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Survey of Iris Recognition using Deep Learning Techniques

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ABSTRACT

Deep learning is an effective data mining method that is used to analyze complex, and large quantities of data accurately and efficiently. In the last few years, the world has gone through an revolutionary change in the way of how data produced and how data are processed not similar to any time before. The data produced must be handled accurately using intelligent methods to get accurate results. For example, iris recognition is one of the applications that needs sophisticated algorithms capable to identify one person from the other via the iris data analysis. In the recent few year, it was clear how deep learning has been used in different areas of life. One of those areas is the pattern recognition area. In this review paper, we focus on the investigation of using the deep learning technologies for these purposes. The research methodology followed in this paper is based on reviewing, analyzing the academic papers published in the last couple of years in terms of the proposed paradigm used on the iris data, and the accuracy results obtained from using that paradigm as well as mentioning the datasets used in these paper. The outcomes of this paper showed that using the deep learning method, in particular, the Convolutional neural networks, has promising future due to its success in this domain.

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1. Introduction

Deep learning is one of the highly demanded and increasingly successful machine learning methods used for the feature selection, classifications, and filters of objects. The major reason behind it is that it was constructed based on the Artificial Neural Nets (ANN). The ANNs are made of a set of arranged layered nodes; in the basic format of it possesses triple-layered nodes and input, one hiding layers and exterior layered nodes. For every layer possesses a set of process items with the input is updated in these process units by the multiplication of this input with weight (Paliwal, 2009) [2].
Deep learning could also be propounded by deep structure algorithms, hierarchical learn or deep machines learning, and deep neural networks, which are a classes of machines, learning techniques that utilizes a cascaded of several layered non-

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linear process unit for features selection and transformations. To understand deep learning, we need to highlight the basics of traditional neural networks.
The deep learning principle idea is mainly based on the same theoretical principles of the conventional artificial neural nets. Both have been inspired by the biological arrangement of the neurons on the human's brains these neurons are synergized as the processing units used in the traditional neural networks as well as their advanced version i.e. the deep neural nets. From the first models of these kinds of networks, it has been noticed that the artificial neurons are considered the fundamental components that are passing by the incoming singles into the other neurons as is the case in the biological networks. The architecture of these neurons is based on lining up them into layers. In its simplest forms, ANNs are composed on two layers i.e. the input layer and the output layer where no hidden layers existing in between and this kind of networks is called the perceptron's. On the other hand, the other types of networks which is called the multi-layer networks where there is more than three layers in it, besides the input and output layers there is one or more hidden layers.

Each progressive layer utilizes the yield from the past layer as info. The calculations might be regulated or solo and applications incorporate example examination (unaided) and grouping (directed) (LeCun, 2015) [1]. The Iris acknowledgment has been had significance in numerous applications and it was examined and concentrated over the most recent couple of many years (Minaee, 2019) [3]. Some numerous approaches and methods have been recommended around here. For this reason, we committed this audit review to inspect the new advances in utilizing the profound learning strategies for iris detection.
The neural networks are fundamentally used for the classification of input data or signals into distinct classes. What makes it distinguished from other traditional methods used for the classification is its capability to recognize complex patterns for data of different types such as signals, sounds, text, or images. In this regard, it is important to know the mechanism of who these neural networks are capable of aggregating data according their patterns. There are two mechanisms used for this purpose, which are the supervised, and the non-supervised mechanisms. From the machine-learning point of view, the supervised learning is when the system is trained on a set of positive and negative examples and when the system is tested a matching between the coming tested samples with what have already been trained in the system. When it comes to the other type, which is the unsupervised learning, this type of learning is different from the supervised in that it does not need a method training process, rather it processes data using the intrinsic characteristics of this data. In this paper, a survey of the most current published works is presented concerning the use of the deep artificial neural nets in the classification process of the iris data. Thus, the aim of this paper is to show the most recent trends in the domain of iris images recognition.

Recognition of the Iris It is possible to verify and authenticate your identity via the use of biometrics such as iris of the eyes, which measures the distinctive patterns of iris. iris recognition is a biometric which is a contactless, quick, and highly accurate technology that can be used across great distances. In fact, some systems that utilize the technology just need a look from the user to be effective.

