Identification Based on Iris Detection Technique

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Abstract—Iris-biometrics are an alternative way of authenticating and identifying a person because biometric identifiers are unique to people. This paper introduces a method aims to efficient human identification by enhanced iris detection method within acceptable time. After preparing various type of images, then perform a series of pre-processing steps and standardize them, after that use Uni-Net learning, so identify the human by Navie-Bays method is the last step based on the output of Uni-Net which is role as feature extractor for the iris part and another sub-net for non-iris part that may involve identification-outcome. The outcome of this method looked good compared to some high-level methods, so, was accuracy-rate 9855, 99.25, and 99.81 for CASIA-v4, ITT-Delhi, and MMU-database respectively. Also, this paper introduces a method of iris recognition using CNN model which is improved the preprocessed patterns that together from dataset applied some procedures to develop them based on techniques of equalization and acclimate contrast ones. After that characteristic extracted and classified using CNN that comprises of 10 layers with back-propagation schema and adjusted moment evaluation Adam-optimizer for modernize weights. The overall accuracy was 95.31% with utilization time 17.58 (mints) for training-model.

Keywords—identification, biological data measures, deep structured-learning, UniNet, fully connected neural network, convolutional deep neural network, Eyeiris detection

1 Introduction

Authentication, identification, and detection are progressed extensively depending on biometric systems, also used to elevate the privacy and security involved[1, 2]. Biometrical measures define as "physical characteristics measurements that are utilized to discriminate a person" [3]. So, these measures use physical and behavioral features to detect and distinguish persons, for this reason, systems of biometric measures are used as an efficient solution of security where the properties cannot be faked, stolen, lost, or forgotten [4]. Recently, demand has increased for improving daily life security in the digitalization direction in order to enhance reliability and intelligent identification systems using biometrics [5]. Traditional eye-iris detection systems are based on the least space between a person and a pictural-device which is less than 1m. So, these systems are based on high user cooperation but the drawback is a person has to pause and look at the sensor-device [6]. The permanence of eye-iris attributes for a person along the living makes the eye-iris detection the preferred one for individual identification [7, 8]. Biometric measures often consist of sequential as: Registration, pre dealing, mapping, and decision-making processes, so numerous functions and strategies for each phase, chiefly for the concluding phase that it is essential for delivering outcome-result[9]. Although the person recognition and identification system are one of the most reliable biometric techniques, the poor factor of the captured images is the main reason for the damage to the performance of this system and elevated False Rejection Rates (FRR) thus its failure to accurately identify the iris of each person [10, 11].

The typical nets of neural technique trouble are that it requires a lot of predealing out and modification to provide high-quality fallout in certified data, also no agreement to have an active answer on all biometrics-measures or on another dataset for the same bio-system. To defeat this trouble, the investigators barely locate characteristics then deep-NN has reached good quality outcomes on numerous standard data. Latest time, deep CNN-supported learning approaches have acquired marvelous achievement in scope of computer vision and pattern recognition applications. Deep learning-based tactics have shown preponderate outcome for a variety of tribulations related to the assignment and catching biometrics[12]. Convolutional neural network (CNN) is a category of non-natural intelligence and has the ability to learn and extract the features automatically as a human, whereas the classical neural network has the inability to learn features automatically [5, 12, 13]. This research paper includes a work which is used an extra preprocessing step before deep learning is used to get time consuming and rapid enhancement of iris image detection. There is a lot of a number of related works which depend on deep learning neural networks for iris detection such as: In 2017, Zhao and Kumar proposed a perfect eye-iris recall based on totally learned related characteristics[14]. Again in 2017, Al-Waisy, and et. al introduce an eye-iris detection system by means of CNN and soft-max classifier as a union-model based on multi data-sets as a trail to answer over-fitting problem, they got some results with accelerate but needing to be enhanced [15]. In 2018, Shi, and et. al they attempted to work out the trouble of unfinished and not apparent images that is utilized for eye-iris classification so have trained a normalization part of iris using convolution neural network, but face the over-fitting problem [16]. Liu, and et. al, in 2019 trained deep learning methods after using Gaussian, triangular-fuzzy-average, and triangular-fuzzy-median smoothing filters to pre-deal with image by vague the area outside the margin to upgrade the value of signal-to-noise scales so speeded up task of convergence and raises the recognition-rate [17, 18]. In 2020, Omran and Al-Shemmary used a deep convolutional neural network to detect iris by classifying the main features of the Indian-Institute-Technology-Delhi (IITD) eye-iris data after extracting them [19]. Anca and Ioan 2020 introduced a SURF-descriptors and quality characteristics utilized in eye-iris detection. They got improved results obtained by applying the method and showed that the schema can be utilized as a sift to minimize the analysis of eye-iris identification [20, 21].In 2021, V. Conti1 and et.al| presented multiple construct biometric systems via eye-iris with eye-retina together. So, the work solved arrangement and recall method usually implement in computerized bioinformatics; such as attributes of main features are selected independently from all eye-iris so as all eye-retina, and the combination is achieved by contrast mark using the Levenshtein distance [22]. The research-paper aims to rely on iris detection for accurate and optimal identification of the person in the least time and cost. This paper is structured as: After the current section, the description of both the two-methodidentification-based iris detection model utilized UniNet and a method of iris recognition model utilized deep learning technology-based CNN are represented in 2nd section. While the 3rd section discusses the experimental results. Some conclusions are shown in the last section.

