TO STUDY AND ANALYZE THE EFFECT OF DIABETES ON RETINA

Dissertation submitted in fulfilment of the requirements for the Degree of

MASTER OF TECHNOLOGY

in

COMPUTER SCIENCE AND ENGINEERING

By

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TOPIC APPROVAL PERFORMA

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PROPOSED TOPIC : Study of diabetes effect on Reina using Image processing i.e Diabetic retinopathy

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	7.33
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	6.67
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	6.83
4	Project Supervision: Project supervisor's is technically competent to guide students, resolve any issues, and impart necessary skills.	7.67
5	Social Applicability: Project work intends to solve a practical problem.	7.00
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ABSTRACT

The diabetes is the disease which affects the human health and also its affect can be shown on the human retina. In this research, the diabetes which cause blindness in the human retina which is detected by using k-mean clustering. In the k-mean clustering algorithm, the central point will be calculated and from that point Euclidian distance will be calculated. The points which have similar value will be clustered in one cluster and other in the second cluster. The technique of classification will be introduced which can classify diseases and non-diseased portion it directly increase accuracy and reduce execution time.

DECLARATION STATEMENT

I hereby declare that the research work reported in the dissertation/dissertation proposal entitled "TO STUDY AND ANALYZE THE EFFECT OF DIABETES ON RETINA" in partial fulfillment of the requirement for the award of Degree for Master of Technology in Computer Science and Engineering at Lovely Professional University, Phagwara, Punjab is an authentic work carried out under supervision of my research supervisor Mr. Krishan Bansal. I have not submitted this work elsewhere for any degree or diploma.

I understand that the work presented here with is in direct compliance with Lovely Professional University's Policy on plagiarism, intellectual property rights, and highest standards of moral and ethical conduct. Therefore, to the best of my knowledge, the content of this dissertation represents authentic and honest research effort conducted, in its entirety, by me. I am fully responsible for the contents of my dissertation work.

SANDEEP KAUR

11614250

SUPERVISOR'S CERTIFICATE

This is to certify that the work reported in the M.Tech Dissertation proposal entitled "**TO STUDY AND ANALYZE THE EFFECT OF DIABETES ON RETINA"**, submitted by **Sandeep Kaur** at **Lovely Professional University, Phagwara, India** is a bonafide record of her original work carried out under my supervision. This work has not been submitted elsewhere for any other degree.

Signature of Supervisor
Mr. Krishan Bansal

Date

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Chapter 1

Introduction

1.1 Image Processing

The operation which is used to improve, correct, analyze, manipulate or render an image is described by image processing. The image data which have to process can be in 2D, 3D or 4D waves. The driving force behind example based image processing is that many complicated image processing tasks can be simplified considerably if some information on the desired effect or outcome is given as an input (Thomas M. Deserno, et.al.,). There are number of applications area where image processing is used such as images from satellites, space probes and aircraft are enhanced by using image processing. The appropriate analysis tools are provided by image processing even in those cases where data have nothing to do with image processing. The use of image processing is getting increased day by day due to the number of advantages provided by it. The advantages of image processing are given below:

- Easy availability of powerful personnel computers
- Large size memory devices
- Graphics software etc

These are the few advantages of image processing due to which its use is getting increase in different application area.

In image processing number of techniques have been developed from last few years and most of the newly developed techniques are for the purpose of enhancing the images which have been obtain from different sources (Hongmei Zhu). Those sources can be space probes, spacecraft and military reconnaissance flights.

Applications of image processing: The requirement of image processing has been emerged from two principle areas of application given below:

- Improvement of pictorial information for human interpretation, and
- Processing of scene data for autonomous machine perception.

There are some applications area where use of image processing is increased to much extent are given below:

- Remote Sensing
- Medical Imaging
- Non-destructive Evaluation
- Forensic Studies
- Textiles
- Material Science
- Military
- Film industry
- Document processing
- Graphic arts
- Printing Industry

There are number of purpose for performing the image processing. Mainly these purpose are divided into 5 groups given below:

- Visualization - Observe the objects that are not visible.
- Image sharpening and restoration - To create a better image.
- Image retrieval - Seek for the image of interest (B. Muthazhagan, et.al.).
- Measurement of pattern – Measures various objects in an image.
- Image Recognition – Distinguish the objects in an image.

