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BP and SVM based Diagnosis of Diabetic Retinopathy

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ABSTRACT: Diabetic retinopathy (DR) is measured as root supply of imaginative and prescient loss for diabetic patients and must identify it early for mighty therapy. In severe cases the sufferer will grow to be blind. The principal phases of diabetic retinopathy are proliferative diabetic retinopathy (PDR) and non-proliferative diabetes retinopathy (NPDR). Microaneurysms is the first clinical indication of DR they usually appear to be little red dots on retinal graphics. The quantity of Microaneurysms is used to point out the seriousness of the syndrome. Early Microaneurysms cognizance can support to scale back the prevalence of lack of sight. In selection aid procedure neural network plays a imperative role. In this project, the primary Goal o is to examine the performance Evaluation of the newly proposed algorithm that is SVM (SUPPORT VECTOR MACHINE) and comparing with the existing algorithm Back Propagation (BP) Neural Network, which gives the best accuracy, efficiency and time span. We will be performing both the operations in MATLAB and conclude the better one for future performance.

KEYWORDS: BP Neural network, Diabetic Retinopathy (DR), PDR, NPDR, SVM.

I. INTRODUCTION

Diabetes is a gathering of metabolic illnesses where in a man or woman has excessive glucose, given that the physique does not create sufficient insulin, or considering that cells don't react to the insulin that's delivered [6]. This is prompting a lot of diabetes associated issues like Diabetic Retinopathy, nephropathy and neuropathy etc. These complications if no longer managed on time can result in a lot of disability on the part of the sufferer and colossal cost and work load on professional and the Management. Diabetic retinopathy (DR) is an eye disorder that can prompt to partial or entire loss of visible ability and some of the common difficulties of diabetes. It is a critical and extensively spread eye disease. It harms the little veins in the retina leading to loss of imaginative and prescient. Diabetic Retinopathy mainly influences both the eyes. The world wellness group (WHO) has projected that diabetic retinopathy is in charge for 4.9% of 37 million situations of lack of sight all throughout the world. The foremost phases of diabetic retinopathy are non proliferative diabetic retinopathy (NPDR) and proliferative retinopathy (PDR).NPDR is an early phase of diabetic retinopathy. On this phase, small blood vessels inside the retina leak blood or liquid. The releasing liquid factors the retina to swell or to form deposits referred to as exudates. PDR is an undertaking via the attention to boost or re-provide the retina with new blood vessels (neovascularization), as a result of trendy closure of the retinal blood supply [2].

II. RELATED WORK

In [2] authors describes about the back propagation to become aware of the exudates and pre-process the images using HIS, median filter and Histogram equalization and eliminated the optic disc. In [3] authors represented associate approach for detection of exudates using neural network. In [4] author described about the classification of DR using Hybrid Multilayer feed forward neural network and by using genetic algorithm detection of exudates, Microaneurysms, blood vessels and Texture properties. In [6] author describes about the classification of DR by using a method called artificial neural network and implemented three layer feed forward BPNN. The Four output nodes correspond to normal DR, preproliferative DR, and PDR. In [5] the author describes about the classification of retinal disease using neural network and features of retina are extracted by using texture analysis. In [7] author describes future process for early detection of diabetic retinopathy in machine learning based mostly mechanized classification. In [1] presents a progression of investigations on spotlight determination and classification of exudates utilizing naive Bayes and

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support vector machine. The learning set consisting of 15 features extracted from each and every constructive instance of exudates pixels and an equal number of terrible examples by way of utilizing navie bayes.

III. PROPOSED SYSTEM

1. **Collection of retina images:** The fundus retina images are stored in JPEG image format File (.jpg) and also images are stored in PNG format (.PNG). In this research the digital fundus images was collected from Jayadeva hospital (Bangalore) and also Diabetic Retinal image used in the experiment from DIARETDB0 (Standard Diabetic Retinopathy Database Calibration level 0) and also from the websites. Images were captured using the Fundus camera and the image size is 1500×1152 each.