2. motivations

Among the biometric systems currently in use, the iris recognition system is widely regarded as one of the most dependable options available.. Computer vision applications in a variety of fields benefit greatly from this technique. Numerous instances have been provided to demonstrate the importance of the iris.
recognition system, such as limiting access to restricted areas, and identification system.
At airports, passengers are subjected to strict control. It may also be used to regulate the temperature.
In addition to financial services, database access is offered. It is possible to see several different iris patterns .In addition to these benefits, iris recognition systems are also very dependable. The Due to the fact that the iris is an interior component of the eye, it is very protected.
During the iris capture procedure, there is no physical touch between the sensors and the subject. Is that correct? The fact that humans live their whole lives is also considered a reasonably constant characteristic. Moreover, Researchers have shown that even identical twins have distinct iris patterns.
It is thus possible to consider the iris a superior option to the face for a person's iris. identity of the individual.

3. Literature Survey

A review is given in this section that highlights the most recent advances made for the field of iris recognition. In particular, the focus is made on using deep learning and artificial intelligence methods in this domain.

In (Zhao, 2017) [3], the creators fostered a novel deep learning-based iris highlight portrayal which can offer prevalent coordinating with precision and speculation capacity for the iris acknowledgment. The extraordinarily planned Extended Triplet Loss capacity can give viable management to learning thorough and spatially comparing iris highlights through the completely convolutional network. Further augmentation of this work should zero in on learning more strong iris masks data through the deep organizations, which is required to additional adventure the spatially comparing highlights for more exact iris acknowledgment. The fundamental point of this paper can be summed up as fostering another deep learning-based iris acknowledgment structure which can be exceptionally summed up for working on various data sets that address assorted organization conditions. Another Extended Triplet Loss work has been created to effectively address the idea of iris design for learning thorough iris highlights. Huge advances subsequently have been made to overcome any barrier between deep learning and iris recognizing.

In (Arsalan, 2017) [4], a two-stage CNN method based on a two-stage approach, which can track down the genuine iris limit inside boisterous iris pictures in a non-agreeable climate was proposed. In the main stage, a harsh iris limit was found through adjusted roundabout HT, which characterizes the ROI by the marginally expanded range of the iris. In the subsequent stage, CNN was applied by VGG-face calibrating to the information got from the return for money invested. The CNN yield layer gives two yield highlights. In this manner, in light of these highlights, the iris, what's more, non-iris focuses are characterized to track down the genuine iris limit. Tests with NICE-II and MICHEdatabases showed that this technique accomplished higher correctnesses of iris segmentation contrasted with the cutting edge strategies. Moreover, in that technique, it is important to diminish the handling time for CNN-based characterization with the window covers separated from the principal stage. To take care of these issues, the creators considered other sorts of CNN, for example, semantic segmentation organization (SSN) which can utilize the entire picture as information. Be that as it may, the exhibition is lower than their proposed technique. Accordingly, this technique gave the accurate ID of the genuine limit even in serious situations, like glasses, off-point eyes, turned eyes, side view, and halfway opened eyes. The primary phase of this technique included base cap separating, clamor expulsion, Canny edge locator, contrast upgrade, and adjusted HT to portion the rough the iris limit. In the subsequent stage, CNN with the picture contribution of 21X 21 pixels was utilized to fit the genuine iris limit. By Using the Second Stage Segmentation Technique just inside the ROI characterized by the surmised iris limit recognized in the main stage, it tends to be seen a decrease in the handling time and blunder of iris segmentation. At last, To lessen the impact of splendid SR in iris segmentation execution, the SR districts inside the picture contribution to CNN are standardized by the normal RGB worth of the iris area.

In (Karakaya,2018) [5], off-point iris identification is being improved using a deep learning method. The creators contemplated and analyzed the impact of the look point in iris/visual/periocular biometrics and circuit the data in diverse off-point pictures [20]. The convolutional neural organizations were utilized to increase the effectiveness of the iris recognition frameworks that are off point. As the deadlock iris recognition frameworks are significantly less compelled than conventional frameworks, the iris pictures caught are probably going to be non-ideal, off-point, and widened. Therefore, the deep learning calculation was utilized to improve the exhibition of off-angle iris recognition in customary and untraditional iris recognition systems. As a principle commitment. The utilization of the convolutional neural organizations (CNNs), included first the investigation of the conventional iris recognition structure with segmentation, standardization, and CNN-based encoding and coordinating. In nontraditional structures, the creators utilized the iris pictures without segmentation what's more, standardization to examine the impact of periocular regions.