There are mainly three common steps in image processing given below:

- Image scanning
- Storing
- Enhancing and interpretation.

1.2 Diabetic Eye Diseases

The metabolic disorder diabetes mellitus is characterized using chronic hyperglycemia along with disturbances of fat, protein and carbohydrates that comes due to defects in insulin secretion, insulin action (Zander E., et.al.). In India as well as in world diabetes has become one of the fast increasing threats in health. The damages of eye are the most feared complications of diabetes. It has been estimated that non diabetic patients have less risk of going blind then in diabetics' patients. The visual impairment major causes

are changes in diabetic retinal and then it is imposed as a particular health, social and economic problems (Hansen A., et.al.). The diabetic retinography and maculopathy are the two main complications associated to the retina. It has been surveyed that diabetic retinopathy will there in around 10% of diabetic patients. The delaying and decrease in visual activity can only be achieved doing early and complete photocoagulation of the affected area.

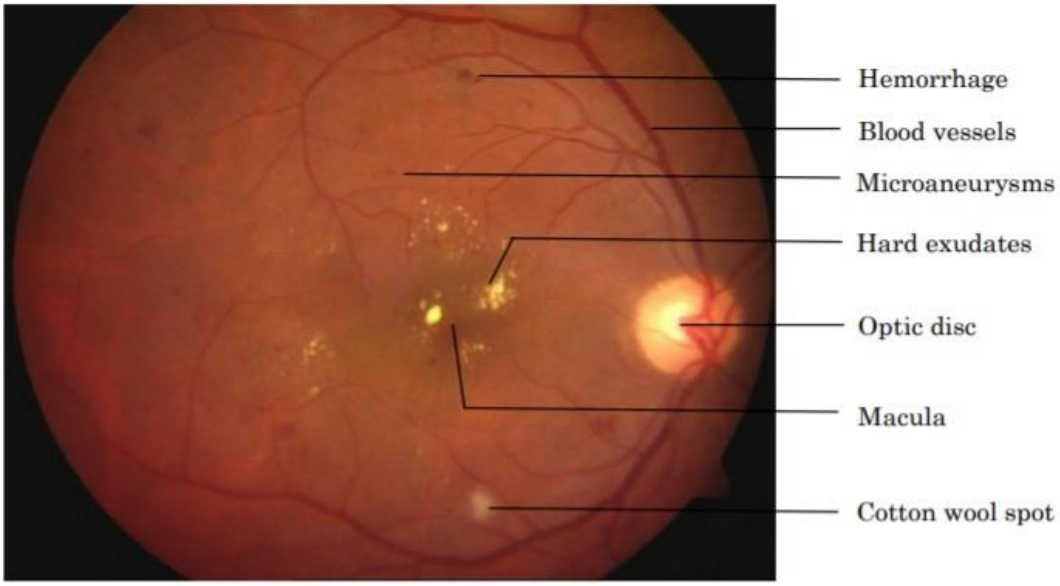

Fig. 1: Anatomical and pathological features in colour retinal image.

The above shown Fig.1 shows the diagram of Anatomical and pathological features in color retinal image.

1.3 Techniques to detect diabetes through Retina images

In most of the clinical applications a high resolution images that are offered by digital imaging systems are prove to be sufficient. A permanent, high quality record retinal digital image can be taken in ophthalmology that contains the appearance of retina with diabetic retinopathy screening program applications (Chowdhury T. A., et.al.). A images analysis of objective quantitative fundus images can be performed on digital retinal images on which automated diagnosis is performed that help in decision making. In terms of colour there is lots of images variability that makes analysis of retinal images very complicated. The interpretation can be erroneous due to retinal anatomical pathological

structures morphology that contains different features of particular patients. This issue need to me resolved by developing new retinal image analysis method.