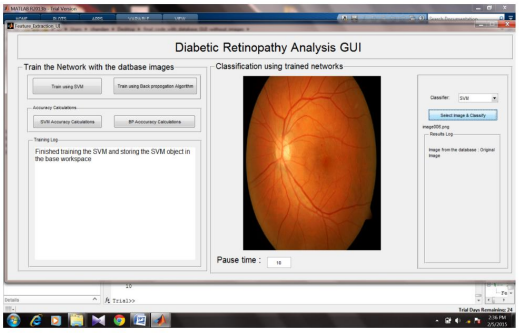

Fig:1 original image

2. **Pre-processing**: Once the input is given, Pre-processing is done on the images at the lowest level of abstraction. It aims at either modifying or enhancing the features of the image. Images are processed, in order to represent the details of the image in numerical form.

   a) **Intensity conversion:** Due to the fact of unknown noise and dig cam settings, the retina graphics within the dataset are commonly noisy and poorly illuminated. The colour of retina has tremendous variant from sufferer to patients. Fetch the values of red, Green, and Blue (RGB) channels. In these channels the green channel exhibits the quality disparity between the vessels and heritage whilst the red and blue one tends to be noisier. The retinal blood vessels emerge darker in gray image; the green channel is used to convert the depth of the image.

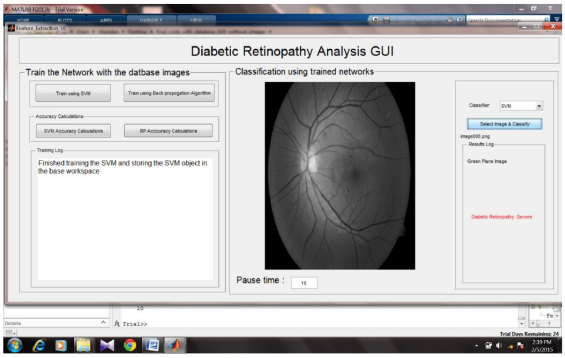

Fig: 2 Green plane image.

   b) **Median filtering:** Here 30×30 median filtering is observe to the gray scale image and the outcomes are subtracted from inexperienced (green) plane to get normalized image and median filtering is form of useful since it is totally and has information to filter any outliers, it's also used to elimination of salt and pepper noise.

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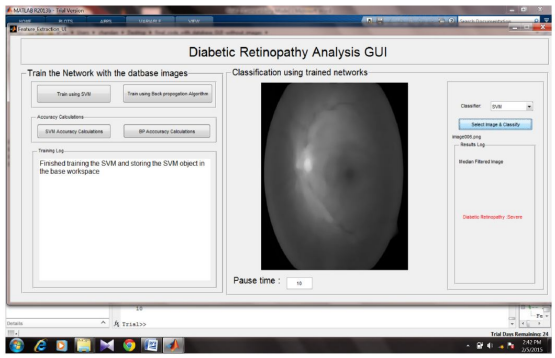
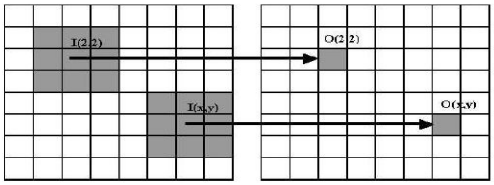
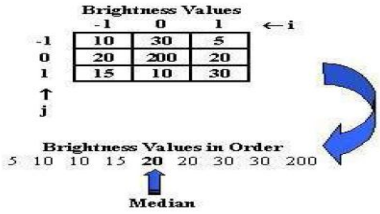


Fig: 3 Median filters.





c) Adaptive Histogram Equalization: Probably the most challenges related to retinal image is uneven illumination. Some areas if the fundus image show up to be brighter than the opposite. The great of an image can also be elevated making use of image enhancement approaches. Adaptive histogram equalization is a regular enhancement method which provides a better procedure for enhancing the dynamic variety and contrast of a picture by using altering the image .It's finding of cumulative distribution perform for a given probability density operate. The small area of pixels, viewed to be noise, is eliminated after applying morphological operations. Submit the transformation, the probability density function of the output will be uniform and image may have high distinction. A dull area together with vessels, MAs and noise are dominant after distinction enhancement

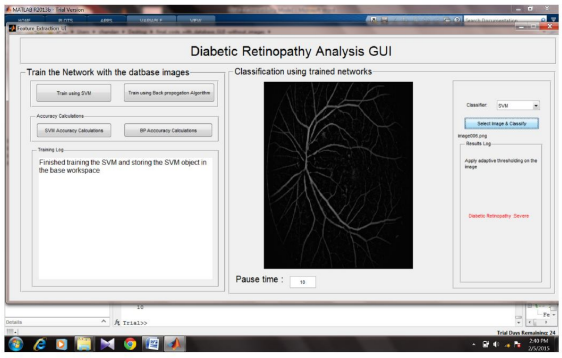


Fig: 4 Adaptive histogram image.

