Diagnosis of Diabetic Retinopathy using Machine Learning Techniques

Eshwari Jagapur[1], Baba Fakruddin Ali B.H[2]
[1]*Assistance Professor, Computer science Department Bangalore University.*
[2]*Technical Head, Nano robotics embedded technology, Bangalore.*

Abstract **-** The complication of diabetics causes an illness known as Diabetic Retinopathy (DR). It is very widespread among middle-aged and elderly People. DR is caused due to deterioration of eyesight as diabetes progresses. People lose their eye visions because of this illness. To cope with DR, an early detection is needed. Patients will have to be checked by doctors regularly which is a waste of time and energy. The two groups which DR is divided into are: non-proliferative (NPDR) and proliferative (PDR). In this study, machine learning (ML) techniques are used to diagnose DR at an early stage. These are PNN, SVM, Bayesian Classification and K-Means Clustering. These techniques will be evaluated and compared with each other to choose the best methodology. A total of 300 fundus photographs are processed for training and testing. Image processing techniques are used to extract features from raw images.
After an experiment, it is concluded that PNN has an accuracy of about 89%, Bayes Classifications 94%, SVM 97% and K-Means Clustering 87%. The preliminary results prove that for early detection of Dr SVM is the best technique.

I. INTRODUCTION

Diabetes prevalence has been rising more rapidly causing health threats worldwide. Diabetes causes heart failure, amputation in lower limb, strokes, kidney failure and blindness and hence the correct and timely treatment of diabetes is very necessary. Late and poor treatment of diabetes are proven very expensive. The Retinal abnormalities occurrences in diabetic patients are common as well as their serious consequences. Diabetes monitoring major role is played by implementing Fundus imaging. However, the candidate for Non-invasive screening is Fundus imaging since the eye fundus is sensitive to vascular diseases. A successful screening approach depends upon obtaining a faultless precise fundus image capture specifically on reliable and accurate algorithms in image processing for discern the abnormalities.
Many research groups have proposed and initiated numerous algorithms for analysis of fundus image. However, there is no existence of commonly representative and accepted fundus image database as well as an evaluation protocol which makes it difficult to judge the reliability and correctness of the approaches. Hence it would be viable to assess the state-of-art and maturity of the present methods to produce the attained selectivity rates and sensitivity.

Diabetes are of two major types: type 1 diabetes and type 2 diabetes. In Type 1 diabetes the insulin production in the pancreas is permanently damaged. Increased resistance to insulin in a person results in Type 2 diabetes. The second type of diabetes is mostly a genetic disease. It is related to limited physical activity and lifestyle. Diabetic Retinopathy causes abnormalities to the retina of the eye. Similarly, nervous system (diabetic neuropathy) and kidney failure (diabetic nephropathy). Diabetes also plays a major role in cardiovascular diseases.

II. LITERATURE

Subhasis Chaudhari et al. proposed a method in the paper titled "Detection of Blood Vessels in Retinal Images Using Two-Dimensional Matched Filters". In this paper the author proposed a method whose accuracy was tested in the public database of fundus images named DIARETDB1. During the evaluation by all the experts who participated, the database consists of 89 colour fundus images of which the non-proliferative signs of diabetic retinopathy have almost 84 of them. The rest 5 color fundus images are considered as normal which do not contain any signs of diabetic retinopathy. With varying imaging controlled50-degree FOV digital fundus camera was used to capture images by the system in Kuopio university hospital, Finland. The image ground truth provided along with database are found because of expert selected findings related to the diabetic retinopathy and normal fundus structures. The major drawbacks found in this proposed methodology are:

1. Only edge detection is in concern.
2. Limited to blood vessels to be recognized.
3. No Disease Detection methodinvolved.