1.3.1 Vessel segmentation methods:

The number of ophthalmologic conditions diagnosis requires a retinal vasculature segmentation and measurement as a primary interest (Al-Rawi M., et.al.). In order to identify retinal anatomy and pathology it is required that retinal blood vessels segmentation should be accurate. The obtained patient images at different time's registration require a segmentation of vessels that prove to be useful. There are four main approaches on which the existing vessel extraction techniques and algorithms are classified given below:

- **Matched filter approaches:** In order to extract object of interest there is need to perform convolution on matched filtering images that uses large number of filters. The Gaussian or Gaussian derivative filter profile is designed to match with their blood vessels and in order to fit those different orientation vessels the kernel is incremented by 30 to 45 degree of rotations (Chaudhuri S., et.al.). A vessel image is obtained by threshold the each pixel selected a highest Matched Filter Response (MFR).

- **Vessel tracking approaches:** In this approach a vessel are segmented into two points unlike the previously used method for vasculature segmentation (Wu D., et.al.). Rather than working on entire vasculature it will only work at single vessel level. This approach typically steps along the vessel and various properties are used to determined center of longitudinal cross section of vessel that also includes measured torusity during tracking and average width of vessel. Highly accurate vessel width and individual vessels information is provided using this approach that can't be obtained using other methods.

- **Classifier based approaches:** The vasculature like methods of retinal features segmentation are performed using artificial neural networks by different researchers (Akita K., et.al,). A matched filter and neural network operations are

analogous to each other as sub window of images are taken by both that return output as measure of probability.

- **Morphological approaches:** the vascular shape features are exploited using morphological image processing and are taken as connected or piecewise linear (Zana F., et.al,). In vessel segmentation it is useful to use an algorithm that extracts linear shapes.

1.3.2 Optic disc and Macula detection methods: In analysis of retinal images it is important to know the location of optic disc that are used for vessel tracking as a reference length (Goldbaum M., et.al,). The retinal images distance is measure using it and it is also useful in registration changes due to diseases in optic disc region. A improved performance of lesion diagnosis can be achieved by removing the regions of false positive optic disc in case of identification of diabetic retinopathy lesions. The glaucoma detection can be possible by varying the diameter of disc. The localization and boundary detection can be performed using various methods and below given a different existing methods along with its drawback.

- **Optic disc localization:** In optic disc region a optic disc can be located in retinal images by varying the optic disc region gray level (Katz N., et.al,). The bright pixels largest cluster can be identified that helps in localizing the optic disc. In retinal normal images the optic disc localization can be performed using this simple, fast and reasonably robust algorithm with negligible variations between images.
- **Optic disc boundary segmentation:** It is a non trivial problem and optic disc contour segmentation is performed after disc localizing. The disc localization can be performed by using morphological filtering technique and color space transformation
- **Fovea localization:** The fovea is temporal to the optic nerve head that is darken in colour without any blood vessels present in the center. It is used for fine vision and it a part of retina that lies in the macula center (Ibanez M., et.al,).

1.3.3 Hard exudates detection methods: In diabetic retinopathy most commonly occurring lesions is exudates that are associated with vascular damage patches along and leakage. When the disease is in progress then the exudates sizes and distribution will vary according to it. The diabetic retinopathy assessment and mass screening contributed by quantification and detection of exudates.

1.3.4 Automatic retinal screening systems: A computer based retinal screening system is required to handle the ever increasing diabetic population and fundas images availability in digital format. The diagnosis aid and ophthalmologists workload will be save using automatic screening system that automated detect the system performance (Abràmoff D. M., et.al,). This has been seen that system performance has been evaluated for automated detection of retinopathy will result in retinopathy in fundus images automated detection.

1.4 Flow chart to detect diabetic patients from retinal images: The below shown fig.2 shows the flow chart of detecting diabetic patient from Retinal images.

