reduced its dimensionality by PCA algorithm. An SVM classifier classifies the iris into authorized and unauthorized categories.

Asim Ali Khan et Al. [6], proposed iris recognition for person authentication using support vector machine and NN techniques. The system uses CASIA V.1 database for evaluation. Hough transforms used to segment out the iris from the eye image. The Gabor filter extracts the features of the segmented image. ANN and SVM classifier is used to classify the feature of iris. From the result, it is found that the SVM classifier gives higher accuracy than the ANN. ANN give 83.65% and SVM gives 90.25% accuracy.

METHODOLOGY

In this paper, we present a robust approach for person identification using iris pattern. This system includes: image acquisition, preprocessing to remove noise, iris segmentation, and iris normalization, post processing, feature extraction and classification. The Block diagram of the proposed system is shown in fig. 1.

These steps are described in detailed below

1. *Image Acquisition*

The input image is used from the CASIA-IrisV4 database [7]. The images were captured with close up camera. The images of the CASIA database are very clear, textured. The features of CASIA-IrisV4 database are tabulated below

Table 1. CASIA-IrisV4

Database	No. of subject	No. of classes	No. of images	Resolution
CASIA-IrisV4	249	395	2639	320x280

2. *Iris image preprocessing*

Image preprocessing is important for good classification. This section consists of three main processing steps: Gaussian filtering, Gradient magnitude calculation and canny edge detection.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

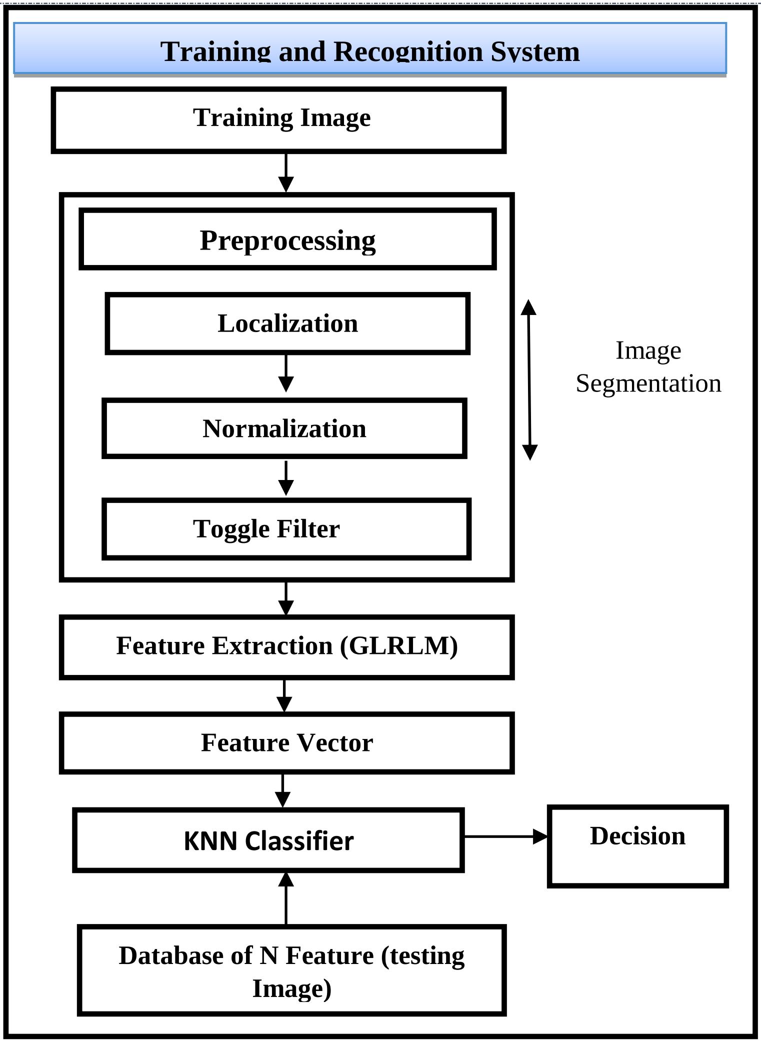

Figure 1. Block diagram of the proposed system

a. *Gaussian filtering*

Gaussian filtering is the smoothing operation. It uses 2D convolution operator which is used to remove the noise by blurring. The concept of the smoothing is to convert each pixel in an image is replaced with its weighted average using neighboring mask pixels. Mask weights are computed by sampling a Gaussian function

$$G_\sigma(x,y) = \frac{1}{2\pi\sigma^2} exp^{-\frac{x^2+y^2}{2\sigma^2}} \qquad (1)$$