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d) Detection and elimination of Optic disc and Blood Vessels

Blood Vessels: In the identification of DR the Detection of blood vessels may be very most important via image processing. For the awareness of diabetic retinopathy the blood vessels are extracted. The honour of the fundus image tends to be vibrant inside the middle and cut down at the part, consequently pre-processing is imperative to shrink this result and have uniform image. After which, the green channel of the image is connected with morphological image processing to do away with the optical disk. To regulate the distinction depth and small pixels viewed to be noise are removed, image segmentation is performed.

Optical Disk: Optical disk detection algorithm utilizes the property of retina that the optical disk area is the brightest area of the fundus image, and as a result the depth price is the used to identify optical disk. For detection of Microaneurysms, the optic disc occupies more discipline of the retinal picture and it should be eliminated. For the removing of the optic disc the connected factor analysis method is used.

e) Detection of Microaneurysms

Microaneurysms are major to determine them in the course of the slight stage of diabetic retinopathy. They are first scientific signal of diabetic retinopathy and developed from the vulnerable blood vessels. The grayscale photo is used to determine the circular border and optical disk masks. Before putting off the round border to fill the enclosed small area the golf green channel of the image first finds the edge utilizing canny system. At the point bigger areas are eliminated.

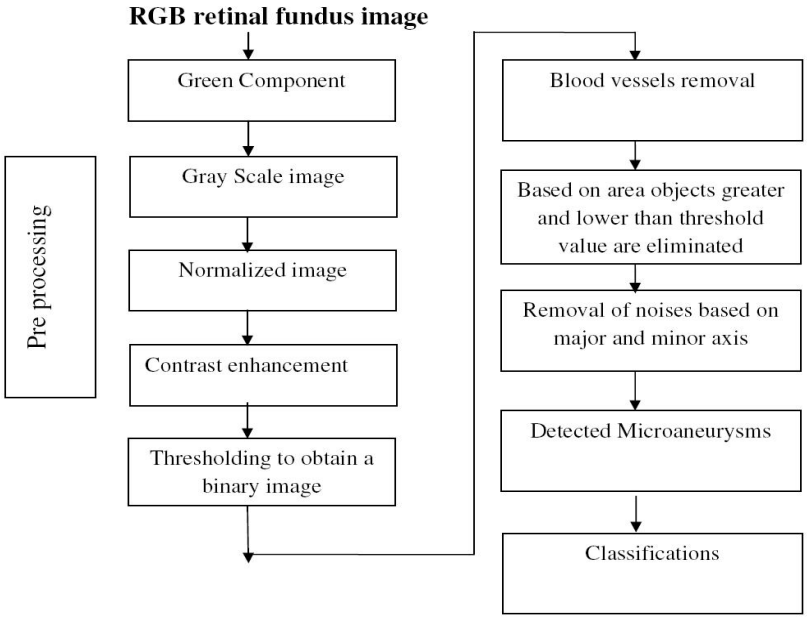

Fig 5: Procedure of detecting Microaneurysms

3. **Feature Extraction:** The main goal of the feature extraction is to select all Microaneurysms present in the pre-processed image. MAs look like an isolated pattern and are detached from the vessels. Based on the shape, intensity level and size the features of Microaneurysms can be extracted. As soon as image is pre-processed, the candidates Microaneurysms are segmented through isolating them from veins. Blood vessels are huge in subject and are related section, hence can recognize from MA situated on area. By the experimentation the threshold value is chosen to remove blood vessels. The threshold value are eliminated if the object having greater area. The size of Microaneurysms are 10-100 microns diameter, depending upon the noise based on area, microaneurysms can be recognized. For the experimentation, two threshold values are chosen to cast off noise objects having greater area and scale down than MAs. The consequential image having objects which have the identical region and some of them are MAs. MAs are identified from the noises which are in irregular shape. We are able to remove the noise

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having same area as Microaneurysms based on the major and minor axis. Based on perimeter and circularity the Microaneurysms are detected. Based on the resultant image from the previous segment the canny edge detection is performed. Each perimeter and object area is manipulated and these outcomes are utilized to form a simple metric representing the roundness of an entity. By finding the length of the boundary pixels of the candidate the perimeter is calculated. In manipulative perimeter, the x and y coordinates are considered as one and inclining neighbors are counted √2 times.

