A NARRATIVE APPROACH FOR ANALYZING DIABETES MELLITUS AND NON PROLIFERATIVE DIABETIC RETINOPATHY USING PSVM CLASSIFIER

Dr.S.SUJATHA

HEAD OF THE DEPARTMENT

School Of IT and Science

Dr.G.R.Damodaran College of Science

DIVYA.D

M.Phil(Scholar)

School of IT and Science

Dr.G.R.Damodaran College of Science

Abstract

Diabetes is a group of metabolic diseases which occurs a person who has a high blood sugar or because the body does not generates sufficient insulin. Detecting Diabetes is a necessary thing for improve the life time of patient. The fast progression of diabetes is one of the major challenges of current health care. This diabetes causes Diabetic Retinopathy, which leads to a loss of sight. Early detection of diabetes is particularly important to prevent vision loss. In most of the existing system, support vector machine is used for classifying Healthy/DM and NPDR/DM-sans samples. However, it does not handle larger number of datasets and Appropriateness of the system is low. To solve this problem, the proposed system introduced for classifying Healthy/DM and NPDR/DM-sans samples with high Appropriateness. By using an image capture device, the tongue images are captured. The captured image is pre-processed by median filter. The proximal support vector machine is a classification technique which is used for separate the diabetes mellitus and non proliferative diabetic retinopathy samples from the healthy samples by utilising three groups of features such as color, texture, and geometry. An experimental result shows that the proposed method achieves high performance in terms Meticulousness, Remember, F-measure and appropriateness

Key word: Diabetes, median filter, Proliferative Diabetic Retinopathy.

I.Introduction

The World Health Organization (WHO) [1] classified the diabetes into four major types. There are Insulin-dependent diabetes mellitus (IDDM), Non-insulin-dependent diabetes mellitus (NIDDM) Gestational diabetes mellitus (GDM) and Diabetes secondary to other conditions.

Diabetes mellitus (DM) is a chronic disease with long-term macro vascular and micro vascular complications, including diabetic nephropathy [2], neuropathy, and retinopathy. It is a leading cause of death, disability, and blindness in the United States for persons 20 −74 years of age. Diabetes retinopathy is difficult to prevent and cure. This diabetes retinopathy leading to blindness or vision loss. Early detection and effective treatment are necessary for effective care. This can be avoided by advanced management of diabetes mellitus and diabetes retinopathy detection.

Diabetes retinopathy is classified into two types. There are Non proliferative Diabetic Retinopathy (NPDR) [3] and Proliferative Diabetic Retinopathy (PDR) [4] .

Non proliferative Diabetic Retinopathy (NPDR)

The starting stage of diabetic retinopathy is known as Non proliferative Diabetic Retinopathy. , the minute blood vessels within the retina leak blood or fluid.

Proliferative Diabetic Retinopathy (PDR) [5]

The final stage of diabetic retinopathy is known as Proliferative Diabetic Retinopathy. The minute blood vessels within the retina leak blood or fluid which leads to traction retinal detachments.

II.Related work

Kanika Verma et.al proposed a Detection and Classification of Diabetic Retinopathy using Retinal Images. Diabetes slowly attacks the retina of the human eye which is leading to Diabetic

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Retinopathy. The retinal image of human eye is acquired by camera. By using density analysis and bounding box methods, the haemorrhage candidates were detected. Finally Random Forests approach is used for classification. It classifies various stages of diabetic retinopathy which is normal, moderate and non proliferative diabetic retinopathy (NPDR) [6] .However it does not use robust classifier for achieve high Appropriateness.

K. Malathi et.al presented an Efficient Method to Detect Diabetic Retinopathy Using Gaussian-Bilateral and Haar Filters with Threshold Based Image Segmentation. The Micro vascular complication leading to diabetes which is known as Diabetic retinopathy. In this system, Gaussian based bilateral filter is used to decrease/remove the noise of the fundus images. Here Haar filter is used to detect the diabetic retinopathy. However it does not detect fovea for improve detecting performance [7].

