Detection of Diabetics in Retinal Images using Machine Learning Algorithms

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Abstract

Normally nearly 90% of the old age person can suffer from Diabetics mellitus. The major cause of the diabetic's mellitus is by the consuming of high sugar content food. So the people who havediabetic's mellitus can suffer from diabetic retinopathy. The DR is the retina disease it can affect the retina of the human eye can cause mild vision or fully blindness if they not treated properly. Hemorrhages, hard Exudates and Micro aneurysms they are commonly called as HEM which can appear in the retina. So the HEM diagnosis has been taken to avoid the blindness. In the past the detection of the DR can be made by the texture features of the retina such as LBP. In this paper we propose the different set of texture features to predict the diabetic retinography in the earlier stage. The local Ternary Pattern and Local Energy-based Shape Histogram (LESH) are the two different set of features. The performance of the LBP can be projected in the method. The support vector machine (SVM) can be used in the classification and extraction of the texture. The texture features are get binned together. we also used other algorithms like random forest, gaussian, k neighbor. From the above methods random forest method is more accurate than other algorithms.

Keywords: *Diabetic Retinopathy, Preprocessing, Image accuracy, Signal to Noise Ratio, Performance, Datasets,*

1. Introduction

In the whole human body eye is the most sensitive and sensational organ. When the eye is subjected to any kind of hard work it suffers a lot. Human eye has the several layers. If we suffer from any health issues the symptoms can be shown through the eye. If we went to doctor, he first checks the eye. In several years back the retinal fungus images can be used for the analysis and predict the current condition of the human health. By gathering the information of the human visual system, it helps in predicting the problems like glaucoma and diabetics retinography. The human layers have the internal organs such as the lens, retina, macula and fovea. Each layer is much sensitive to the external agents. The diabetic retinography is the leakage of blood in the retina blood vessels. The analysis is made in the pupil part. Retina is much sensitive to the both longer and smaller wavelength light. The Diabetic retinography should be treated in the earlier stage otherwise the complete blindness will be created. The major symptoms are the HEM which is the Hemorrhages, hard Exudates, micro aneurysm it should be treated in the initial stage. When the person is suffered from the Diabetics, they should be undergoing a proper eye test regularly. It will help to avoid the blindness problem.

The HEM is the second major symptoms of the disorder. The difference is shown by projecting the normal retina layer of the eye and the disease affected retina layer of the eye. The images can be classified into several sets of patterns. The researchers are made using various tools such CAD computer aided detection but it will not show the clear prediction of the HEM, till now it is the challenging task in prediction. To become more precautions several terms should be followed retina in not subjected to the

brighter light region, spherical shape of the eye, and the uneven contrast of the light in the overall eye region. Due to the presence of the object in the retina such as the blood vessels, optical disc it is more difficult to found the HEM. The image of the retina is not proper due to the presence of the tiny particles in the layer.So, in this paper they propose the prediction of the HEM using the texture features. Local ternary pattern and local energy-based system can commonly call as LESH. The LESH is used for the prediction which can classified the images into patterns and they subjected to the SVM algorithm for the better result. The accuracy of SVM is about 0.92% and the accuracy of other algorithms like random forest is about 0.94% and for K neighbor is about 0.93%.

2. Literature Survey

SohiniRoychowdhuryet., al., proposed the person who have the diabetics are suffered from the proliferative diabetics retinopathy (PDR). The PDR can create the complete blindness, it is due to the bleeding of blood in the blood vessel. This paper presentsthe classification of the neurovascularization in the single optic disc NVE and NVD separately. The OD and the blood vessel region are evaluated in the initial stage. The blood vessel layer are in the single optic disc are get separated for the NVD and the major NVE. The classifications are made in the texture formation. The NVD and NVE needs nearly 8 and 10 features in the optimal region. The performance of the NVD and NVE is about 86%. The accuracy, sensitivity are about 69% and 82% for NVE and NVD. The NVD and NVE can playa important role in the screening of diabetic retinography of the patients. The images of the retina are captured and it gets classified into patterns using the above NVD and NVE methods. [1]

PavlePrentašićet., al., proposed several type of disease such as the fungal, viral, chronic disease. Under the chronic disease the diabetic retinopathy takes place. The diabetic retinopathy can cause leakage in the blood vessel. It can lead to complete blindness of the human. So to prevent the blindness the diagnosis can take place. For the early diagnose the screening program is applied. The automated screening program helps to create the fundus image database. The new database is created which can consist of the image the images such as the diabetic retinopathy. Two sets of databases are available in the current scenario already presented database and the newly created database. The images of the fundus can provide the clear projection of the diabetic retinopathy.The fundus structure can helps in evaluation and identification of the diabetic retinopathy in the earlier stage. The algorithm is proposed which can use the color fundus images for the detection of the diabetic retinopathy. [2]