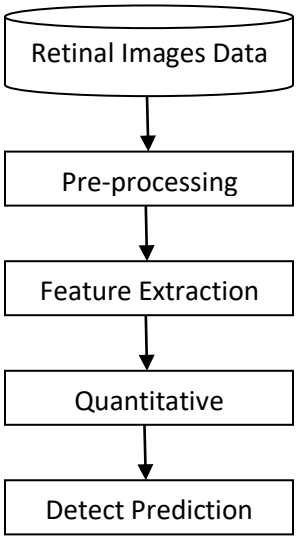

Fig. 1: Flow chart to detect diabetic patient from Retinal images

1.4.1 Retinal images data set:

A large set of high resolution images are provided by different platform. These images are taken under different conditions of imaging (G. Bergers, et.al.). A clinician (trained

pathologist) has rated the data set in the presence of diabetic retinopathy in each image on a scale of 0 to 4, according to the following scale:

0 - No DR

1 - Mild

2 - Moderate

3 - Severe

4 - Proliferative DR

The variety of models and cameras has been used for taking images due to which some images may be dark and out of focus. The data set can include number of images of normal and diabetic retinopathy for performing analysis on it.

1.4.2 Pre-processing: In pre-processing step the images are pre-processed in order to detect diabetic retinopathy. In this step mainly segmentation of images has been take place that help to ensure only relevant features are displayed by dataset. The images are divided into two sections name as normal and abnormal substances. The features are enhanced after being segmented.

1.4.3 Feature Extraction: The next step of pre-processing is extracting the features of segmented and enhanced images (C. I. Sanchez, et.al.). There are different types of features that are extracted given below:

- **Optic distance:** The optic nerve fibers leave the retina at optic distance or optic nerve head in eye that carries about 1 million neurons from eye towards the brain.
- **Fovea:** The fovea vision is a cone cells that found in that area and attracted towards ganglion cells and provide sharpest central vision in retina.
- **Blood vessel:** The subconjunctival hemorrhage occurs when small, dedicate blood vessels break beneath the tissue covering white portion of the eye. In case of normal images Blood vessel area is 37230.56 that reduces due to contraction occurs in diabetic retinopathy.

- **Exudate number:** The lesions area or inflammation area is filter out the exudates fluid from circulatory system. The white blood cells, fibrin and serum composed a fluid.
- **Edema:** The area in retina center name as edema is made by fluid available in the macula. The retina is present at the back of eye that are light effected fragile tissue on the other hand a portion of retina is name as macula that are mainly responsible for sharp, straight ahead vision.

1.4.4 Quantitative analysis and detecting prediction:

This is the last step of detecting the diabetic and non diabetic person on the basis on features extracted from last step.

Chapter 2

Literature Survey

Enrique V. Carrera, et.al, (2017), have analyzed that diabetic patients are commonly suffer from eye diseases that results in main cause of blindness in the population. The vision loss can avoid by early detection of diabetic retinopathy. In this paper, authors have proposed a computerized diagnosis based on digital processing of retinal images that help people to advance detection of diabetic retinopathy. The classification of non-proliferative diabetic retinopathy grades in any retinal image is the main objective of proposed approach. In order to achieve that an initial image processing stage isolates blood vessels, micro aneurysms and hard exudates to extract features. The extracted features given to Support vector machine (SVM) that help in figuring out the retinopathy grade of each retinal image. The database of 400 retinal images is used for testing the proposed approach that labeled it according to a four grade scale of no-proliferative diabetic retinopathy. The results show that the maximum sensitivity of 95% and 94% predictive capacity has been obtained using it. They have also evaluated the robustness with respect to changes in algorithm parameters.

G. Nagarjuna Reddy, et.al, (2016), have presented a new better technique for identification of micro aneurysms (MAs) in retinal fundus images. In order to classify diabetic retinopathy (DR) it becomes necessary to diagnose it. The ROI processing has been removed using this new optic disc technique. The MA identification has been achieved using cross section profile analysis of local maximum smoothing image pixels. The peak shape, width and height is obtained after detecting peaks for each profile. In all directions around 360, these properties are calculated for each local maximum profiles. On above specified characteristic, a feature set for classification constitutes Statistical properties like mean, standard deviation, coefficient of variation. To achieve MA classification a KNN classifiers has been used. The proposed techniques in this paper, is able to identify vessels crossings, optic veins and MAs. The simulation results show that

the proposed scheme is prove to be very efficient as compared to existing methods by removing optic disc in preprocessing.