Where, G (x, y) = Gaussian mask
σ = standard deviation
x, y = Grid value

Gaussian filtering uses this Gaussian mask and convolves with the image to get filtered image

b. Gradient magnitude

The smooth image is noise free. The next task is to find out the gradient in an image. The edge detection algorithm is processed through the gradient calculation which has different variations. This gradient may be in horizontal or vertical direction. The mathematically gradient function is represented by

$$g(x.y) = \sqrt{(\Delta x^2 + \Delta y^2)} \qquad (2)$$

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

$$\theta(x, y) = tan^{-1}\left(\frac{\Delta x}{\Delta y}\right) \qquad (3)$$

Where, g (x, y) = Gradients of an image
Δx = horizontal mask
Δy = vertical mask
θ (x, y) = Gradient direction

c. Canny Edge detection

Canny is an edge detection algorithm goes through four steps:

i. Smoothing
ii. Gradient computation
iii. Non maximal suppression
iv. Threshold

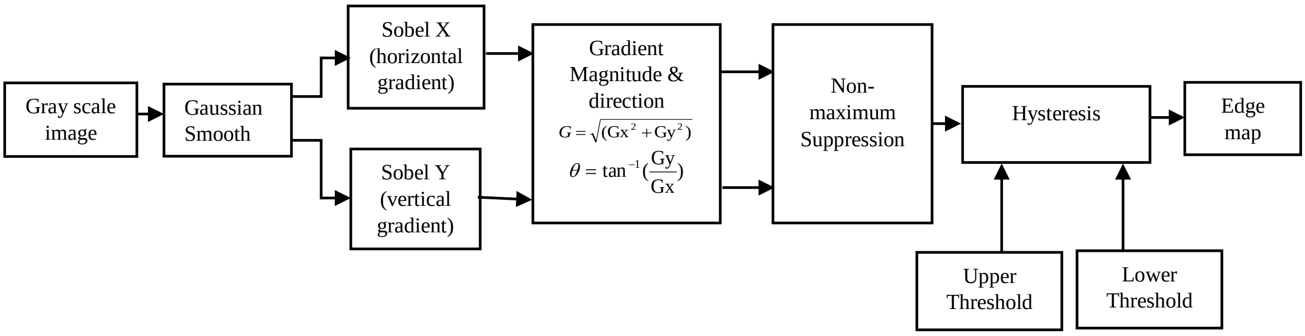

Figure 2. Process of canny edge detection

The input image to the canny edge detection algorithm is smooth using eq. 1. Then find the gradient of the image by eq. 2. The edges find in the after applying gradient magnitude is broad, to thin that edges non maxima pixels are suppressed to do so the following algorithm is used:

1. Check whether non zero element in the gradient image M_T is greater than its neighbor along the direction θ (m, n).
2. If so, M_T is retained, else set to zero

Fourth step is thresholding. Threshold the previous result by two different thresholds:

1. T1 and T2 (where T1<T2) to obtain two binary images T1 and T2.
2. Note that T2 with greater T2 has less noise and fewer false edges, but greater gaps between edge segments, when compared to T1 with smaller T1.
3. Link edge segments in T2 to form continuous edges. To do so, Trace each segment in T2 to its end and then search its neighbors in T1 to find any edge segment in T1 to bridge the gap until reaching another edge segment in T2.