ÖmerDeperlıoğluet., al., proposed the major problem arise in the developing countries and developed countries is the diabetic retinopathy. The diabetic retinopathy is caused due to the diabetic mellitus. The diabetic retinopathy can affects the blindness completely. At the initial stage the mild blindness occur after some period of time the blindness is totally affected. In this paper they proposes the image process technique for the prediction and diagnose the diabetic retinopathy. At the final stage the Gaussian low pass filter is used to the fundus images. CNN algorithm is used for the classification of the retinal fundus images. The experiment is performed using the 375 fundus images in the diabetic retinopathy database. The classification and study has been performed for the each stages of the image processing. The performance is about 97%, accuracy is about 89%, specificity is about 79% and the score is about 96%. This method is more accurate, reliable and effective. [3]

MoriumAkteret., al., proposed human eye is the sensitive part of the human body. The eye has the several structures inside itprotect the eye. The retina which is sensitive to the light, the large contrast and uneven reflection of the light cause more irritation to the retina. Several disorders may affect the eye which leads to blindness. Under the blindness there are color blindness, mild blindness, normal blindness etc. The person who have the diabetic mellitus can suffer from diabetic retinopathy. The diabetics mellitus is caused due to the over consumption of thesugar content food particles. The diabetic retinopathy is the leaks of blood in the blood vessel in the retina. So the diabetic retinopathy should be detected in the initial stage to prevent from blindness. In this paper they propose the detection and extraction of the diabetic retinopathy using color fundus images. The color fundus images are applied to each layers and the several process takes place for the prevention of diabetic retinopathy in the earlier period. [4]

Enrique V. Carreraet., al., proposed nearly 80% of the people lost the blindness due to the any preventive measures are not place for the diabetic retinopathy. So to avoid the problem in this paper they propose the computer assisted based digital image processing method. The computer can act as the robot and retinal images are obtained as from the results of the digital processing. The retinal images can use to detect the diabetic retinopathy. The second stage is to classify the grade of non-proliferative diabetic retinopathy. Before the second stage the image processing technique can separate the blood vessels, hard exudates. The separation is based on features using support vector machine. This method is tested using 356 retinal images in the database which use the 4 grade scale of non proliferative diabetic retinopathy. The accuracy is about 86% and the performance is about 97%. [5]

R. Geetha Ramaniet., al., proposed for the research of the diabetic retinopathy the retinal images can helps as the main part. The computerized technology also helps in this process. Data mining van plays a vital role in the extraction of the retinal images the data base. To deal with the blindness caused by

the diabetic retinopathy classification is implied. The classification can takes place in two levels. The first set of classification is primary first trees the mismatched classified data are removed as the noise and the outer layer are getting removed as the unwanted signal. The second set of classification is the J48graft trees. The cross valuated results are consider as the 3 folds and the rules are formed for the generation of the diabetic retinopathy. Experiment is performed using the benchmark database of diabetic retinopathy from the machine learning repository. This method has the accuracy of about 955 when compared to the earlier works. It can helpthe ophthalmologist's society. [6]

Asti Herlianaet., al., proposed as the education and technology is get improved nowadays many expert are there in the medical field. Several equipments are used to predict the diseases. But the prediction of the diabetic retinopathy is difficult in the earlier stage. This is due to recognize the earlier symptoms of the disease. To avoid the problem in this paper they propose the data mining concept in the extraction of the beast retinal images. The classification is made to detect the disease in the earlier stage. So the PSO method is applied in the dataset the best features retinal image can be separated from the normal retinal images. For this swam optimization can plays a vital role in the classification. After the selection of the features it is the further classified using neural network. The using of the neural network in the PSO is about 89%. In further the accuracy is of about 78% and the performance is about 83%.[7]

Vaishali Suryawanshiet., al., proposed the diabetic retinopathy is the common cause of the blindness. If the preventive measures are not taken in the earlier stage it can cause major problem. The diabetic's retinopathy is caused by the lesions present in the human eye layer such as micro aneurysms, cotton wool spots, hemorrhages. These can cause the diabetic retinopathy and affect the blindness. So in this paper they propose the texture based approach to the various layer of lesion using the gray level Co-occurrence matrix (GLCM).The retinal image classification happens into several pattern structure and the feed forward network is applied with the sigmoid output the neural network can occur the maximum accuracy value. The images in the database can be classified using the neural network method. Texture approach is needed for the better classification of the retinal patterns. [8]

FarrikhAlzamiet., al., proposed several terms can cause the diabetic retinopathy disease among this glaucoma is consider in this paper. This disease affects the optical nervous system and result in loss in the vision. The fractal dimensions are the feature extraction which can be used in the retinopathy field. In this paper they propose the fractal dimension it can separate the healthy patient and the diabetic retinopathy patient. The disease affected person is

separated is the main of this paper. The MESSIDOR dataset is used for the classification of the data in the database random forest algorithm is used. By this we can able to distinguish the healthy person and the diabetic affected person. But this will not provide the clear result so it can extend to the future analysis for that the univariate, multivariate and other features are used to pay attention to the red lesion. For the need of more information about the diabetic retinopathy grade level is used for the performance. [9]