Bob Zhang yet.al introduced a new method for detecting Diabetes Mellitus and Non proliferative Diabetic Retinopathy which is based on tongue image features. The complication of Diabetes mellitus (DM) is known as diabetic retinopathy (DR**).** To detect DM and non proliferative diabetic retinopathy (NPDR), **t**he tongue color, texture, and geometry feature are extracted. The support vector machine is used for classification [8] . The proposed method can separate Healthy/DM tongues as well as NPDR/DM-sans NPDR. However it does not suitable for large data set.

SujithKumar S B et.al [9] presented a new diabetic retinopathy detection which is performed in Non-dilated RGB Retinal Fundus Images. The small dots are appeared in the retinal fundus to form a Microaneurysms. Microaneurysms is a first symptoms of diabetic retinopathy. Earlier detection of microaneurysm can assist minimize the blindness of people. The preprocessing, feature extraction and classification methods are used to performed diabetic retinopathy detection. However it does not achieve high accuracy.

Dr.Chandrashekar et.al [10] proposed a method for Detection of Vascular Abnormalities. The proposed system detects the irregularity in the retina by utilizing morphological techniques which is used for extract the features from retina such as blood vessels, micro aneurysms and etc. To calculate the severirty of the dieases the ares features are extracted. Classification method is used to classify normal, mild and high severity Vascular Abnormalities. It is possible to large number of fundus images and it can be reduce the cost. However it does consider the colour feature for obtimal detection.

III.Proposed system

A novel approach is used for analyzing diabetes mellitus and non proliferative diabetic retinopathy using tongue features. After a completion of tongue image capturing process, median filter is used for remove the unwanted noise. To classify Healthy/DM and NPDR/DM-sans samples the proximal support vector machine utilizes three groups of features for final classification.

A. Image capturing process

Tongue images were captured by an appropriate device. In order to produce homogeneous illumination, the capturing device has three-chip CCD camera with 8 bit resolution, and two D65 fluorescent tubes were placed symmetrically around the camera**.**The captured image has a ranging from 257 × 189 pixels to 443 × 355 pixels which is in the form of JPEG format.

B. Preprocessing process

In order to eliminate the unwanted noise, the preprocessing is applied on the extracted image. Here the median filter is used for improve the visual appearance. The automatic segmentation is done after the completion of capturing process which is for take apart of foreground pixels from its background. The color, texture, and geometry features in tongue foreground image are extracted for identify diabetes mellitus and non proliferative diabetic retinopathy.

C. Feature extraction

1.Tongue Color feature extraction

The tongue color gamut represents all possible colors that appear on the tongue surface. The 12 colors representing the tongue color gamut are extracted. For the foreground pixels of a tongue image, corresponding RGB values are first extracted, and converted to CIELAB values.

2.Texture feature extraction

The tongue images are divided into eight blocks to denote the texture of tongue images. Each block has 64 × 64 size. Automatically compute the blocks by placing the centre of the tongue using a

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segmented image. Block 1 is positioned at the tip; Blocks 2 and 3, and Blocks 4 and 5 are on each side; Blocks 6 and 7 are at the origin and Block 8 is placed at the center. The 2-D Gabor filter is applied for calculate the each block texture value which is represented as

$$G_k(x,y) = exp\left(\frac{x'^2 + \gamma^2 . y'^2}{-2\sigma^2}\right) cos\left(2\pi \frac{x'}{\lambda}\right)$$

Where,
$x' = x \cdot \cos\theta + y \cdot \sin\theta$,
$y' = -x \cdot \sin\theta + y \cdot \cos\theta$,
σ = variance,
λ - Wavelength,
γ - Aspect ratio of the sinusoidal function
θ - Orientation
Each filter is convolved with a texture block to produce a response $R_k(x, y)$:

$$R_k(x,y) = G_k(x,y) * im(x,y)$$

Where,

$im(x,y)$ - Texture block

*- 2-D convolution

Responsible block are merge to form FR_i. This final answer is estimated as follows

$$FR_i(x,y) = max(R_1(x,y), R_2(x,y), \dots, R_n(x,y))$$

It denotes the texture of a block by averaging the pixel values of FR_i. Here the Healthy samples have a higher texture values and diabetes mellitus samples have a lower texture values.