Karan Bhatia, et.al, (2016), analyzed that Diabetic Retinopathy is one of the human eye disease. This can cause complete blindness by damaging retina of eye so, it is necessary to detect diabetic retinopathy in early stages. It can be detected using different physical tests like visual acuity test, pupil dilation, optical coherence tomography. In this paper, authors have given a review on decision about the presence of disease by applying ensemble of machine learning classifying algorithms on features extracted from output of different retinal image processing algorithms. They have proposed a method in which author will train individual classifier algorithm and not the ensemble of that. Then the extracted features will be used to train the classifiers and the best individual classifiers are used to identify DR or non-DR categories. This algorithms can be diameter of optic disk, lesion specific (microaneurysms, exudates), image level (prescreening, AM/FM, quality assessment). In last it has been concluded that different alternating decision tree, adaBoost, Naïve Bayes, Random Forest and SVM has been used in decision making for diabetic retinopathy prediction.

Jiri Minar, et.al, (2016), have proposed a novel method that helps in extracting human eye medical images veins and blood vessels. The ophthalmology can use retinal fundus images that help in detecting various eye diseases like glaucoma, diabetic retinopathy or macula oedema. In this paper, a CLAHE algorithm adaptive histogram equalization image processing approach has been utilized by authors that are taken from green channel of fundus retinal images. The use of image convolution with filter mask and adaptive filters are the proposed algorithm key points then small segments from image has been removed by applying erosion processed image operation on it. This will help in enhancing blood vessels extraction from fundus image and then public fundus image dataset has been used to analyzed the detection and precision evaluation of proposed approach. There are different datasets that can be used like public fundus image libraries DRIVE, and HRF. In last they obtained results are compared with reference training results provided by these libraries. The results shows improvement using adaptive filters

in case of HRF database accuracy achieved is between 91.92 % - 96.37 %. In case of DRIVE database accuracy achieved is between 96.07 % - 97.19 %.

Caroline Viola Stella Mary, et.al, (2016), recommended the use of image processing technologies in ophthalmology due to increase in development of digital imaging and computer vision. The development in medical diagnostic systems has started using image processing system for standard clinical practices. The visual systems health of sensory part important information is provided by retinal images. The artifacts like glaucoma, diabetic retinopathy, age related macular degeneration, stargardt disease, and retinopathy of prematurity retinal diseases lead to blindness. The number of patients is increasing day by day and the existing methods that are used for retinal diseases treatment have number of challenges like high sensitivity, specificity type of cost effective approach. The approach should be able to detect the patient in early stages of disease and it should be applied on time and in early stages it is tough to detect glaucoma disease. The delay in treatment can be caused due to very less awareness about this disease that leads to increase in number of patients and affected people. In this paper, authors did a survey on how computer-aided approaches may be applied in the diagnosis and staging of glaucoma. The localization, optic nerve head segmentation, changes in glaucomatic in pixel levels, use of 3D datasets for disgnosis and detection by artificial neural networks can be done using computer technology.

Umer Farooq, et.al, (2015), have analyzed that fundas images are the creation of a human eye interior surface photograph that includes retina, optic dish, macula and posterior pole. A fundus photography is mostly used by opthamologist and trained medical professionals that helps in monitoring the diagnosis of disease progression and in programs screening epidemiology. The major blood vessels are entered through optic disc and supplied to retina. In ophthalmology, number of diseases can be detected by detecting and then localizing ophthalmic fundus images optic disc. These diseases can vary from 0 m Glaucoma to Diabetic Retinopathy and many more. In this paper, authors aim on image processing method for detecting optic disc then they have compared the proposed algorithm results by image processing algorithm used for same purpose. In this approach a Support Vector Machine (SVM) results of training are stored in database and

domain expert marked images are trained using SVM which is the machine learning approach. The results are verified using SVM after being after being processed by image processing algorithm and it is also tested on a known public repository MESSIDOR and STARE Fundus image database. They have applied the results on 100 different images.