3. *Iris Segmentation*

a. Iris Localization

In iris localization the part of non-eye image is removed and select the only iris part for the further processing. The canny edge detection algorithm finds out different edges in an iris image. in this step, the pupil and iris parts from the image is detected by using circular Hough transform. The circular Hough transform can be employed to deduce the radius and center coordinates of the pupil and iris regions by assigning different radii and center we can find pupil and iris.

$$x^2 + y^2 - c^2 = 0 \qquad (4)$$

b. Iris Normalization

The normalized images may be of different size and shape. It may effect on the classification of the system. So to minimize this effect, the image is normalized. In normalization process, the circular iris image into the rectangular image. The circular intensities in the iris image are converted into polar intensity by using

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Daugman's rubbersheet model. The normalization process by Daugman's Rubber Sheet Model, iris point is remapped to the pair of polar co-ordinates which is represented by (r, θ) into a Cartesian coordinate (x, y) is given by

$$I(X(r,\theta), y(r,\theta)) \rightarrow I(r,\theta) \quad (5)$$

Where,

$$x(r,\theta) = (1-r)\,xp(\theta) + rxi(\theta)$$
$$y(r,\theta) = (1-r)yp(\theta) + ryi(\theta)$$

4. Postprocessing (Toggle filter)

Toggle filter is a morphological way, which may be used to sharpen the edges in the image. It is defined by two morphological processes, i.e. Erosion and Dilation. If D is dilation, E is Erosion, and I is an image, then toggle filter image represented as:

1. If (D-I) > (I-E) then the erosion operation is applied to the image
2. If (D-I) < (I-E) then the dilation operation is applied to the image
3. Otherwise the original image retains as it is.

5. Feature Extraction

Gray Level Run Length Matrix (GLRLM) is a matrix in which texture features can be calculated. Texture is an interpretable format of the gray intensity in a particular direction say θ from the referred pixel. The term gray level run refers to a set of continuous pixels having same gray level is called a gray level run. The term run length is a number of neighboring gray levels in particular direction θ. The GLRLM for degree 0 and for four gray levels is represented as

1	2	3	4
1	3	4	4
3	2	2	2
4	1	4	1

Gray Level	Run Length (j)			
i	1	2	3	4
1	4	0	0	0
2	1	0	1	0
3	3	0	0	0
4	3	1	0	0

In addition to the 0º direction, GLRL matrix can also be formed in the other direction, i.e. 45º, 90º or 135º

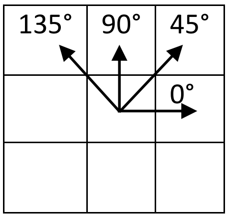

Table 2. GLRLM features, formulae and description

Sr. No	Features	Description
1	SRE $= \frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N}\frac{p(i,j)}{j^2}$	Short Run Emphasis measures the distribution of short runs. The SRE is extremely subordinate on the simultaneousness of short runs and is expected large for fine textures.
2	LRE $= \frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N}p(i,j) * j^2$	Long Run Emphasis measures the distribution of long runs. The LRE is extremely subordinate on the simultaneousness of long runs and is expected large for coarse structural

		textures.
3	GLN = $\frac{1}{n_r}\sum_{i=1}^{M}\left(\sum_{j=1}^{N}p(i,j)\right)^2$	Gray Level Non uniformity measures the closeness of gray level values all over the image. The GLN is expected small if the gray level values are alike all over the image.
4	RP = $\frac{n_r}{n_p}$	Run percentage measures the homogeneity and the distribution of runs of an image in a particular direction. The RP is the largest when the length of runs is 1 for all gray levels in a particular direction.
5	RLN = $\frac{1}{n_r}\sum_{j=1}^{M}\left(\sum_{i=1}^{N}p(i,j)\right)^2$	Run Length Non uniformity measures the similarity of the length of runs all over the image. The RLN is expected small if the run lengths are alike all over the image.
6	LGRE = $\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N}\frac{p(i,j)}{i^2}$	Low Gray Level Run Emphasis measures the distribution of lower gray level values. The LGRE is expected large for the image with lower gray level values.
7	HGRE = $\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N}p(i,j)*i^2$	High Gray Level Run Emphasis measures the distribution of high gray level values. The HGRE is expected large for the image with high gray level values.

