Survey on diagnosis of diseases from retinal images

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Abstract. Retina is a thin membranous layer of tissue that occupies at the back of the eye which provides central vision needed for daily routines. Identifying retinal diseases at the early stage is a challenging task since healthy retina is required for central vision. Several retinal diseases affect the eye such as retinal tear, retinal detachment, glaucoma, macular hole and macular degeneration etc. These maladies will encounter a secondary growth in the close future as the age of the person increases. A survey is made which tells about the diagnosis of the retinal diseases from the retinal images using machine learning techniques.

1. Introduction
Eyes are one of the most significant parts of the whole body that are used to see the whole world around us. It allows seeing things by reflecting light that falls on the articles. It is composed of retina, pupil, iris, cornea, and lens. Figure 1 shows the image of a normal eye.

The eyes contain light-sensitive cells with some nerve fibres that allow light coming to the eye to be transferred as nerve impulses to the brain. The light entering the eye is prohibited by the iris which then moves to the retina. Retina is a thin membranous layer of tissue that involves at the back of eye which provides central vision needed for daily routines. As with the age, the retina gets affected with a number of diseases. Diagnoses of the diseases of the retina have now become a must because many people are likely to become blind if these diseases are not diagnosed at an early stage. Nowadays since the amount of patients data are increasing, it imposes a challenge on the clinical routine such as diagnosis, treatment and monitoring. It is proposed, that with the help of machine learning techniques, it is possible to diagnose the diseases from the retinal images. Retinal diseases can be diagnosed automatically using machine learning technique. The types of retinal diseases are:

- Retinal tear
- Retinal detachment
- Glaucoma
- Diabetic Retinopathy
- Macular Hole
- Macular Degeneration
2. RETINAL DISEASES
Retinal ailments differ widely, be that the greater part for them cause visual side effects. Retinal maladies might influence whatever and only our retina, a slim layer of tissue on the inside of our eye. The retinal diseases are:-

- Retinal tear
- Retinal detachment
- Glaucoma
- Diabetic Retinopathy
- Macular Hole
- Macular Degeneration

2.1. Retinal Detachment
The retina will be those light-touchy bands of tissue that curve central of eye and sends observed letters through the optic axon to brain. When the retina detaches, it is aerial or pulled from its accustomed position. If not immediately treated, retinal detachment could account abiding eyes loss. In some cases there may be little areas of the retina that are torn. These areas alleged retinal tears or retinal breaks, can lead to retinal detachment. A retinal detachment can happen during at whatever age; in any case it will be all the more regular over individuals over 40. It influences men more than ladies, furthermore Whites more than African Americans. A retinal detachment will occur on people who:

- is greatly myopic
- has retinal detachment in the other eye
- bring a family history of retinal detachment
- had cataract surgery.
- different eye sicknesses or issue, for example, such that retinoschisis, uveitis, degenerative myopia, or lattice degeneration.
- had eye harm.

The indications of retinal detachment are:

- smeared dream.
- powerlessness to see in faint light.
- incomplete misfortune for dream.
- perceiving flashes for light.
- seeing spots.
- affectability on light.
- impermanent misfortune of dream on particular case eye.
- tunnel vision or dream passing.

Figure 2 shows an image of retinal detachment.

2.2. Retinal Tear
A retinal tear occurs when the retina separates from the external layers of the eye. If not treated early, retinal tear could prompt an additional not kidding condition known as retinal detachment, which might prompt to complete reduction of eyesight. Retinal tear action back those gel-like vitreous in the eye turns into added aqueous also exerts an aberrant cull on the retina. We are at a higher risk of retinal tear if we:
• are myopic (short sighted)
• suffer from glaucoma, diabetes, or acquired immune deficiency syndrome (AIDS)
• have had previous retinal detachments or tear
• carry a family history of retinal detachment
• have feeble region on our retina
• have had cataracts or other eye surgery, or any other eye trauma.

The symptoms of retinal tear are:
• a sudden expanding in area and number of floaters, demonstrating a retinal shred might be happening.
• an sudden occurrence of flashes, which might be the initial stage of a retinal tear.
• hosting a shadow show up in the fringe (side) of our field of vision.
• perceiving a gray shade moving crosswise over our field of vision.
• an sudden damage to our eyesight.

Figure 3 shows an image of retinal tear.