1.1 Difficulties of eye-identification technique

Pre progressing is an essential action in the eye recognition system and involves the exactness of identical. Some of the most important actions are eye-iris pinpoint ion and eye-iris image excellence valuation. Iris-pinpointing is discovery of the internal and external borders of the eye-iris. The pinpoint ion schema aspires for rapid and precise willpower of the eye-iris borders. So accurate schemes need a lengthy time to situate iris [23, 24]. Start step is the pinpointing which means detecting the eye-pupil, which is the black rounded component enclosed by iris tissues. Pupil-edges is can be detected easily from the binarized image because the eye-pupile is the biggest darkness by using a suitable threshold on the intensity image. However, the trouble of binarization happens if someone having very gloomy pupil, and the pinpointing does not succeed for this reason required to decide on a reasonable threshold value. Again, sometimes the pupil is not an ideal perimeter [25].At the same time, Little excellent eye-images contain deprived illumination defocus haze, of-angle, and serious occlusion, So This does not give any positive result even if the best hashing algorithms are used [26, 27]. Irises may be catched in diverse dimension same as the iris of the same one may alter for the reason that difference of the lighting. Therefore, need Normalization that regulates data to reduce redundancy and separate a database into records and with relations between the records. The problems are that the eye-image has problems of illumination. So, image enhancement using histogram equalization and some filtering to noise elimination. The problem with histogram equalization is that shaped unwanted results when operated on iris-images with low color depth [25]. High dimensional troubles are becoming more and more ordinary. So, feature extraction is the next action of identification by bio measures that generates feature vectors corresponding to human being iris images and to matching based on a number of distance measures. One of these difficulties in attributes-based identification of iris is matching performance is prejudiced by a lot of factors in the feature selection process. Besides that, staying the ordinary reflexes of the eye. In addition, there is another action called template matching. Such that, the pattern is compared with the other patterns saved in a database until either a matching pattern is discovered and the human being is recognized, or no match is located and human being still unknown. All those developments the performance for contrasting images by linearly-scale of time, and size. So, need to the error rates like False reject rate (FRR) thatcomputes the biometric measurement from live-failure to match the patterns, and the False accept rate (FAR) that computes the measurement from the live closes to another subject's pattern which a right match is stated by mistake [28].

2 Identification based iris detection using deep learning

Iris as a biometric measure has many compensations over other measures. The iris is protected from different environmental situations. distinctiveness and unpredictability, and it has aconceptual biometric system. Deep learning is an efficient and powerful technique that is broadly employed in computer vision applications of account to the capability to obtain distinguishing characteristics from an eye-iris image in this work, the proposed method of iris identification based deep learning and iris recognition based CNN method are compared to get a decision of high performance and accuracy.