Rakshitha et.al., (2016), have analyzed the three enhancement techniques and their comparison has been computed in terms of PSNR. The main problem occurs while reconstructing an image using wavelet is the missing data that can't be regained. The noisy images are amplified using curvelet transform results in image enhancement but it will also result in information loss of geometric shape. Due to this it become very difficult to edges and noises in the image. The drwaebacks of above mentioned two transforms are removed using Contourlet transform technique that mainly concentrates on enhancing the image perceivability in terms of Edge Improvement Index, Contrast Improvement Index and Peak signal to Noise ratio like metrics. There is preferable contour conversation in using contourlet transform with respect to different existing techniques. The noise reduction and uneven brightness is not being considered in conventional techniques. In medical diagnosis there is need of method that considers both uneven brightness and noise reduction which can be achieved using proposed technique that gives enhanced quality images.

Kasurde and Randive, (2015), have presented a Proliferative Diabetic Retinopathy (PDR) automatic detection where PDR is a retinopathy stage. In this stage blood vessels grows and its indication is revascularization or abnormal new vessels growth. Firstly the image is converted into binary images by vessel segmentation that separates the vessel and non vessel part. The lines, straight vessels like structuring elements were detected using morphological operation which are then are removed and the remaining part is a new vessel. The 45°, 90°, 135° and 180° are multiple operations taken by morphological operations and new vessels are distinguished from normal vasculature by removing straight vessels. In every window numbers of vessel pixels are calculated by windowing mage into 50 by 50 using feature extraction. The results are compared and have concluded that PDR was detected if numbers of vessel pixels are greater than threshold value.

Venkateshand Ramamurthy, (2014), have recommended the use of automated method that help in classifying fundus images. In this method image processing has been done using Cannyedge detector, histogram equalization and then features are extracted using PCA and reduces a dimensionality. The extracted features are given to SVM and NN that classify fundus images into DRP or DRNP. In comparison to canny a best results are achieved using histogram based images that has been concluded from obtained preliminary results.

Rajput et.al., (2015), have used wavelet to detect lesions of non proliferative diabetic retinopathy and the used K-means clustering to classify it. The STARE, DRIVE, Dirarect DBO, Diarect DBL and SASWADE like online databases are used to classify it. In this paper, authors have used SASWADE database then mean, variance, standard deviation and correlation are calculated using NPSR lesion that helps in correlation and classification. The used database is classified using K-means clustering and in classifying NPDR a accuracy of 95% was achieved.

Chapter 3

Scope of Study

The image processing is the technique which can process the information stored in the digitally in the form of pixels. The diabetese is the disease which can affect the human health and effect the human neuron system. This research is based on the detection of diabetic retinopathy from the human eye which cause blindness and complete vision loss. In the base paper, the textual features are analyzed by applying the technique of k-mean clustering. In the k-mean clustering the arithmetic mean of the whole data is calculated and Euclidian distance is calculated from the central point. The points get clustered which has similar distance. To increase the accuracy of base paper techniques, the classification will be introduced which can classify retina into diseases and non-diseases part

Chapter 4

Objectives

Following are the various objectives of this research work :-

1. To study and analyze various clustering and classification techniques is used for the detection of blindness on the human retina of the diabetic patient.

2. To propose improvement in the k-mean clustering algorithm for diabetics detection diabetes on the human retina which caused blindness in the human eye.

3. The proposed improvement will be based on the SVM classification for the detection of Diabetic retinopathy in the human eye and analyzed the effects on the human eye.