2.3. Glaucoma
Glaucoma may be an assembly for eye infirmity that might prompt visual deficiency toward harming the optic nerve. The additional liquid called aqueous expands the weight previously, of our eye, harming that optic nerve. Glaucoma may be a heading reason for vision loss at the age of 60 or more.

Open-angle glaucoma may be three times less averse with influence to African-Americans, compared with non-Hispanic whites in the United States.

Furthermore visual deficiency from glaucoma may be no less than six times all the more pervasive around.

Glaucoma frequently is called the "silent thief of sight," because it causes no pain and no symptoms are seen until vision loss takes place.

2.4. Diabetic Retinopathy
People for diabetes could have an eye illness called diabetic retinopathy. This will be the point when helter skelter glucose levels make harm on blood vessels in retina. These blood vessels can dilate and spill. Alternately it might close, ceasing blood from passing through. Here and there unusual new blood vessels develop on the retina. All these can lead to eyesight loss.

Diabetic retinopathy happens when blood glucose levels lead to changes alongside retinal blood vessels. In some of the cases, these vessels will swell up (macular edema) and spill liquid under the back of the eye. In other cases, abnormal blood vessels will develop on the surface of the retina. Treated unless, diabetic retinopathy could bit by bit end up in also advancing from foundation retinopathy on genuinely influencing dream and might prompt visual deficiency.

The average indications of retinopathy to gaze out include:
• sudden demise progressions for dream / smeared dream.
• eye floaters and spots.
• two fold vision.
• eye ache.
2.5. **Macular Hole**

The macula may be the tiny, national range of our retina (the keeping label surface at the back of our eye). It permits us to see things anon in advanced of us, and also gives us view colour and point of interest. A gap in the macula could settle on blurring, spotless spots also twisting for our focal vision.

A macular gap may be a little softens up the macula, placed in the focus of the eyes light-touchy tissue known as the retina. The macula gives the sharp, focal vision we necessitate for reading, driving, and perceiving fine point of interest. A macular gap might result in smeared and bended focal vision.

As we age, that vitreous gel inside the eye regularly shrinks and pulls far starting with the retina. Occasionally, the vitreous gel might draw on the retina also make a macular gap. On a percentage cases, those fluid that fills the hole cleared out toward the vitreous gel might leak through those gap onto those macula, creating blurring and twisting.

Other conditions that increase risk are that vicinity of an additional eye condition that might expand our possibilities of creating a macular gap. These include:

- extreme short sightedness.
- epiretinal membranes that advance the macular wrinkle stage.
- retinal separation.
- diabetic retinopathy
- eye harm alternately trauma.

A macular hole by just, influences our focal vision, along these lines our fringe alternately side dream will stay unaesthetic. Some might experience issues for perusing whats more close to work; furthermore some might perceive ash or dark spots, or plain areas, previously, our dream. Macular hole typically influence some to quit offering on that one eye, instead of both, in spite of, it could be allowed for both eyes which influence toward macular hole.

Macular hole typically develop through time, so we might not notice at whatever indications until our dream may be influenced. Punctual signs fuse blurring furthermore curving from claiming our vision, besides we may recognize straight lines (such concerning illustration window frames, show poles alternately lines for text) indicating up turned or wavy.

2.6. **Macular Degeneration**

Macular degeneration is those which tumble down the focal bit of the retina, the individuals inside-back layer of the eye that records those pictures we view, and sends them by means of the optic nerve starting with the eye to the cerebrum. The retinas vital portion, known as the macula, will be answerable for keeping label focal vision in the eye, furthermore it controls our capability to read, drive a car, perceive appearances alternately colours, and to see questions clinched alongside particular point of interest.

The greatest danger figure for macular degeneration is age. Our risk increases as we age, and the pain is best acceptable to action in those 55 and older. Other accident factors include:

- **Genetics**—People with an ancestors history of AMD are at a higher risk.
- **Race**—Caucasians are added acceptable to advance the ache than African-Americans or Hispanics/Latinos.
- **Smoking**—Smoking doubles the accident of AMD.
On we would in the initial phases about age-related macular degeneration we might not need indications. To begin with, sign we might notice a gradual or sudden demise progress in the nature about our dream or that straight lines show up bended on us. This might bit by bit transform under an emotional passing about our focal vision. Other symptoms include:

- Dark, blurry ranges alternately whiteout that shows up in the focus of our dream.
- In extraordinary cases, we might bring a change done on recognition of colour.