3.Geometry feature extraction

Based on the measurement of length, width and distance the 13 geometry features extracted.

Width is defined as the horizontal distance between tongue right edge (x max) to its left edge (x min), the length of tongue is defined as the vertical distance between tongue from bottom edge (y_{max}) point to its furthest top edge point (y_{min}), Length–width ratio is defined as tongue's length to width ratio and Smaller half-distance (z) represented as the half distance of length or width is known as smaller half-distance which are extracted from tongue images.

And also Center distance, Center distance ratio, Circle area, Circle area ratio, Square area, Square area ratio, Triangle area and Triangle area ratio features are extracted for further classification.

IV.Classification technique

The extraction of color, texture and geometry features are used for classify Healthy/DM and NPDR/DM-sans NPDR samples. Here proximal support vector machine approach is used for classify the samples. As the size of the patterns increases, the training time increases and also the computational complexity increases in case for SVM. In order to overcome the drawbacks of SVM, proximal support vector machine (PSVM) was developed. By applying each feature individually to separate Healthy/DM, the highest average Appropriateness achieved via proximal Support Vector Machines.

Algorithm

Input: Training image

Output: Result analysis

Step 1. Initialize N

// N-Number of training samples

Step 2. I← Capture

Step 3. I← Preprocess

Step 4 . Median filter ← Preprocess

Step 5. Color feature extraction

$$G_k(x,y) = exp\left(\frac{x'^2 + \gamma^2 . y'^2}{-2\sigma^2}\right) cos\left(2\pi \frac{x'}{\lambda}\right)$$

// $x' = x \cdot \cos\theta + y \cdot \sin\theta$, $y' = -x \cdot \sin\theta + y \cdot \cos\theta$, σ is variance, λ is wavelength, γ is aspect ratio.

Step 6. I ←Texture feature extraction

Step 7. If I is normal

High texture value

Step 8. Else

Low texture value

Step 9. I ← geometry feature extraction

Step 10. Compute PSVM classification

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Step 11. The target function of Proximal Support Vector Machine is denoted by

$$\text{Min } \frac{c}{2}||y||^2 + \frac{1}{2}(\mathrm{w}^{\mathrm{T}}\mathrm{w} + \mathrm{r}^2)$$

// C is castigation factor, y express sample output, w figure the normal vector of the classification hyperplane, e is units vector, g is parameter.

Step 12. The cost function is given as follows:

$$min_{\omega,b,\xi}\, J(\omega, b, \xi) = \frac{1}{2}||[\omega, b]^T||^2 + \frac{c}{2}\sum_{i=1}^{m}||\xi_i||^2$$

Step 13. Samples result

V. Experimental results

The experimental tests that were conducted for both existing methodology (support vector machine based diabetes detection) and proposed approach median filter and proximal support vector machine based diabetes detection. The comparison is made in terms of the performance metrics called the Meticulousness, remember, F-measure and Appropriateness which are explained detailed in the following sub sections.

A.Meticulousness

The Percentage of accurate predicted results from the set of given input is called as Meticulousness. Meticulousness value is computed by using the following equation

$$\text{Meticulousness} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

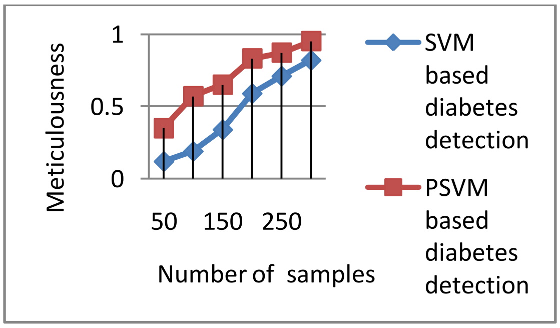

Fig.1. Meticulousness comparison

In this graph, x axis will be the two approaches of diabetics detection and y axis will be Meticulousness. From the above graph it can be proved that the proposed methodology provides high meticulousness value better than the existing approach.