Delta=diff (boundary) ^2;

Perimeter=sum ($\sqrt{sum(delta,2)}$)

Metric=$4 * \pi * Area$/Perimeter^2

For a circle this metric is equal to one and for any other shape it is less than one. The separable process can be controlled by setting a suitable threshold α. As Microaneurysms are round in shape, they can be recognized from noise which is uneven.

4. **Classification:** After the detection of Microaneurysms, Depending on the count of detected Microaneurysms, the images are classified whether it is normal, mild moderate and severe by using SVM and BPNN.

5. **SVM Classifier**: SVM training approach is utilized to compare coaching information to discover a fine viable way to categories the DR images into their respective categories, natural, slight, moderate and severe. It is robust procedure for the categorization of information and deterioration. It appears for a hyper aircraft that may linearly separate courses of objects. It looks for a hyper plane that can linearly separate classes of items. This technique is utilized to recognize the different classes. (Figure 6a).it is used to differentiate the various categories.

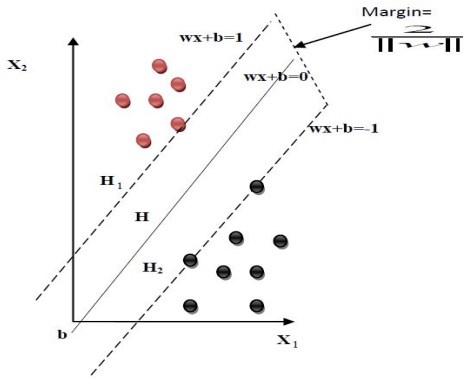

Fig: 6 a) Linear Classification

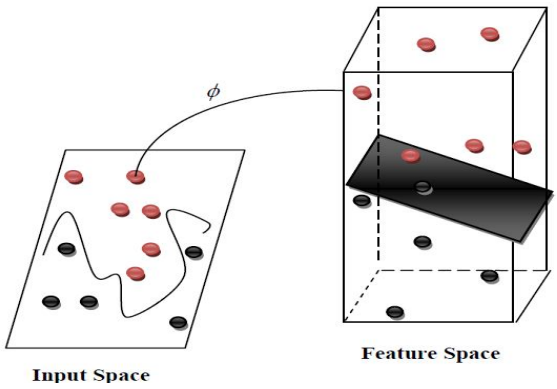

Fig: 6b) Nonlinear Classification

The training information should be adequate to be statistically important. The support vector machine algorithm is applied to create the classification parameters according to calculated features. The resulting classification parameters are used to classify the images. The image substance can be segregated into different classification in conditions of designed support vector classifier. To fit nonlinear curves to the information, SVM make utilization of a Kernel task to guide the information into a dissimilar space where a hyper plane can be utilized to do partition. SVM are in general utilized to non-linear classification with the aid of non-linear kernel functions to map the enter know-how onto a better dimensional feature area where the enter information can also be divided with the linear classifier (Figure 6b).Kernel perform K(x,y) represents the interior product <ϕ(x),ϕ(y)> in feature space. The polynomial kernel is given by

$$k(x.x')=(x.x'+1)^d$$

Where x and x' are training vectors is the kernel parameter. The size of the input retina photo is 1500×1152 and the output is categorized.

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SVM Application

- SVM has been utilized effectively in many real-world problems
  - It used for Text (and hypertext) classification.
  - It is used for the classification of the images.
  - It used for Bioinformatics (Protein organization, Cancer categorization).
  - It is used for Hand-written character identification.

6. Back propagation: A neural network system is effective information demonstrating tool that encompasses a capability to capture and represent complicated input/output interaction. Back propagation is style of supervised learning for multi-layer networks, also called as the generalized delta law. Error information at the output layers is "back propagated" to prior ones permitting incoming weights to those layers to be restructured. It is frequently utilized as training algorithm in current neural network applications. A back propagation network with a one hidden layer of processing elements can model any continuous task to any degree of accuracy.