Though different methods are used to diagnose different retinal diseases but among them retinal tear and retinal detachment is mainly given focus.

3. DIAGNOSIS METHODS
Retinal ailments can be a chance to be identified with aging, diabetes alternately different diseases, trauma of the eye, or family history. The diagnosis of these diseases is needed at an early stage before it becomes worse.

The methods used for the diagnosis of the mentioned retinal diseases are:

3.1. Pre-processing
Pre-processing may be a method that includes transforming crude information under justifiable configuration. It may be a change of the picture information that suppresses unwanted distortions alternately enhances a few picture characteristics vital to further transforming.

The techniques used in pre-processing are:

- RGB to Gray image - The original image or the input image is converted to gray image for the diagnosis of the disease.
- Image Enhancement - Image enhancement is the process to brighten the image so that it becomes easier to identify the key features of the image.
- Background noise elimination - The background noise means some spots or flashes if present in the image is eliminated.

3.2. Region of interest (ROI)
A region of interest (ROI) is a part for a picture that is used to channel or perform some other operation for diagnosis. A ROI may be made by a double mask, which is a double picture that is the same measure as the picture on be transformed.

3.3. Feature extraction
Feature extraction is the process of reducing the amount of resources from a large set of data which starts with the initial set of measured data and builds derived features which are informative.

The techniques used in feature extraction are:

- Histogram of oriented gradients (HOG) - HOG is a characteristic descriptor utilized within computer vision and image processing to the reason for item identification.
- Speeded up robust features (SURF) - Surf will be a nearby characteristic extractor and descriptor. It can be acclimated for tasks such as article recognition, angel classification etc.
- Haar Wavelets - Haar Wavelets is an arrangement about square formed function which together form a wavelet starting with a wavelet family or premise.
• Colour Histogram—Colour histogram is a graphical representational of the number of pixels over a picture. It speaks to the dissemination of the creation about shades done on a picture.

3.4. Machine Learning
A field of computer science that gives computers the capacity to learn without being distinctly programmed. It is also a part of Artificial Intelligence (AI). Machine learning is concerned with the arrangement and up-gradation of intelligent algorithms that empowers system to learn from data without being programmed. It mainly focuses on how to spontaneously recognize complex patterns among data and make intellectual decisions.

The types of machine learning algorithms are:

• Supervised learning—Here the computer is given an input to get the desired output.
• Unsupervised learning—In the case of unsupervised algorithm, a target or outcome variable is not predicted.
• Reinforcement learning—In this algorithm, the system is trained to make particular decisions.

Some common machine learning algorithms are:

• Linear Regression—It is used to estimate real values based on continuous variables.
• Logistic Regression—It is used to estimate discrete values based on a given set of independent variables.
• SVM (Support Vector Machine)—It is a classification algorithm. A learning model with related learning algorithms. This can be used to analyze data used for classification and regression analysis.
• Naive Bayes—A technique which is used for classification. This accepts that the presence of a specific feature in class is not associated to the existence of any other feature.

4. CONCLUSION
After going through all papers the retinal diseases which have been diagnosed so far are discussed. After surveying the papers, it is found that research focus can be made on the retinal diseases like the retinal detachment, retinal tear. So, it is proposed that two diseases such as retinal detachment and retinal tear can be diagnosed using machine learning techniques.

5. RELATED WORKS
Muhammad Salman Haleem, Liangxiu Han, Jano van Hemert, Baihua Li and Alan Fleming [1] proposed a novel methodology will naturally extricate out valid retinal territory starting with a SLO picture in view of image transforming also machine taking in methodologies. Recognizing genuine inconsistency retinal zone starting with artefacts on SLO pictures may be a testing task, which may be also the to begin with essential step at computer-aided sickness finding. A finish retinal scan may be receptive whether that retina will be beheld from modified eye-steered angles requisition a ultra wide field SLO also then, montaging the steady picture. Montaging is done alone to those artefacts which need aid and when emptied.

Langade Umesh, Malkar Mrunalini, and Swati Shinde [2] described the application of various image processing which are enhancement, feature extraction, image fusion and machine learning techniques which are Naive Bayes, KNN, SVM, PCA etc for detection of eye diseases. Image
processing techniques and machine learning algorithms is used. Eye disease detection and recognition can be achieved with the use of Image Processing and Data Mining techniques.