2.1 Datasets of iris image

There is a sufficient quantity of database available to assist in assessing progress procedure and confirm heftiness. Most of these databases are obtained in the near-infrared or visible spectrum. So, Images-databases gathered in no-compacted and compacted configures. Usually are caught in a variety of situations. Table 1 provides the catalog of not many of the eye image databases existing[29]. CASIA-V4 that contains 2576 NIRYESI-KEMB-100 Double-CAMERA extension to precursors but includes iris-images with various age stages 2,446 patterns of 142 subjects. Each sample was catching the higher division of a person-face and gripped together two eye-irises.

Table 1. Some iris database

Name	imaging device	Decree	No. topics	No. images	Configure
Bio Sec	LGIris Access	640*480	200	3200	-
CASIA-V3	OKI iris-passh	640*480	1614	22,548	.jepg
CASIA-V4	IKEMB-100	640*480	3284	32,537	.jepg
ITTD	JirisJPC1000	320*240	224	2240	.bmp
ICE	LG2000	640*480	244	3953	.Jpeg
MMU	IrisAcess2200	320*240	1445	289	.bmp
UBIRIS-V2	CanonEOS5D	400*300	522	11,101	.tiff
UTIRIS	Canon EOS10D/ISG	2048*1360/1000*776	79	1540	.Jpeg/bmp
WVU	Iris Pass	640*480	945	220	.bmp

The patterns are obtained from 3 meters. All the right eye-images for each topic are composing the set of training, so the testing set includes each left eye-images [30]. Multimedia-University (MMU) dataset is collected from a publicly available database which is composed of iris patterns that can be used for training process based biometric identification models. This dataset comprises 460 images for 46 persons with 5 images for each of the left and right eyes[31]. Iris images are color with the size of 320×240 pixels for each image and with depth as 3 dimensions or channels. IIT Delhi dataset consists of 1120 images and is prearranged as 224 specific covering, all images are transformed into numbers discriminating [32].

2.2 Iris identification method using UniNet

The methodology of implementing the model is divided into three stages as shown in Figure 1. All eye-iris images are subject to some pre-dealing out before the full convolution network is began then the following identification stage.

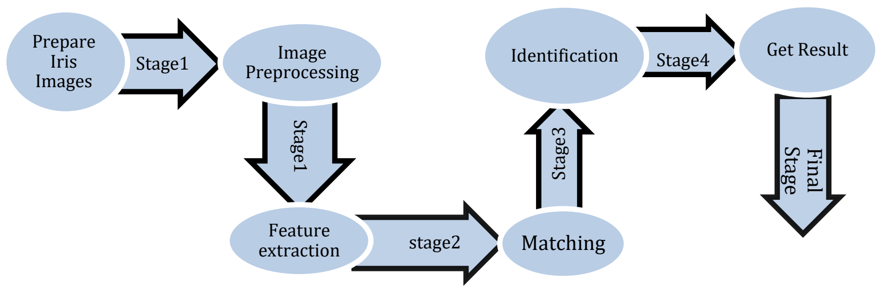

Fig. 1. Block diagram of identification stages

Preprocessing iris images stage. Preprocessing stage is an actual essential role in the classification or detection development, so this stage comprises the following tasks:

First: Iris region detection task. Duo methods are applied to find out the eye-iris region, one of these is to find out the region by window-schema. The pupil and iris are detected within a window. Stipulation this schema isn't achieved to locate exact ending-results, another schema is employed, which deals with the complete eye-iris image as required-region i.e: the same steps but no dipping, there are many steps for this task, as shown in Figure 2. Detection Step of eye-pupil after eye-iris detection of eye-iris applied Modified Hough Transform (MHT)[33], So, chosen value=50 as terminus to get binary eye-iris image subsequently estimated center and radius of a pupil by CH transform. Apply HT for detecting the outer iris. The amount of pupil radius values was 15–50, but for iris was 55-100[34]. These steps are applied to different types of iris-images as shown in Figure 3.