(Zanlorensi,2018) [6], the creators proposed a deep learning system for iris recognition, all the more explicitly, models dependent on VGG and ResNet-50 organizations, for managing the pictures utilizing (and not) iris segmentation and standardization. The creators utilized exchange gaining from the face space and proposed a particular information increase method for iris pictures. To improve speculation and stay away from overfitting, two Convolutional Neural Network (CNN) models prepared for face recognition were stored and afterward utilized as iris detection (or highlights). From the correlation of the acquired outcomes, it was observed that the methodologies utilizing just depicted however non-standardized and non-fragmented iris picture as a contribution for the organizations produced new best in class results for the authority convention of the NICE.II rivalry.

In (Varkarakis, 2018) [7], the creators thought about the up-and-coming age of wearable AR/VR show glasses and the difficulties of individual confirmation on such gadgets. The utilization of iris verification as a means of making a consistent biometric connection between the client and his information offers a suitable methodology, however,

because of the feasible area of client confronting cameras, there are a few difficulties in accomplishing an exact segmentation of the iris. In this paper, a deep neural organization was prepared to precisely section contorted iris locales. A suitable increase strategy is introduced to create the mutilated iris dataset utilized for preparing from freely accessible front-facing iris datasets. In this way, that work primarily centered around executing a deep learning strategy to portion mutilated iris pictures. The fundamental commitment is an information expansion procedure that reproduced iris pictures from an AR/VR head-mounted showcase with off-pivot cameras. On a choice of the mutilated iris pictures a subsequent expansion measure was applied, adding contrast, obscuring, or shadows to the pictures mirroring the fluctuation of pictures quality accomplished, in real life.

In (Bazrafkan, 2018) [8], the fundamental focus depended on carrying out a deep learning procedure utilized for improving segmentation execution on non-decent quality iris pictures. The principle idea of this paper is the utilization of particular information used for preparing tests to emulate the original pictures acquired on handheld cameras. In this work, while preparing a deep neural net, the dissemination of the information assumes a critical part of the ANN mechanism and how this system acts in the test phase. circumstances Consequently, in a particular issue, if one can give enough varieties of the info information to address the reality there would be a network, which might get similarities with these varieties and sum them up and the network will perform well on the raw data. The organization for the segmentation task is a deep U-formed network with 13 layers. It begins with 3x3 portions, planning the contribution to the first convolutional covered-up layer. In these investigations the pooling activity brings about undesirable noise at the final result of the network, in this way, pooling layers are stayed away from. The portions become bigger towards the focal point of the network, the greatest portion is 15x15. From the focal point of the networks, the piece size is diminishing towards the yield [22]. The skip associations utilized in the organization assist the yield with a remaining edge. This strategy likewise brings about less yield value. The test outcomes depict noticeable improvements in segmenting unrestrained low-quality photos shot in the outdoors without any restrictions.

The iris recognition and filtering were investigated in (Minaee, 2019) [9], where a residue convolution neural net (CNN), which could be learning jointly from the features representational and performance recognitions. In this work, an iris recognizing frameworks built under the concept of transferred learning technique. Previously enrolled convolutional neural network parameters settings were performed using famous iris recognizing datasets. The IIT Delhi's iris databases having 2240 iris pictures captured from 224 different persons, the resolutions of such images equal 320 by 240 pixels. The researchers in this work were focusing on iris-recognizing tasks. They selected datasets with a huge list of topics. However, they were not much as per class, a transfer learning method was suggested for performing and identifying the image using deep residue convolution networks. They utilized a previously trainable Res Net50 (He, 2016) [24] model for training an ImageNet dataset, and fine-tuning it on the training images. ResNet is a famous CNN structure, which was the winning method of the image Net 2015 visual recognition campaign. It produced simpler gradients flowing for more efficient training. The core idea of Res Net is to introduce identity shortcut connections that skip one or more layers. This can help the organization to give an immediate way to early layers in the networks, making the slope value for those layers a lot simpler. The creators prepared the model for 100 iterations utilizing an Nvidia Tesla GPU. The cluster size is set to 24, and the Adam-streamlining agent is utilized to improve the losses work, with a learning pace of 0.0002. All pictures are down-tested to 224x224 before being fed to the neural net.

