A NEW LOGIC FOR DIABETES MELLITUS AND NPDR DETECTION USING TEXTURE, GEOMETRY AND COLOUR FEATURES OF TONGUE

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Abstract— *Diabetes mellitus(DM) and non proliferative diabetic retinopathy(NPDR) are one of the serious health care issues today. It creates various financial problems to our health care departments.This paper suggests a technique for classifying DM,NPDR and healthy samples in a non invasive manner.Initially, tongue images are obtained using a capture device.Images are preprocessd which involves color space conversion and region based segmentation.Then color,texture and geometry features are extracted.Applying a combination of all these features fuzzy logic can be used to classify healthy/DM tongues and healthy/NPDR tongues.*

Key Words: Diabetes mellitus (DM), nonproliferative diabetic retinopathy (NPDR) , tongue color features, tongue geometry features, tongue texture features.

1.INTRODUCTION

Diabetes mellitus (DM), commonly referred to as diabetes, includes a group of metabolic diseases in which there are high blood sugar levels over a prolonged period[2]. Symptoms of high blood sugar include frequent urination, increased thirst, and increased hunger. If it is kept untreated, diabetes can cause various complications .Acute complications are diabetic ketoacidosis and nonketotic hyperosmolar coma. Other long-term complications include cardiovascular disease, stroke, chronic kidney failure, foot ulcers, and eye damage.Diabetes may occur due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced. Two main types of diabetes mellitus includes

- Type 1 DM that results from the pancreas's failure to produce enough insulin. This form was earlier referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The cause for this is unknown.

- Type 2 DM is associated with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses a lack of insulin may also develop This form was previously referred to as "non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The major cause is high body weight and not enough exercise.

 Diabetes Mellitus is the cause of death of about 175 million people in the world and this number would increase to 360 million in the future.It results in death,other disabilities and economic problems.Various tests are done to detect diabetes.FPG(Fasting Plasma Glucose)test is the common test used.It requires that the patient has to sit without food for atleast 12 hour.It also involves taking the blood sample by piercing the finger for analyzing blood sugar levels(invasive process). Diabetic retinopathy (DR) is a microvascular complication of DM that accounts for about 5% of the 37 million cases of blindness in the world, estimated by World Health Organisation [3] . If disease is detected at its initial stage known as nonproliferative diabetic retinopathy (NPDR),   it can be treated to prevent further progression and sight loss. Different imaging modalities like red-free , angiography, and color fundus imaging are ways to examine the human retina in order to detect DR and subsequently NPDR. These imaging modalities can be regarded as invasive, exposing the eye to bright flashes of light or having fluorescein injected into a vein in the case of angiography. Therefore, there is a need to develop a noninvasive and accurate detection technique for DR and NPDR.

2.TONGUE IMAGE PREPROCESSING

Tongue images are captured using a CCD camera with 8 bit resolution and two D65 fluorescent tubes placed symmetrically around the camera in order to produce a uniform illumination. According to CIE(Commission Internationale de l'Eclairage),incident light and emergent light should be separated by 45 degrees.[2]While capturing the image, patients placed their chin on a chinrest showing their tongue to the camera. The images are captured in JPEG format and color corrected to compensate for any changes caused by illumination. It helps in proper feature extraction and classification of images. [4]This capture device is noninvasive, neither requiring a bright flash nor injection of dye into a patient's blood stream. Overview of proposed model is shown below in figure 1.Image preprocessing involves colour space conversion and region based segmentation .
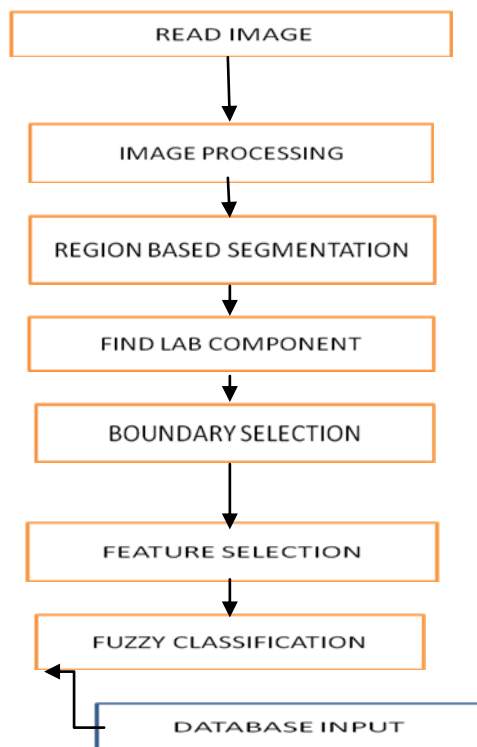