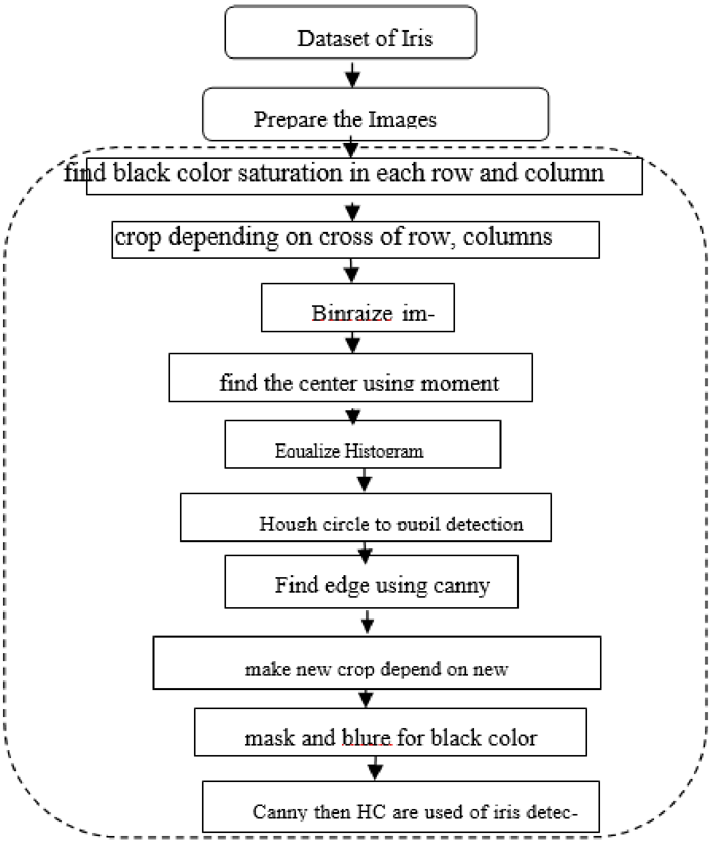

Fig. 2. Iris region detection steps

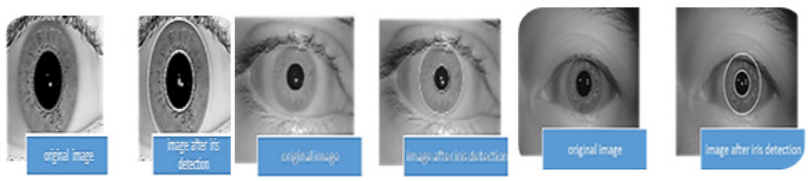

Fig. 3. Iris detection results

Second: Normalization task. As a part of preprocessing stage, the normalization task is employed to provide a permanent dimension vector of attributes that is considered as input-record to learning-phase after the iris region detection task was completed. Normalization is implemented by applying Daugman's-rubber-sheet modeling that converts the data-iris image from cartesian to polar coordinates[33].Daugman's mapping receipts all position (x, y) within detect-region to a pair of polar-coordinates (r, θ) with stabilized[35, 36].The converting process is represented as eq (1)(2)(3).

$$I\big(x(r,\theta), y(r,\theta)\big) \rightarrow I(r,\theta) \quad (1)$$

$$x(r,\theta) = (1-r)x_p(\theta)rx_i(\theta) \quad (2)$$

$$y(r,\theta) = (1-r)y_p(\theta)ry_i(\theta) \quad (3)$$

Where,
r is in between [0, 1]
θ is the angle in between [0, 2π]
I(x,y) is the concentration rate at(x,y)
The constraints x_p, x_l, y_p, and y_l is organizing of the eye-pupil and eye-iris margins next to $\boldsymbol{\theta}$ track as illustration Figure 4.