In (Li, 2019) [10], a hybridization of the technique for edge-based and learning-based calculations for iris recognition was proposed. A well-planned Faster R-CNN with six layers was built for finding and grouping the eyes. The pupillary region was arranged utilizing a Gaussian combination model with the bouncing box found by Faster R-CNN. The circle limit of the pupillary region was dependent on five key limit points. A limit point determination was used to find the limit points of the limbus, and the limit of the limbus was constructed utilizing these limit points.

In (Khalifa, 2019) [11], an iris gender-based recognizable proof procedure dependent on deep convolutional neural nets was proposed. The mechanism of this technique fragments the iris from an original picture using the diagram cut segmentation strategy. This model has 16 resulting layers. Three are convolutional layers utilized for include extraction with variation convolution window sizes. The expansion strategies involved in this exploration to overcome the overfitting issue and make the primary design stronger and safer from essentially retaining the preparation information. On top of that, the expansion cycle not just expanded the number of dataset pictures to 9,000 for the preparation stage, 3,000 pictures for the testing stage, and 3,000 pictures for the check stage yet

additionally prompted a huge improvement in testing accuracy, where the proposed method accomplished 98.88%. A verification methodology to quantify the accuracy of the proposed design was used. The procedure depends on applying new increment strategies to the architecture of confirmed pictures. On the confirmation set, the proposed method accomplished a precision of 90.03% in its deteriorated scenario, which shows that it sums up the information as opposed to retaining it. Utilizing pretrained structures may decrease the calculation time in the preparation stage and may prompt better testing accuracy.

In (Liu, 2019) [12], A Gaussian, triangle fuzzy mean and triangle fuzzified medium smooth filter to pre-process the images by fuzzifications of the regions behind the boundaries for improving the signals to noises rates is suggested in this work. The modified image utilizing the fuzzy operation was used for the training phase of the deep learning method, which fastens up the process of convergence and maximizes the recognition accuracy rates. Through the observations detected from that paper training on fuzzified images performs better than training on raw images overall. When compared to traditional data augmentation methods, the fuzzified picture filters used could be increasing the signal-to-noise ratios by a greater margin Following the processing of the original pictures, the accuracy has improved, and the speed of convergence has risen even more. When compared to CNN and Capsules, the F-CNN and F-Capsules improved the integrity of deep learning training results. The fuzzy classification using the proposed Gaussian method of the triangular fuzzy membership function showed an improved tests results when this model is embedded in the Convolutional Neural Network, and this model also showed an improved performance when it is compared to the traditional crisp model of sets used in the same CNN neural net.

In (Lozej, 2019) [13], the effect of irises recognition and detection framework was examined. The deep neural net model CNN was utilized for encoding the irises surface and performs different tests pointed toward evaluating the effect of the methodology on the iris detection system. Specifically, the authors conducted the examinations: i) consequently produced segmentation segments utilizing CNN-based segmentation models, ii) physically explained ground-truth segments.

Since deep learning models can demonstrate complex (nonlinear) information changes, the creators avoided the iris opening up advance out and out and show that exceptionally serious exhibition can be accomplished even without normalizing the iris surface. For examination purposes, the outcomes for standard (heuristic) segmentation Techniques were incorporated, trailed by iris opening up. The examinations were on the CASIA-Thousand (containing close to infrared (NIR) pictures) and SBVPI (containing apparent range (VIS) pictures) datasets and as a side result of the investigation likewise show that a solitary CNN-based recognition model can be utilized to encode heterogeneous iris surfaces caught in various pieces of the EM range. ‘

In this paper, the importance of the image segmentation for the iris data was made clear, it was clarified that the segmentation using the proposed method has achieved the best results when it is compared to other segmentation methods. Another advantage of segmentation, explicitly for deep learning, got clean during preparation. During the preparation of the models on bigger datasets (for example CASIA-Iris-Thousand) the model just united accurately (for example to a sufficiently high degree), when segmentation was used. The immediate preparation of the information pictures leads the model to unite at a low exactness (10%-20%). Along these lines, for this situation, the segmentation likewise diminished the trouble of the issue by guiding the recognition model to a discriminative area, so the preparation was simpler. Last, that review suggested that more exploration may be needed to be led to additional research on the impact of iris standardization.