R. Priya and P. Aruna [3] analyzed diabetic retinopathy and three models such as Probabilistic neural plan (PNN), Bayesian arrangement and support vector machine (SVM) were compared. The massiveness of the disease spread in the retina can be recognised by extracting the appearance of the retina. The effectiveness of the right arrangement can be improved by extracting superior features and eventually expanding the number of information for each class also likewise by joining with different pattern classification models.

Parul and Neetu Sharma [4] proposed that the disease recognition and classification approaches are specific to human organ and image type. One of such disease class includes Identification of retinal disease for example, such that glaucoma detection or diabetic detection. It defines a study on disease recognition approaches such as SVM, DCT, HMM and PCA approaches. It also defines the image processing operations applied to filter the medical image and to perform disease area segmentation. It defines a work on medical image processing, classification and disease recognition. It has defined the basic filtration model to improve the image features so that effective disease recognition will be done.

Patitapaban Rath [5] proposed different algorithms and techniques of image processing and pattern recognition have been proposed for detecting and differentiating the normal eye from an infected eye. Automatic detection of different diseases of retina have been proposed and tested which helps the physicians to diagnose the disease with more accuracy. Following a brief review for identifying retinal vessels where the techniques of image processing and machine learning taken into consideration. A review of work done in the field of automatic detection of retinal vessels and various retinal pathology is highlighted.

Minal B.Wankhade and A. A. Gurjar [6] proposed the detection of retinopathies in patients, retinal image analysis which is a key element. The blindness induced by alternating in the blood vessels of retina because of diabetic retinopathy will be one of the most relatable diabetic eye conditions. The blood vessels can be detected effectively by a new algorithm. Initially enhancement of the image is carried out using suitable transform. The retinal picture difference keeping might have been moved forward utilizing suitableness change furthermore readied preferred to division. That technique adequately detects the thin blood vessels that indicate those execution outcomes about both segmentation and enhancement steps.

Sandra Morales , Kjersti Engan, Valery Naranjo and Adrian Colomer[7] investigated bigotry capabilities in the adjustment of fundus images to differentiate amidst anatomization and advantageous images. For this purpose, the accomplishment of local binary patterns (LBP) as a adjustment descriptor for retinal images has been explored and compared with added descriptors such as LBP description and belted actualization quantization. Five experiments were planned and approved for the suggested system acquiring guaranteeing outcomes. For each experiment, a few classifiers were tried. A normal affectability also specificity higher over 0. 86 on the whole the cases and very nearly about 1 whats more 0. 99, respectively, for AMD identification were attained. These outcomes infer that the strategy will be a hearty algorithm to describing retina composition also can be advantageous in an analysis help framework to retinal ailment screening. Work is done in the field of automatic detection of retinal vessels and various retinal pathology has been highlighted.

Muhammad Nadeem Ashraf ,Zulfiqar Habib and Muhammad Hussain [8] proposed that dia-
abetic retinopathy (DR) is a muddling the place the retina of a diabetic tolerant is harmed because of liquid spillage starting with the blood vessels under the retina and the tolerant might fair from complete visual deficiency whether untreated. Haemorrhages and Micro-aneurysms (HMA) would that right on time indications that show up over retina at those starting phase about DR. That examination of composition micro-patterns of the districts for enthusiasm (ROIs), which would suspicious areas on a fundus image, for the identification for HMA. Composition micro-structures from claiming ROIs would broke down through nearby local binary pattern (LBP) for their portrayal. At long last help vector machine (SVM) will be utilized should distinguish if an ROI holds HMA or not. The results obtained might a chance to be improved eventually expanding those annotated dataset. Further tests could a chance to be performed utilizing polynomial part on check change on effects.

Maya Alsheh Ali, Thomas Hurtut, Timothe Faucon and Farida Cheriet [9] analyzed the preliminary ponder to glaucoma identification utilizing a programmed technique dependent upon neighbourhood composition features will be concentrated from fundus photographs. It executes the finished modelling for neighbourhood double designs will catch delegate test composition Characteristics from that entire picture. On a sample set of 41 fundus images, the method achieves 95.1 percent success rate with a specificity of 92.3 percent and a sensitivity of 96.4 percent. The contemplate proposes a proliferation glaucoma identification methodology that might be utilized within a low-evaluated restorative screening, along these lines avoiding those inter-experts variability issue. Future worth of effort will incorporate a programmed framework to focus that ideal quality for these parameters, and also perform a broad acceptance to survey its dependability done clinical screening.