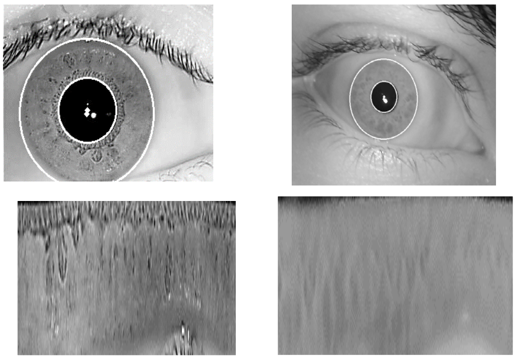

Fig. 4. Normalization task results

Feature extraction stage. UniNet is a modified deep learning structure that is used together masking of eyeiris-region and features mining, which is rooted in fully-convolutional networks (FCN). Uni-Net structure is assembled of 2 sub-networks, a feature sub-network (Feat.Net) and a masking network (Mask.Net) as illustrated in Figure 5. Both are constructed on FCN. The major units of FC-Nets are multi layers of convolutional, pool layers unit, active functions unit, and the rest. Merging the up-sampling layers, fully-CNets is capable of performing all pixel's prediction. Feat Net is intended for mining discriminative eye-iris attributes, that are utilized in the matching-stage. Mask Net is established to achieve no-eye-iris region masking for returned to normal eye-iris images, that observed the same as trouble for segmentation semantically approach. The vital of masking grantees for loss function and matching-stage. The final-result of this stage is explained in Figure 6.

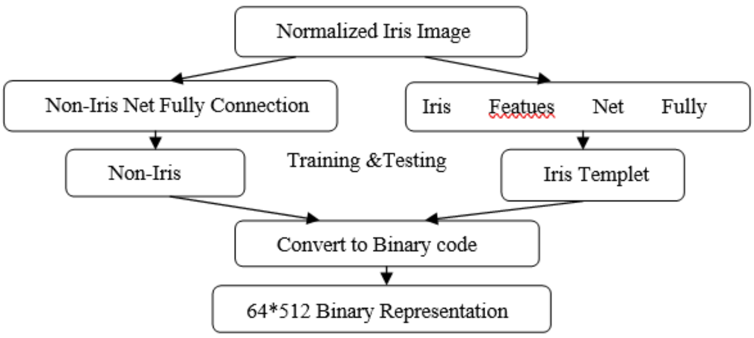

Fig. 5. UniNet architecture [23]

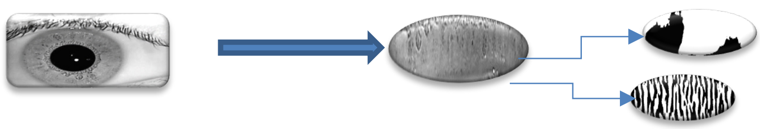

Fig. 6. Feature extraction stage

Triplet network learning. A triplet network is executed to be trained the kernels within Feat.Net. Where three like Uninets, where weights are reserved equal through learning, are located in equivalence to ahead and back-propagate data with incline for anchor, both of them +ve with -ve samples correspondingly. Anchor+ve (AP)-pair must appear of matching someone though anchor-ve (AN)-pair appears of dissimilar someone. Triplet-loss procedure challenges to lessen anchored distance meanwhile enlarge the anchor-ve distance. To guarantee extra proper with authentic control in making of eye-iris attributes-features based FC-Nets function, the triplet-loss is improved by integrating a bit-shifting process called (Extensive-Triplet-Loss (ETL))[16].

ETL process. Earliest loss work for networks of triplet describes using eq (4):

$$L = \frac{1}{N}\sum_{i=1}^{N}\left[\left\|f_i^A - f_i^P\right\|^2 - \left\|f_i^A - f_i^N\right\|^2 + \alpha\right]_+ .. \quad (4)$$

Such N is no. of triplet patterns in a small set

f_i^A,f_i^N, andf_i^P are attributes plans +ve and –ve anchor in i[th] triplet correspondingly.

[+] is equal to max (•, 0).

α is a factor to manage preferred border of anchor+ve,anchor-ve distance.

So, Improving the original loss leads to minimizing anchor+ve and maximizing anchor-ve distance until their border is more of a specific value. By means of Euclidean-distance being variation metric is not as efficient as required. Applying spatial attributes-features is proposed that have similar ruling with the record-enter; the matching procedure deals with no-eyeiris region masking and straight shifting, that are often pragmatic in eye-iris patterns. So, the earliest triplet-loss task is comprehensive, and cites as ETL. See eq (5), and Masked-Distance (MMSD) method, termed as eq (6):

$$ETL = \frac{1}{N}\sum_{i=1}^{N}[D(f_i^A, f_i^P) - D(f_i^A, f_i^N) + \alpha]_{+\ldots} \quad (5)$$

Where D (f^1,f^2) is Minimum Shifted

$$D(f^1, f^2) = {}_{-B\leq b\leq B}^{min}\{FD(f_b^1, f^2)\} \quad (6)$$

A lot of arithmetical functions including derivations are applied to guarantee that main-features are trained in legal eye-iris zones, whereas no-eyeiris zones will do not take into account. after everything else the last convolutional-tier, a sole-channel attribute-record is produced to gauge the matches of eye-iris images.