In (Wang, 2019) [14], a novel performs various tasks structure which comprises of two sections: the initial segment is a Fully Convolutional Encoder-Decoder Network outfitted with consideration modules which could learn more discriminative highlights for delivering different likelihood maps. By streamlining central misfortune (Lin, 2017) and adjusted sigmoid cross-entropy misfortune (Xie, 2015) [23], the model could lighten the class imbalanced issue and unite rapidly. The second part is a powerful post-handling strategy including edge denoising, Viterbi-based coarse forms identification (Sutra, 2012) [21], and least-squares circle fitting for iris limitation. Three delegate iris datasets and name the student place just as inward/external limit for every iris image were chosen. In addition, complete assessment conventions for assessing the presence of iris segmentation and restriction calculations were thought of. The strategy in that paper named IrisParseNet misused the intrinsic connections between's student, iris, and sclera to support up the presentation of iris segmentation and restriction in a bound together model.

In (Kerrigan, 2019) [15], triple novel, open-sourced irises segmentations apparatuses dependent on traditional neural nets was invendted, prepared for iris segmentations task, and not open-sourced beforehand in iris recognition setting: Deep ResidualsNetworks (He, 2016) [24], CNN joining expanded convolutions and SegNet; segmentation aftereffects of two model iris pictures the strategy how to apply the subsequent sporadic segmentation covers to a traditional, Gaborwavelet-based iris coordinating, alongside the appraisal of the subsequent iris recognition exactness acquired. Thus, the performance of the CNN was clear in the outcomes of the segemenation of the iris data. in which a large number of iris data has been obtained using various groups and various sensor data including those taken from CASIA Iris Intervals v-four Vio Sec, Nds Iris 405 UBIRISs WARSW Bio base posts Morterm Irises v2 posthumous irs pictures.

(Kuo,2019) [16], In this paper, the creators have presented another methodology for more precise iris acknowledgment. Compulsory student expansion and scale changes during the iris imaging establish the critical hotspot for the oftentimes noticed iris mishappenings. their methodology endeavors to resolve this issue by fusing the widened convolutional bit and remaining learning in our system for

more exact iris coordinating. Such a methodology additionally improved the engineering of the deep neural organization. The trial results utilizing within database and cross-information base execution assessment, on three diverse public iris picture data sets delineate beating results and approve the adequacy of this methodology. Iris pictures innately represent visual data and could be

consolidated in the deep neural organization model to additionally improve the iris picture coordinating with exactness and it is important for additional exploration around here. This methodology utilized the MaskNet which was independently prepared. Improvement of a start to finish engineering which can all the while overlook concealed pieces, or fuse start to finish MaskNet preparing, is deeply attractive and part of additional work in this domain.

In (Sardar, 2020) [17], an intuitive variation of UNet for iris segmentation was proposed. The Squeeze Expand modules were utilized in that work to lessen the preparation time. Simultaneously this would be improving capacity efficiency using the minimization in the number of boundaries included. The intelligent part helped with producing the ground truth for datasets having insufficient clarified examples. This work can be considered as a classification based method that utilized the prospects and the advancements of the deep learning techniques, in that paper it was discovered that the less unpredictable model helped with abstaining from over-fitting while at the same time preparing the generally more modest iris datasets accessible. Intelligent learning is joined to go around the issue of restricted explanations in the freely accessible iris datasets. The model can use picture explicit data for vigorous treatment of huge setting varieties among different pictures. Intuitive and robotized age of ground truth helped with lessening the time cost of specialists whereas creating precise segmentation.