B.Remember

The remember or true positive rate (TP) is the proportion of positive cases that were correctly identified, as calculated using the equation:

$$\text{Remember} = \frac{\text{True Positive}}{\text{True Positive} + \text{True Negative}}$$

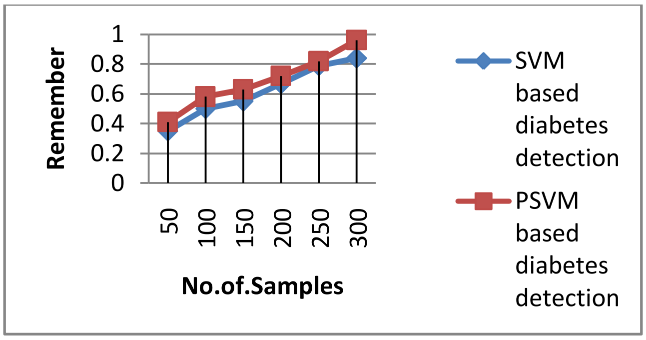

Fig.2. Remember comparison

In this graph, x axis will be the two approaches of diabetes detection and y axis will be remember. From the above graph it can be proved that the proposed methodology provides high remember values better than the existing approach.

C.F-measure

The F-measure of the system is defined as the weighted harmonic mean of its Meticulousness and remember, F-measure can be represented as

$$F = \frac{2(Precision)(Recall)}{Precision + Recall}$$

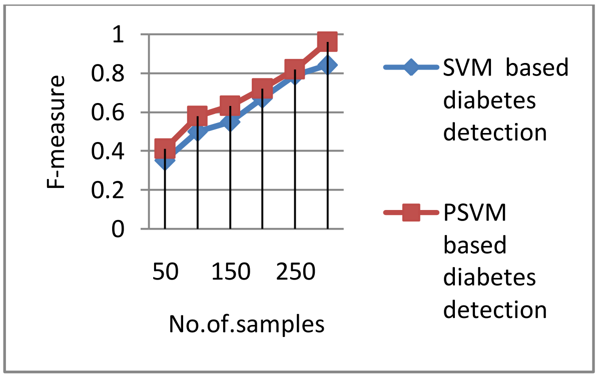

Fig.3.F measure comparison

In this graph, x axis will be the two approaches of diabetes detection and y axis will be F measure.

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From the graph, F measure of the system is our proposed system is better than existing system.

D. Appropriateness

The Appropriateness of the system is calculated with the values of the True Negative, True Positive, False Positive, False negative actual class and predicted class outcome it is defined as follows,

$$\text{Appropriateness} = \frac{\text{True positive} + \text{True negative}}{\text{True positive} + \text{True negative} + \text{False positve} + \text{False negative}}$$

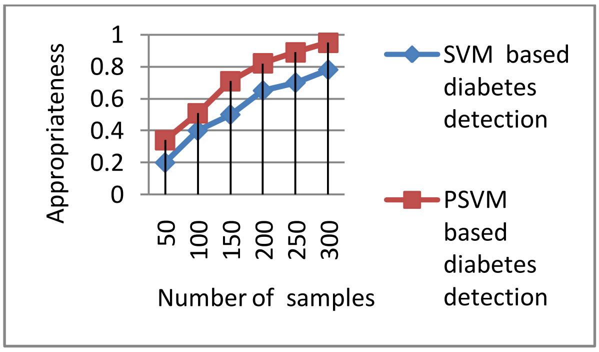

Fig. 4. appropriateness comparison

In this graph, x axis will be the two approaches of diabetes detection and y axis will be appropriateness in %. From the above graph it can be proved that the proposed methodology provides better result than the existing approach.

VI.Conclusion

In this system, a narrative classification approach is used for classify Healthy/DM and NPDR/DM-sans NPDR samples by utilise three type of features**.** In order to achieve high Appropriateness median filter is used for preprocessing. After the feature extraction the PSVM classifier used in this produces the more accurate information than the SVM classifier. An experimental result shows that the proposed method achieves high performance in terms Meticulousness, remember, F-measure and Appropriateness which is better than support vector machine classification.

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