4. Implement proposed algorithm and compare with existing algorithm in terms of various parameters .

Chapter 4

Research Methodology

This research work is based on the for the detection of Diabetic retinopathy in the human eye and analyzed the effects on the human eye. The proposed improvement will be based on the clustering and classification technique. In the proposed improvement the sobal edge detection algorithm is applied which will detect edges from the image. The algorithm of feature extraction is applied which will extract textural features from the image. The region based segmentation algorithm k-means is applied which will segment whole input image. Firstly the eyeball from the background by detecting the eyeball edge using widely sobal operator and this technique is based on edge detection technique. The k-means clustering for color based segmentation of the fundus image to choose the exudates related color with reduced computational cost. Colors of an image are expressed as three-dimensional vectors (RGB) of pixel intensity. Similar colors can be grouped together and number of components can be reduced neglecting redundant components for compression. Clustering technique is used to put similar data items in a same group. K-means is a popular clustering technique. K-Means technique is an unsupervised clustering method to classify the input datasets into multiple classes based on their inherent distance. It is an iterative algorithm and start with an initial cancroids guess. Clusters are formed depending on nearest centroids. Using these clusters, the algorithm then redefines the centroids iteratively until the error converges. K-means clustering for color based segmentation of the fundus image to choose the exudates related color with reduced computational cost. Colors of an image are expressed as three-dimensional vectors (RGB) of pixel intensity. Similar colors can be grouped together and number of components can be reduced neglecting redundant components for compression. Clustering technique is used to put similar data items in a same group. K-means is a popular clustering technique. K-Means technique is an unsupervised clustering method to classify the input datasets into multiple classes based on their inherent distance. It is an iterative algorithm and start with an initial centroids guess. Clusters are formed depending on nearest centroids. Using these clusters, the algorithm then redefines the

centroids iteratively until the error converges.The of diabetic retinopathy system is based on effective attribute selection so the segmented exudates contain region properties attributes. In the last phase to classify diabetes part and non-diabetes part from the retina image. In the base paper, the fuzzy logic technique is applied which classify data into two classes In the proposed improvement, fuzzy logic technique will be replaced with SVM classifier. The SVM classifier will classify the input image into diabetes and non-diabetes part.

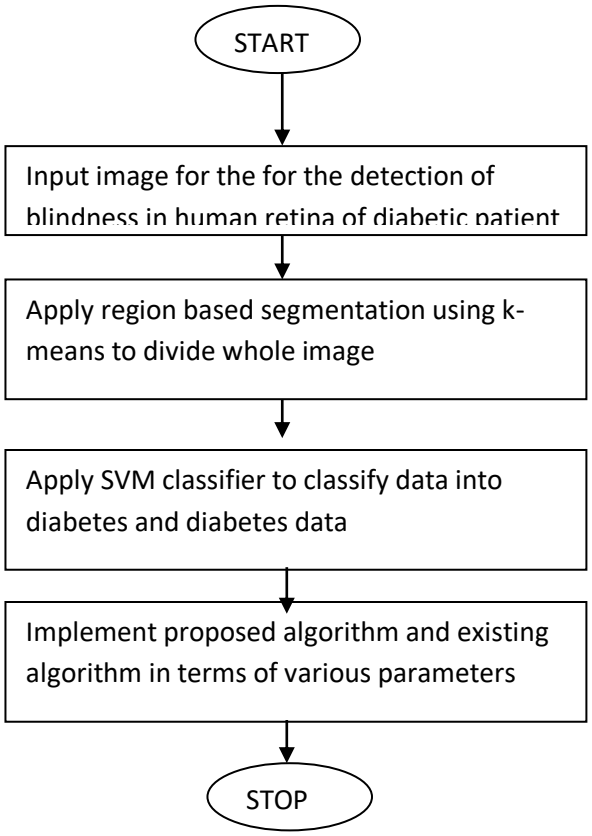

Fig 2: Proposed Flowchart

CHAPTER 6

Expected Outcomes

Following are the various expected outcomes of this research :-

1. The k-mean algorithm with SVM is used for the detection of diabetes and analyze the effect of it on the human retina which caused blindness in the human eye. The technique of k-mean clustering is applied and in this research classification will be applied which can increase accuracy of detection.

2. The classification will be introduced with the clustering which can define the diseased and non-diseased portion and also reduce execution time.

CHAPTER 7

Conclusion

In this research work, it has been concluded that diabetes is the disease which can affect the human nervous system. The affect of diabetes can be seen of the human retina. In the base paper, technique k-mean clustering algorithm is applied which can calculate arithmetic mean of the whole dataset which will be the central point. The Euclidian distance will be calculated from the central point. The points which have similar value will be clustered in one cluster and other in the second. To increase accuracy of detection of blindness from the retina of the diabetic patient, the technique of classification will be introduced which will classify disease into two classes. The first class will be of diabetes and second of non diabetes. The proposed improvement can lead to increase accuracy of clustering and reduce execution time

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