In (Thakkar, 2020) [18], a Self-Learning computationally intelligence system was proposed. In this paper, the author used Gabor channels for making highlight vector from iris highlights. Here examination is with the prepared neural net was introduced. In this work, creators were utilizing a managed neural organization, which was first prepared with various contributions of various iris include vectors, and afterward, recognition was directed. After discovering edge picture from dim scale iris image and discovering Hough change from edge picture, the centroid of the inward circle of the student for the indicated sweep was acquired. The pixel position with the most noteworthy force is the middle mark of the inward circle of the understudy. iris ring from the picture is extricated with eliminating the pointless parts. At that point Map, the iris ring into square shape picture of 64x512 pixels was framed. low-pass Gaussian channel was then applied to eliminate commotion It has a high concentration of recurrence this cycle is called Normalize picture. 20 Gabor channels were acquired and applied all channels on 8 sub-pictures to get 160 sifted sub-pictures. the normal total deviation (AAD) from each sifted sub-pictures as highlights was figured. Making 1-D cluster of 160x1 as an element vector from AAD esteems. This one-dimensional cluster was applied as a contribution to the refined neural organization for getting yield as a certified client or not on the off chance that real client, the organization gives yield as file number of the individual. The proposed calculation separated comprehensive and restricted information of the iris. The execution showed results that this calculation can successfully confirm individuals by recognizing their irises.

In (Wang, 2020) [19], a high-proficiency deep learning-based iris segmentation approach was introduced. Unique to numerous past CNN-based iris segmentation strategies, which just an indication on foreseeing precise iris covers by

following well known semantic segmentation structures, this approach is a final segmentation of the iris system, i.e., iris masks and defined inward and external iris limits are together accomplished by effectively displaying them into a bound together perform various tasks organization. Also, an extravagantly planned consideration To enhance the segmentation execution, the module has been combined into it.. To prepare and assess the proposed approach, the equivalent datasets utilized in (Wang, 2019) were utilized. alongside different kinds of commotions. Also, a few bound together assessment conventions were worked for reasonable examinations. Broad analyses were directed on these recently explained information bases, and results showed that this methodology accomplished best-in-class execution on different benchmarks. Further, as an overall drop-in substitution, iris segmentation strategy that proposed above can be utilized for any recognition of iris technique, and would altogether improve the exhibition of non-helpful iris acknowledgment.

In (Zakaria 2017) [25], this paper doesn't use deep learning framework. Using biometric technologies to achieve security in airports, ports, and companies has proven to be extremely successful and secure when compared to traditional security methods. This is due to the fact that biometric technologies are associated with a user and cannot be lent or stolen, in addition to the fact that biometric technologies are not susceptible to dictionary attacks and are not susceptible to dictionary attacks Another conclusion is that there are no real characteristics in an iris that can be retrieved and utilized as references for categorization decision-making at a later point in the process. The final conclusion is that directed edge detection algorithms such as Canny and Hough are nearly always required in any IRS described in the literature. A novel method, referred to as HV projections, has been developed and tested for iris isolation, which is described in detail in this article. A two-step procedure was used to obtain the iris isolation required for the present study. The first step is to isolate the pupil region using HV projection, and then, based on the location of the pupil's center, the radius of the iris is estimated using a novel method to determine the radius of the iris, which is described below. In comparison to the implementation of the Mask System, these algorithms produced results that were almost identical, although with a shorter execution time. As soon as the isolated portion of the iris has been identified, it has been transformed into a rectangular and normalized shape, which allows us to get the iris in Cartesian coordinate. The iris has been twisted in order to highlight and show previously unseen characteristics of the subject. We choose the Log-Gabor filter for this convolution mechanism because it is the simplest filter that can modulate the iris pixels with sine and cosine frequencies, and it is also the most efficient. It has the power of Gabor (Gaussian modulated by sine/cosine), but it is far more straightforward to use in practice. In this way, the system may code the iris as a complex (pairs of coordinates) plane.

In Table 1, a summary of the most recent literature review was listed.

Tables 1. Litterature review summary

id	Reference	technique	data	Accuracy
1	(Zhao, 2017)	fully convolutional network (FCN)	ND-IRIS-0405 Iris Image Dataset (ICE 2006), WVU Non-ideal Iris Database – Release 1, IITD Iris Database, CASIA V4 distance and WVU Non-ideal Iris Database – Release 1	Higher performance using the FCN method
2	(Arsalan, 2017)	convolutional neural network (CNN)	The mobile iris challenge evaluation (MICHE) dataset and the noisy iris challenge evaluation part-II (NICE-II) when training database (both from the UBIRIS.v2 database) were used.	The overall accuracy of iris segmentation is better than the best techniques available.