Mamta Aroraet., al., proposed the diabetic person can mainly suffer from the diabetic retinopathy. It can cause the partial or the complete vision loss of the human. If the detection is not made in the earlier stage it leads to complete blindness.The early detection of the disease can be needed. In this paper they propose the filter which use the vessel extraction using fuzzy C means algorithm. For the classification of the fundus image the support vector machine is used. It can classify the non-proliferate diabetic retinopathy and proliferate diabetic retinopathy.The classification is made to detect the disease in the earlier stage.So,the PSO method is applied in the dataset the best features retinal image can be separated from the normal retinal images. This method provides the efficiency of about 92% and it can be used in the common diabetic retinopathy disease.[10]

3. Proposed Method of Diabetic Retinopathy Detection Using Machine Learning

The main of the paper is the detection of the diabetic retinopathy in the earlier stage. It can be caused due to the diabetic's mellitus if the detection is not made at initial stage it leads to complete blindness. The HEM layer is formed in the retina.So, to diagnose the HEM the local ternary pattern and local energy based method is implied in the removal. The classification of the texture features can be made through the support vector machine. The accuracy of the method is about 0.92%. We also used other machine learning algorithms like random forest, kneighbor , gaussian (NB) and their accuracy is about 0.94% ,0.93% and 0.94%.
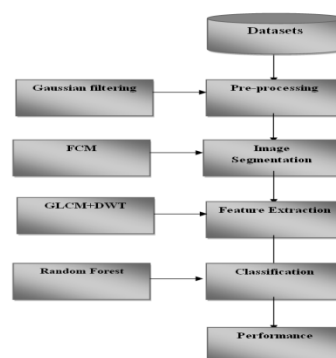

Figure 1: Block Diagram of Diabetic Retinopathy Detection

4. Results and Discussions

In our proposed system we are going to analyze the retina of the persons who are coming for checking their diabetic level. We already have a set of bench mark data sets which will have both good and bad retina images. The given input retina image has to undergo pre-processing stage. First the input image will be in RGB format it has to be converted into grey scale. Then resize of the input image takes place. Generally, the input image won't be clear as noise presence will be very high. So first we need to remove the noise it is done will the help of median filter. Then the process of matching the input image and the stored images takes place. Then final stages are segmentation and classification stage. In segmentation stage the infected part alone will be segmented and in the classification stage what type of infection stage will be displayed in red and blue colours where the red colour indicates the diabetics is in severe stage and the blue colour indicates the diabetics is in starting stage. Among all the algorithms Random forest performance is better compared to other algorithms.

	accuracy_all	accuracy_selection	diff_accuracy	cvs_all	cvs_selection	diff_cvs
SGD	0.798246	0.842105	0.043860	0.727449	0.834824	0.107375
SVC	0.921053	0.921053	0.000000	0.885641	0.885641	0.000000
NuSVC	0.921053	0.921053	0.000000	0.852445	0.854200	0.001754
LinearSVC	0.868421	0.745614	-0.122807	0.845304	0.824360	-0.020944
KNeighbors	0.938596	0.921053	-0.017544	0.885779	0.882270	-0.003509
GaussianNB	0.947368	0.947368	0.000000	0.913895	0.908663	-0.005232
RandomForest	0.947368	0.938596	-0.008772	0.947306	0.922698	-0.024608
ExtraTrees	0.947368	0.938596	-0.008772	0.940273	0.915681	-0.024592
DecisionTree	0.921053	0.877193	-0.043860	0.906878	0.901553	-0.005325

Figure 2: Diabetic Retinopathy Detection Results

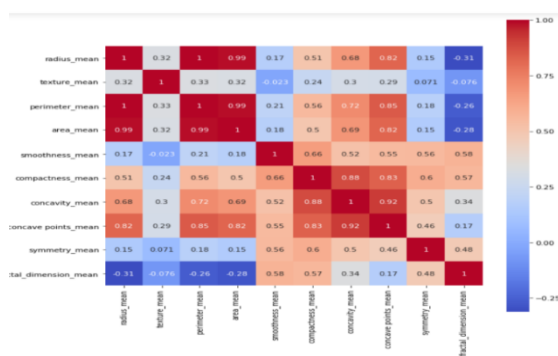
Figure 3: Detection of diabetics in starting and final stages.

5. Conclusion

Diabetic retinal ulceration plays a vital role in all patients who are been affected by diabetic. Retinal ulceration is really a dangerous infection for a diabetic patient. If Early detection of retinal ulceration is not done properly the wound in the eye will become severe which may results in loss of eye sight in the extreme stage. Our proposed system will help in detecting the retinal damages caused due to diabetic with correct accuracy.

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