Where,

p (i, j) = Original run-length matrix
n = Number of pixels in an image
n_r = Total number of runs
n_p = Number of pixels in the image

6. Classification

The features are extracted by the GLRLM technique. For classification, KNN classifier is implemented. KNN classifier is widely used for classification of features. In this classification algorithm, a train dataset with respective labels are assigned to the classifier. In the testing phase, unknown data are provided to the classifier whose label is unknown. The classifier measures the distance between test feature and each feature vector in train dataset. The obtained distance is sorted and assign labels of shortest distance train data feature set. In the KNN classifier value of K plays a vital role.

In this approach, the distance is measured by the Euclidean distance formula

$$d(p,q) = \sqrt{q_i - p_i} \qquad (6)$$

Where,
d = feature vector of train dataset
q_i = query data
Pi = test point data

RESULTS AND DISCUSSION

The proposed system is implemented in MATLAB 2013 (b). To perform the analysis, the images from CASIA database have been utilized. The qualitative and quantitative analysis of the system is shown in below subsections.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

1. Qualitative analysis

The qualitative analysis of the proposed iris recognition system is as shown below

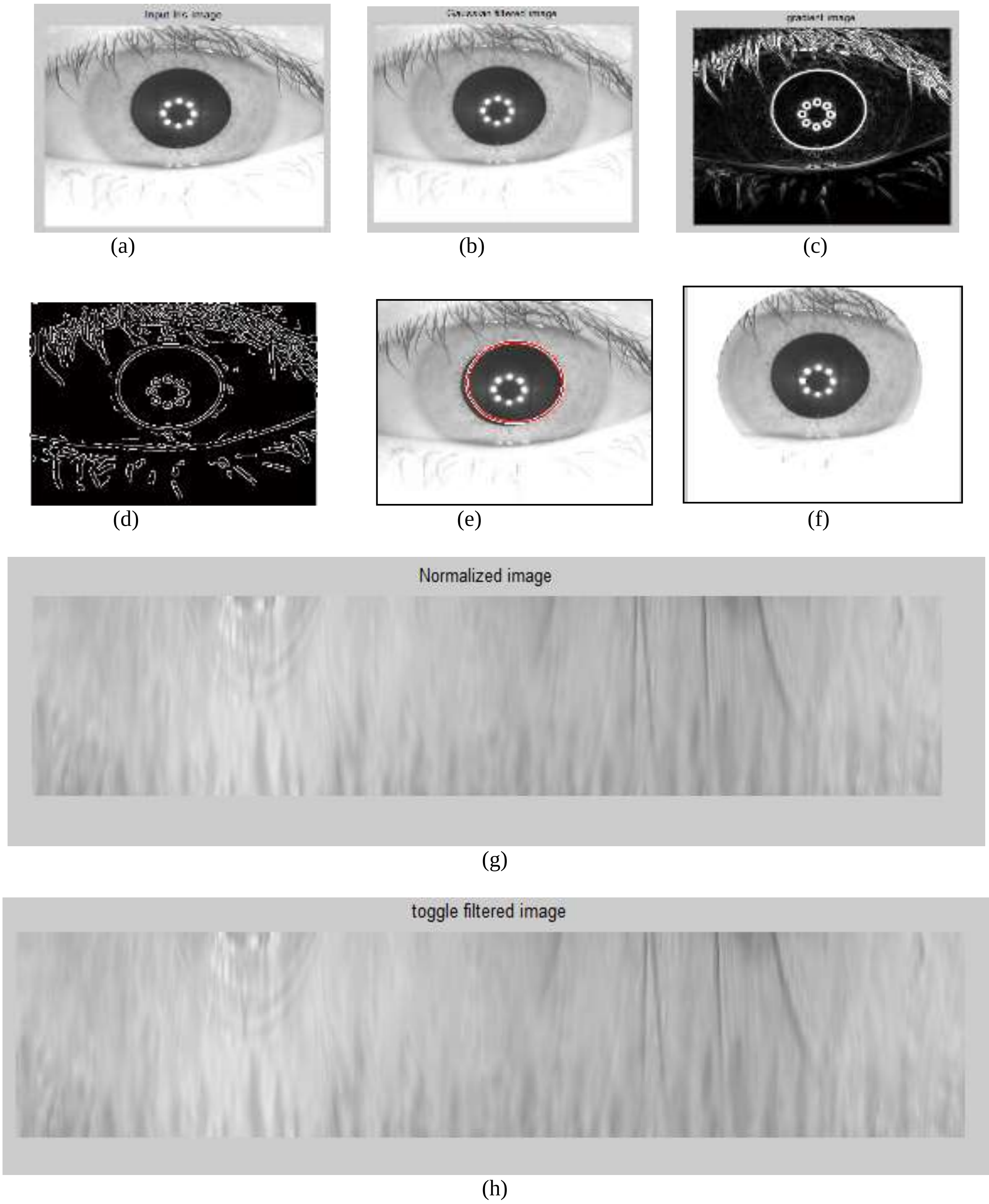

Figure 3. Qualitative analysis:(a) Input Image from CASIA database (b) Gaussian filter output (c) Gradient image (d) Canny Edge detection output (e) Pupil detection (f) Iris detection (g) Normalized image of Daugman's rubbersheet Model output (h) Toggle filter output

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

2. Quantitative analysis

The statistical analysis of the proposed system is evaluated by accuracy parameter.

Table3. Quantitative analysis

Database	Image resolution	Training			Testing		Accuracy
		No. of person taken for identification	Total no. of images	Selected for this system	No. of person	Selected images for this system	
CASIA V4	320X280	150 out of 249	2639	1544	150	150	92.66%

CONCLUSION