3	(Karakaya,2018)	convolutional neural networks (CNNs)	Iris dataset with an off-angle view. It comprises 24360 iris photos from 2 near-infrared sensitive IDS-UI-3240ML-NIR cameras for 116 subject (Karakaya,2013)	Cropped pictures with just an iris texture produced better results
4	(Zanlorensi, 2018)	VGG and ResNet-50 networks	UBIRIS database sub-set.	The ResNet-50 models produced the greatest results here when non-segmented images were used.
5	(Varkarakis,2018)	Deep neural networks	The CASIA Thousand and Bath 800	Bath 800(99.12%) CASIA Thousand (99.34%)
6	(Bazrafkan,2019)	Deep learning	The CASIA Thousand and Bath 800	98.55% for the Bath 800 and 99.71% for CASIA
7	(Minaee, 2019)	deep learning/CNN	IIT Delhi iris database	95.5% accuracy
8	(Li, 2019)	DEEp learning/Faster R-CNN	CASIA-Iris-,ousand database	95.49% accuracy
9	(Khalifa, 2019)	DEEp learning/CNN	The original dataset contains 3,000 photos, 1,500 of which are of males and 1,500 of which are of women.	98.88%. accuracy
10	(Liu, 2019)	fuzzy pre-processing filters with deep learning	CASIA, ATVs and Vista datasets,	CASIA (83.1), Cogent (83.3), Vista (88.4) ATVS (89.2)
11	(Lozej, 2019)	CNN-based segmentation model	CASIA Thousand and SBVPI datasets	CASIA (82.87%) SBVPI (84.23%) Combined (86.05%)
12	(wang, 2019)	Fully Convolutional Encoder-Decoder Attention Network	UBIRIS.v2, CASIA-Iris-Distance, and MICHE-I	CASIA-Iris-Distance (94.30) UBIRIS.v2 (91.70)

13	(Kerrigan, 2019)	an existing iris identification technique based on Gabor wavelets	CASIAIris- Interval-v4, BioSec, ND-Iris-0405, ND-TWINS-2009-2010 (iris pictures obtained from twins), Warsaw-BioBase-Post-Mortem-Iris v2.0 (post-mortem iris photos)	Using deep learning-based segmentation to do Gabor-based iris matching does not always provide superior results.
14	(Kuo,2019)	residual network learning with dilated convolutional kernel	ND-IRIS-0405 picture of iris (ICE2006), WVU Non-ideal Iris Database - Release 1 , and CASIA V4-distance	results in superior precision over several classic and cutting-edge iris recognition methods
15	(Sardar, 2020)	deep learning/CNN	CASIA-IrisV4-Interval , IITD ,	CASIA-IrisV4-Interval (0.987) IITD (0.985)
16	(Thakkar,2020)		CASIA iris databases	99%
17	(Wang, 2020)	deep learning using CNN	CASIA.v4-distance MICHE-I, UBIRIS.v2, and MICHE-I	Improved noncooperative iris recognition performance considerably

as shown above, Convolution neural networks (CNNs) are a deep learning architecture that is often utilized in computer vision for recognition applications, extending from AlexNet to GoogLeNet, have advanced significantly in recent years and now outperform humans in terms of accuracy. in this survey of iris recognition, CNN used to have a good feature extraction than preprocessing.

3. Conclusion

Due to the increasing advancements in the area of artificial intelligence in different areas of life, therefore, it becomes important to review these advances and developments for further research. In this regard, iris recognition using deep learning techniques is considered one of the active research areas in the last decade, the thing that made it necessary to review the recently published works in this domain. The importance of iris recognition is not only limited to a particular set of applications; rather, it can be used in many different areas where authentication using biometrics is required. That the iris is considered as one of the most effective means used to identify one person from the other uniquely as each one of us has his/her own biometric eyes' iris patterns. Such property of the iris made it a competitive counterpart to other biometrics used such as fingerprint and face recognition. In this review paper, we scanned the most recent published works in the area of iris recognition. The idea we concluded in our paper that using deep learning techniques has been the most successful technique in the area of iris recognition. However, more studies are required to compare the different deep learning neural network structures used in this domain.

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