Third: Matching task. To get the correct match of iris images, apply some steps as follows:

1. Binarized the iris-image features which are a real value to get less storage and the (0,1) values is a further confrontation to illumination change, distorting, and another underlying clatter.
2. Compute the Hamming-distance of the attributes-plan of step1 and comprehensive masks. See eq (7):

$$D_H = \frac{\sum_{i=1}^{K}|(codeA\oplus codeB)\cap(maskA\cap maskB)|}{\sum_{i-1}^{k}(maskA\cap maskB)} \quad (7)$$

Where, D_H ="0" for no-eyeiris-regions, and "1" for eyeiris-regions.

Fourth: Discussion of identification task based matching task. The assessment if duo eye-irises are belonged to an exact person is ended by pre-identified threshold-rate. Based on the identical results got using NB classifier if the features are matched with the database, then the person is accepted, if not the person is rejected.

2.3 Iris recognition method using CNN [5]

In this method, the learning based 2D-CNN model is classified images of eye-iris based eye features were extracted. Iris dataset is gathered, enhanced using histogram equalization (HE) schema with contrast limited adaptive equalization (CLAHE) schemas, and augmented. After that, CNN model classifies the iris images after extracted features. The construction of CNN consists of features-mining that includes convolutional-layers and ReLu-layers, factors-reduction includes pooling-layers, classifier of features-mining includes FC-layer and Softmax-layer. So, applying backpropagation of errors schema and adjusted moment estimation-Adam for achieving training phase and weights renovating.

Iris recognition steps using CNN. Data augmentation is a very important technique for creating the better database and enlarging its size. This work handled dataset includes 460 iris images then augmented images for maximizing the size of the dataset by creating adapted editions of images like images cropping-task, shifting-task, scaling-task, shearing-task, and flipping-task. After that adjust the contrast in the original image using, HE and CLAHE techniques. Then the total number of the dataset became 4600 when completing the image preprocessing and augmentation. The CNN structure has ten layers, beginning with the input layer and continuing with two convolution layers, two activation RuLe, duo pool-layers, one FC- layer, SoftMax layer, and finally the output-result-layer, as demonstrated in Figure 7. Then back-propagation algorithm is used for the training procedure and Adam optimizer for updating the weight. The total set of data was split into 0.80 of all images to do train mode with 0.20 of all images for testing-set. The images were trained using 4 as bunch size, learning value-rate of 0.0001, and utmost of 400 epochs using Adam optimizer.

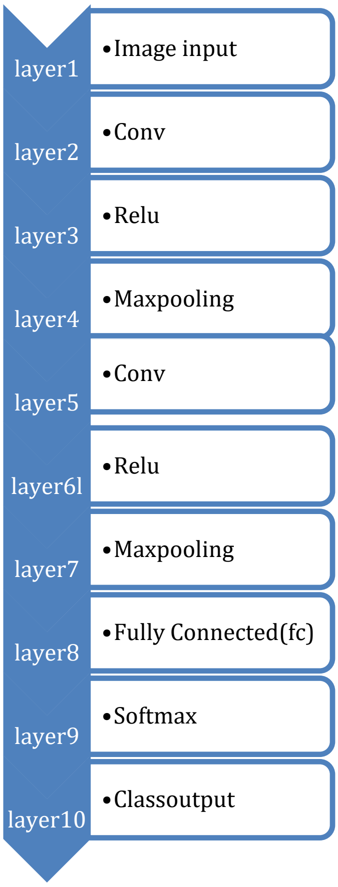

Fig.7.CNN-layers diagram for iris recognition [5]