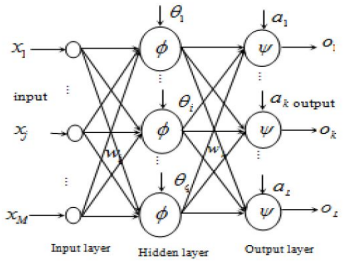

Fig 7: Structure of BP Network

Commonly a three layer community is developed throughout this classification. The input vector and associated favoured output are considered first. The input is propagated ahead through the network to compute the output vector. The output vector is when compared with the desired output and the error are determined .The system is repetitive except blunders being reduced.

IV. RESULT AND DISCUSSION

The image size considered here is 1500×1152 pixels. For experimentation, from the data set, Forty eight Normal images, seventeen mild images, forty three moderate images and twenty two severe are taken. Table shows comparison results for SVM and BPNN and is done based on count of detected Microaneurysms. The parameters which can be used to calculate the correctness of the algorithms are Sensitivity and Specificity.
False negative states that the abnormal image is wrongly identified as normal
True negative states that the normal image is properly identified as normal
True positive states that the abnormal image is properly recognized as abnormal
False positive is defines as normal image is wrongly identified as abnormal

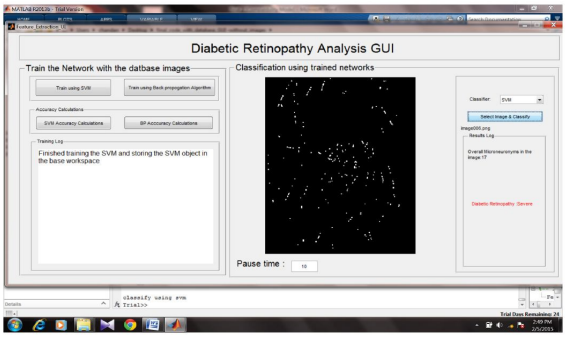

Fig: 8 Overall Microaneurysms in the image

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Table 1: Comparison results for SVM and BPNN

Training Methodology	Number of Images used for training	Sensitivity	Specificity	Accuracy
SVM	130	0.74	1	83.00%
BP Neural network	130	1	0.15	68.50%

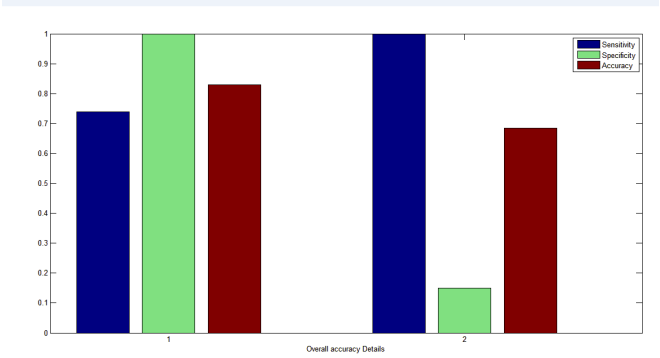

Fig: 9 Graph of sensitivity and specificity and accuracy for SVM and BPNN

In the above graph 1 indicates SVM and 2 indicates BPNN, the overall accuracy in graph shows that when compared to BPNN, the SVM gives best results.

To calculate the accuracy

$$\text{Sensitivity}=\frac{TP}{TP+FN}$$

$$\text{Specificity}=\frac{TN}{TN+FP}$$

Overall accuracy

$$\text{Accuracy}=\frac{(TP+TN)}{(TP+FN+TN+FP)}$$

V. CONCLUSION AND FUTURE WORK

The main aim of the work is implementation using Microaneurysms was leveraged as a distinctive feature for reflecting the retinopathy condition of a human eye. In order to classify a healthy against a diseased patient a Neural Network based approach as well as a Support Vector Machine based classification approach was investigated. During the development of the solution it is observed that given the simplicity of the SVMs as well as the training makes them a viable choice when compared to the NN classifiers as the training process is lengthier as well as the accuracy observed was less when compared to the SVMs. Overall execution time for the SVMs also show a better performance when compared to the NNs. Nevertheless there are both positives in both these approaches and for this particular classification data set and the objectives of the project, SVM is a more apt choice and has been illustrated via the work presented in the project report in the form of tabulations and results.

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