In this research paper, robust algorithm for iris recognition is proposed. In this system the pupil and iris are detected by using circular Hough transform. The circular image convert to rectangular by Daugman's Rubber sheet model and further post process by using morphological toggle filters. This system extracts 7 statistical features (SRE, LRE, GLN, RLN, RP, LGRE, and HGRE) by using the GLRLM technique with 0 directions. It is very good feature extraction technique. The K- nearest neighbor is used to classify whether the person is authorized or unauthorized. This system gives 92.66% Accuracy on CASIA database.

In future, the accuracy of the system will increase by using different feature extraction techniques and classification technique. The system will test on different databases, like UPOL, IITD, and UBIRIS.

REFERENCES

[1] John Daugman, "High Confidence Personal Identification By Rapid Video Analysis Of Iris Texture", Proceedings of the I.E.E.E. 1992 International Carnahan Conference on Security Technology, pp 50-60.
[2] Yulin Si, Jiangyuan Mei, and HuijunGao, "Novel Approaches to Improve Robustness, Accuracy and Rapidity of Iris Recognition Systems" IEEE transactions on industrial informatics, vol. 8, no. 1, pp. 110-117, February 2012.
[3] Seyed Mehdi Lajevardi, Arathi Arakala, Stephen A. Davis, and Kathy J. Horadam, "Retina Verification System Based on Biometric Graph Matching" IEEE Transactions on Image Processing, vol. 22, no. 9, pp.3625- 3635 September 2013.
[4] Kishori B. Jagtap and M. P. Stone, "Biometric Solution for Person Identification Using Iris Recognition System", International0 Journal of Engineering and Innovative Technology (IJEIT), Volume 3, Issue 12, pp 261-266 June 2014
[5] Upasana Tiwari, Deepali Kelkar, Abhishek Tiwari, "Study of different IRIS recognition methods", International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 2, Issue 1, ISSN 2249-6343.]
[6] Asim Ali Khan, Smriti Kumar, Mister Khan, "Iris Pattern Recognition using Support Vector Machines and Artificial Neural Networks", International Journal of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering, Vol. 2, Issue 12, December 2014.
[7] CASIA iris image database. http://www.sinobiometrics.com.