P. Kahai, K. R. Namuduri, and H. Thompson proposed a support framework for screening of diabetic retinopathy in their paper titled "A Decision Support Framework for Automated Screening of Diabetic Retinopathy". For the univariate case, a decision support framework for automated screening of DR was proposed in this paper. An extension is done to multiple disorders that would include the covariance linked with all the signs of DR.This model can be extended to multiple disorders that would include the covariance associated with all the signs of DR.The automated screening process includes all the disorders related to DRof the experiments which support the feasibility of the screening mechanism.The precision of the classifier as a new feature value is presented to it by modifying the priors. Hence the machine can be made complaint by including Bayesian

learning mechanism for improvement. The drawbacks here include the following:

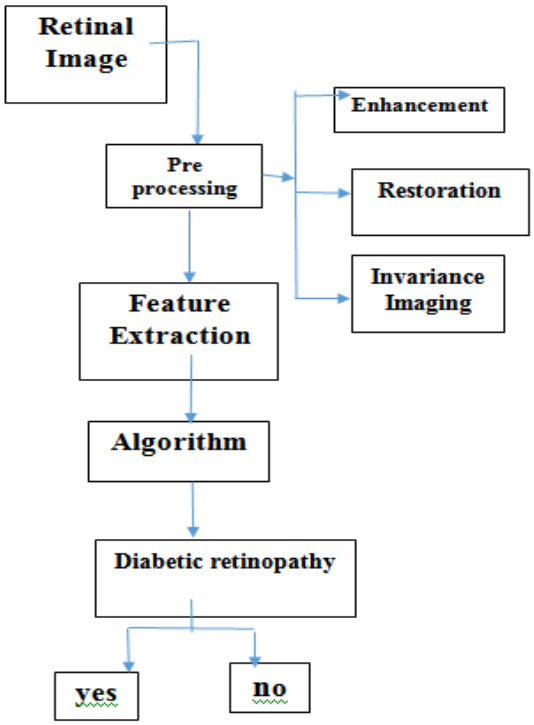
1. Only screening mechanism involved.
2. No early stage detection is made

Raju Maher et al proposed "Automatic diagnosis of Diabetic Retinopathy from Low cost retinal Images usingMathematical Morphology Methods". Microaneurysm are one of the primary signs of retinopathy. This paper proposes a set of optimally adjusted morphological operators examined to be used for Microaneurysm detection on low contrast images of diabetic retinopathy. The steps included are to detect the blood vessels and optic disk and later to identify the abnormalities in retina like exudates and microaneurysms causing DR.Automatic tool for diagnosis of diabetic retinopathy must go through some well-defined steps. This method has resulted with sensitivity and specificity for Microaneurysm detection upto 80% and 90%, respectively.Drawback include problems in edge filtering and feature selection process in the automatic software tool.

III. METHOD

G G Gardner et al has shown a method to recognize common features of DR on fundus images by training a neural network. The presence of vessels, exudates, and hemorrhages with high predictive values can be identified by using neural networks. Since there are similar pixel values to vessels of the retina it is considered the most difficult to recognize retinal hemorrhages. The training of different image pre-processing and neural network variables to recognize different features on a fundus image of DR is demonstrated to show that neural network can be trained.

IV. FRONT END ARCHITECTURE



V. METHODOLOGY

The approach of diabetic retinopathy consists of an aim of proving ways of digital image studies to diagnose DR and identify the severity of the disease. It typically includes application of Image processing on digital images of the retinal structures. Progress in this area has been achieved in recent times and improved medical care is available for the patients. According to a recent survey, diabetes has been recognized as the main cause of blindness. If not diagnosed early and treated in time, it can lead to severe damage to retinal structure leading to partial or even complete blindness.

Diagnosis and detection of diabetes allied disease for instance, diabetic retinopathy (DR) using medical digital image processing with constant check-up and screening activities is very important.The sensitive inner area of the eye is damaged in diabetic retinopathy. Non-proliferative (NPDR) and Proliferative (PDR) Diabetic Retinopathy are two types of DR.

The Non-proliferative DR in early stages due to fluid leaks affects fewer blood vessels in the eye leading to blurred vision. The probability of affected vision loss in majority cases is very rare in this condition. The proliferative retinopathy in some cases involve macula which may lead to more advanced stage. In proliferative DR the fluid leaks are more serious which in turn puts pressurein the blood vessels and future ruptures causing bleeding called hemorrhage. Scarring of the retina and vision loss is caused by DR.