3 Results analysis

This work aims to achieve high accuracy with compete speed, therefore introducing two methods of iris detection that depend on deep structured learning to compare the efficient performance of these two methods. So, in this method, has been hired with a lot of preprocessing methods to get more accurate and also faster than the state of using the image without preprocessing. Also using two methods for pupil detection made this work more accurate. In addition, the use of the normalization process by removing dimensional in consistency had a role to speed up and accurate results. At a matching stage, the detection task uses (0,1) as attribute-features don't be low in the achievement contrasted with actual-valued of attributes to even yield enhancements in some standard dataset scenarios. This method was applied to various datasets with images caught by a particular camera-device. The Testing set of CASIA-V4 produces 20,702 valid matches up and 2,969,533 cheat matches up. Testing set IIT-D contains 2,240 valid matches up and 624,400 cheat match up. Cross-DB (i.e training is done by dataset differs from the tested one) and Within-DB arrangements are used for testing this work, The goal of Cross-DB is to check the performance of the framework if limited training samples are existing. Within Database using only one set of data to train the net then applying fine-tune it based differ training sets. Then fine-tuned model is assessment on the special testing set. The fine-tuned models of within-DB arrangement are done well rather than cross-DB, with expected higher correlation of image quality between the training and testing sets. All experimental outcomes are generated as many-to-many similar policies. The dextractor of attributes was achieved high accuracy also capable of generality. The final accurate-results of this work structure are measure up to other related works that aim to its state of the art method with good performance. Assessment includes SIRIS [37],Gabor filter (GABOR) [38, 39], and outcome of Cross and within a dataset of this method .The output of that method is evaluated against other related works that aim to its state-of-the-art method that is the high ranking of standards. The accuracy rates[40] is regard to the rate of recognition (FAR, EER, FRR),The results of the assessment are shown in Table 2.

Table 2. Results comparison

	MMU		**CASIA**		**IITD**	
	FRR%	***EER%***	***FRR%***	***EER%***	***FRR%***	***EER%***
OSIRIS	17.83	3.43	19.93	6.39	1.6	1.11
GABOR	18.58	5.47	20.72	7.71	1.81	1.38
CROSS	14.37	3.12	13.22	5.03	0.80	0.61
WITN	9.92	5.27	11.9	4.74	1.16	0.7

Table 2 illustrates the FRR is the chance that is false to an exact person and theEqual Error Rate (EER) which is computed by an all-against-all comparison: As a result, as the ratio of missing data is increased, more and more false rejections of valid data, resulting in increased EER. The percentage values of overall training accuracy were 96.5, and 98.1 for CROSS DB, and WITHN DB respectively. In the second method, increasing the number of epochs will improve the training process by achieving the best results and increasing the reliability but would be also increased the amount elapsed. The percentage values of overall training accuracy were 95.31% and a spending time 17.59 minutes for 400 epochs. Training and validation steps show that the overall accuracy is very good. Table 3 shows the FAR criteria for the different terminus of method on CASIA-V4, ITTD, and MMU dataset.

Table 3. FAR measure with different terminus value in the method

Terminus(threshold)		FAR		
		CASIA	***ITT-D***	***MMU***
40	CROSS	10.61	0.64	0.71
	WTHIN	8.54	0.52	0.60
50	CROSS	11.76	0.65	0.70
	WTHIN	10.43	0.54	0.61
60	CROSS	12.8	0.65	0.70

Table 4 illustrates the results of EER and accuracy after applying the steps of the method on the various eye images dataset.

Table 4. Results of EER and accuracy

EER		AUC.
CASIA-V4	4.93%	98.49%
ITT-D	0.84%	99.12%
MMU	3.43%	98.02%

Table 5 illustrates the value accuracy[41, 42] rate of identification after applying the two mentioned methods to MMU dataset.

Table 5. Accuracy-rate of identification for MMU dataset

	Accuracy	Time consumption(sec)
UniNet Method	98.845%	31.646
Identification basedCNN[5]	96.313%	11.576

4 Conclusion

Due to the employment of couple of subnets for feature extraction and a mask for no-eyeiris parts, the usage of UNINET proves successful in eye-iris recognition. By formative and discarding no-eyeiris parts before the identical part, the matching(identical) result is more fast and more truthful the effective pre-dealing out methods used to deliver UNINET input are another factor in these encouraging outcomes. Thestrategy yields good accuracy, although more preparation and investigation datasets are required. Additionally, a high-declaration dataset was required.

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