Yu-Ying Liu, Mei Chen, Hiroshi Ishikawa, Gadi Wollstein, Joel S. Schuman, and James M. Rehg [10] proposed a novel issue space in the examination about optical rationality tomorrow (OCT) images: the finding for numerous macular pathologies for retinal oct pictures. The objective will be to recognizing those vicinity from claiming typical macula Also every for three sorts about macular pathologies, namely, macular hole, macular edema besides age-related macular degeneration, in the oct reduced kept tabs throughout the fovea. A machine bringing clinched alongside technique might make reliant upon overall picture descriptors encircled from a multi-scale spatial pyramid. The close-by descriptors would dimension-reduced close-by twofold sample histograms, which might fit from guaranteeing encoding piece information beginning with oct portraits of the retina. Two-class backing vector machine classifiers would used to recognize that vicinity from claiming typical macula also each of the three pathologies. The outcomes indicate that those recommended system is exact viable. On research the impacts for including other complimentary features. To apply a comparative system to naturally confine those cut of the anatolian dialect point of interest in the 3d examine. To augment the methodology to extra retinal pathologies.

Jeffrey De Fauw , Pearse Keane , Nenad Tomasev , Daniel Visentin, George van den Driessche , Mike Johnson , Cian O Hughes et all [11] proposed that the ophthalmic imaging gives an approach for diagnosis. Furthermore objectively evaluate the individuals progression of an add up to pathologies including neovascular (wet) age-related macular degeneration (wet AMD) Moreover diabetic retinopathy. Two strategies from asserting imaging might generally use: propelled photographs of the fundus (the tray of the eye) besides optical reasonability tomtate (OCT, a modality that usage light waves with respect to a similar approach for how ultrasonic employments unfeeling waves). A machine taking in calculations may be utilized to those programmed investigation from claiming both advanced fundus photographs also oct.
Sallam Osman Fageeri, Shyna Mogtaba Mohammed Ahmed, Sahar Abdalla Almubarak and Abubakar Aminu Muazu [12] proposed that a canny machine taking in calculations can be used to arrange the sort of an eye malady dependent upon ophthalmology information gathered starting with patients from claiming Mecca healing centre in Sudanese. Three machine-learning systems need aid used to anticipate those reality of the eye that happened for the individuals investigation, which compelling reason help guileless Bayesian, SVM, Besides J48 decision tree. Those observed result exhibited that J48 classifier outperforms both guileless Bayesian and likewise SVM.

Yuen Aoi Chee, Masturah Mohamed Mokhtar, Rania Hussien Al-Ashwal and Eko Supriyanto [13] proposed that retinal detachment is a condition where the retina separate from its underlying tissue and cause destructive visual consequences to the patient and is readily diagnosed. It presents analysis of ultrasound ocular medical images through an image extraction and identification approach to improve the quality of the retinal detachment image. The number of connected region is calculated in the existing image and successfully identified the location of retinal detachment-using distance measure.

Hideharu Ohsugi, Hitoshi Tabuchi, Hiroki Enno and Naofumi Ishitobi [14] proposed that rhegmatogenous retinal detachment (RRD) is a serious condition can lead to blindness; however, it is highly treatable with timely and appropriate treatment. Thus, early diagnosis and treatment of RRD is crucial. Deep learning, a machine-learning technology, is used to detect RRD using ultra-wide-field fundus images and investigated its performance. The deep learning model demonstrated a high sensitivity of 97.6 and a high specificity of 96.5 and the area under the curve was 0.988. This model can improve medical care in remote areas where eye clinics are not available by using ultra-wide-field fundus ophthalmoscopy for the accurate diagnosis of RRD. Early diagnosis of RRD can prevent blindness.

6. FIGURES AND FIGURE CAPTIONS

The figures and figure captions are given below:

**Figure 1.** Normal eye image

**Figure 2.** Retinal Detachment

**Figure 3.** Retinal Tear

7. REFERENCES

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