In the image pre-processing technique the aim is to improve the image data. This image data suppresses unwanted distortions, or some image features are enhanced which are for further processing. Image preprocessing is the initial step in automated retinal pathology diagnosis. It includes techniques such as contrast enhancement, gray/green component, image de-noising, etc.

In the Feature Extraction, the features a like exudates, blood vessels, optic disks and micro-aneurysms are extracted for further analysis. The Exudates are Small yellow white patches with sharp margins and different shapes. Early occurring lesions are the one of the exudates variety. The name "cotton wool spots" are often given to soft exudates and are usually seen in advanced DR. The micro-aneurysms are first clinical abnormality to be perceive in the eye. Within the light sensitive retina, the micro-aneurysms may appear in isolation or in clusters as dark, tiny red spots or even looking like tiny hemorrhages.

VI. CONCLUSION &FUTURE SCOPE

We focus on several ML techniques for DR detection. It is found that the risk of vision loss can be reduced at early detection of DR. up to 76%. Also, this work presents a novel model to diagnose DR based on ML techniques. Among of all of these techniques it can be said that SVM is the best with a percentage of 97.3, Naive Bayes Classification %86.4 and PNN with a percentage of %78 K-Means Clustering is % 81 percentages. It can be

concluded from the study that results are promising.In this proposed method detection of DR has been carried out. The Computer Aided System(CAS) still needs to be developed which not only diagnose DR but also would help diagnose the diabetic disease. The growth can be restricted if not prevented while checking the progression of disease. In future, we need to develop hybrid and automated techniques for DR detection which are more accurate, robust. Hence affordable automated techniques for DR detection at low cost is projected here.

VII. REFERENCES

[1]. (http://webeye.ophth.uiowa.edu/ROC/) (Downloaded in October 16, 2017)
[2]. Rowe, C., et al., Insulin resistance correlates with maculopathy and severity of retinopathy in young adults with Type 1 Diabetes Mellitus. diabetes research and clinical practice, 2017. 131: p. 154-160.
[3]. Thomas, R.L., et al., Retrospective analysis of newly recorded certifications of visual impairment due to diabetic retinopathy in Wales during 2007–2015. BMJ open, 2017. 7(7): p. e015024.
[4]. Bartczak, P., et al., Spectrally optimal illuminations for diabetic retinopathy detection in retinal imaging. Optical Review, 2017. 24(2): p. 105-116.
[5]. Zhou, W., et al. Automatic microaneurysm detection of diabetic retinopathy in fundus images. in Control and Decision Conference (CCDC), 2017 29th Chinese. 2017. IEEE.
[6]. Chaudhuri, S., Chatterjee, S., Katz, N., Nelson, M. and Goldbaum, M. (1989). Detection of blood vessels in retinal images using two-dimensional matched filters. IEEE Transactions on Medical Imaging, 8(3), pp.263-269.
[7]. Kahai, P., Namuduri, K. and Thompson, H. (2006). A Decision Support Framework for Automated Screening of Diabetic Retinopathy. International Journal of Biomedical Imaging, 2006, pp.1-8.
[8]. Maher, R., Kayte, S., Panchal, D., G., S., Sathe, P. and Kayte, J. (2015). Automatic Diagnosis of Diabetic Retinopathy Micro aneurysm from Low Contrast Retinal Images using Mathematical Morphology Methods. International Journal of Computer Applications, 130(6), pp.50-56.
[9]. Gardner, G., Keating, D., Williamson, T. and Elliott, A. (2000). Automatic detection of diabetic retinopathy using an artificial neural network: a screening tool. British J7ournal of Ophthalmology, (80), pp.940-944.

M.Tech degree in Computer Science and Engineering at Canara Engineering College, Mangalore. Currently he is working as technical head in development sector of embedded division for Nano Robotics Embed Technologies, His areas of interest are Internet of Things, Artificial intelligence, machine learning Image processing, embedded system. He has published 4 international journal and 1 national conference paper and 1 international conference,