Fig -1 Overview of proposed model

3. COLOUR SPACE CONVERSION

Various models are   called color space as it can be mapped to 2-D ,3-D or 4-D co-ordinate system. Different colour models include CIE RGB,CIE XYZ,CIE xyY,CIE LAB.These colour models provide colour information that makes calculations easy or helps in identifying colors that is more intuitive.CIE is the authority of light that

describes various rules on colour models. RGB color space defines colour as percentages of red,green and blue hues mixed together.HSV(Hue Saturation Value) is a transformation of RGB colour space .This transformation is useful in many applications.CIE XYZ is the extrapolation of RGB created mathematically to avoid negative numbers. Figure 2 shows the HSV image of tongue.
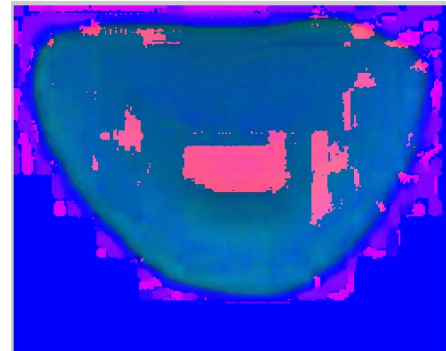

Fig - 2 HSV image

4.REGION BASED SEGMENTATION

For segmentation, input image is taken and calculate the boundary region to identify the contour segmented image(boundary region calculated by number of iterations)Figure 3 shows the segmented image
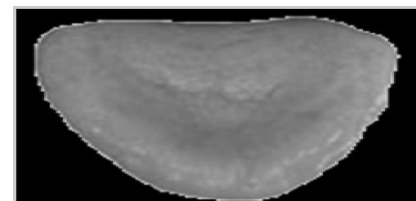

Fig - 3 Contour segmented image

5 FEATURE EXTRACTION

5.1TONGUE COLOR FEATURE

 To get the foreground pixels of a tongue image,corresponding RGB vaues are first obtained and then converted to CIELAB values and to CIEXYZ.Then boundary selection is performed to obtain the single pixel values.

5.2 TONGUE TEXTURE FEATURE

Gabor filters are very useful for texture representation and descrimination.It is a linear filter used for edge

detection. Frequency and orientation representations of Gabor filters are similar to human visual systems.

5.3 TONGUE GEOMETRY FEATURES

Following are the various geometry features extracted

1 Centroid-Intersection of 3 medians of a triangle

2 Area-Number of tongue foreground pixels

3 Eccentricity-Parametere that determines how much conic section deviates from being circular

4 Minor axis length

5 Major axis length

6 Equivalent diameter

7 Extrema

8 Filled area

allows membership degrees to the variables. Different cases of each input's fuzzy sets are evaluated according to if-then rules of the fuzzy system. As a result of this operation, the optimum outputs are obtained much close to the target outputs. Mamdani's fuzzy inference method is the most commonly seen fuzzy methodology. Fuzzy logic allows making definite decisions based on imprecise or ambiguous data For a multiple-input fuzzy model, it is helpful to have a tool for viewing the process of fuzzy inference; Figure 4 is the fuzzy inference viewer available in the Matlab Fuzzy Logic Toolbox, where you can change the input values by click and drag the input vertical lines and then see the interactive changes of qualified consequent MFs and overall output MF.
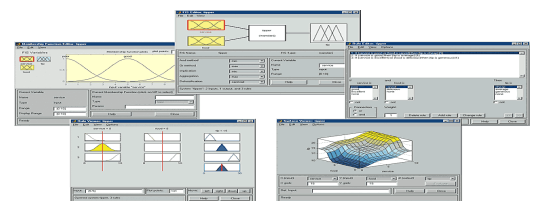

Fig 4 Fuzzy inference viewer

7. CONCLUSION

In this paper, a noninvasive technique to classify Healthy/DM/NPDR samples were developed using three groups of features extracted from tongue images. These three groups include color, texture, and geometry.All these features are used to classify healthy/DM and healthy/NPDR using an effective fyzzy logic technique.

Parameter	DM		Normal		NPDR	
	min	max	min	max	min	max
Centroid	98.60	129.99	119.85..	131.58..	18000	20350..
Area	36841	36841	44013	44013	10	33565
Eccentricity	0.4725	0.4725	0.1042	0.1042	0.3391	0.6575
Minor axis length	207.11	207.11	237.65..	237.65..	3.2083	204.06..
Major axis length	235.01	235.01	238.95..	238.95..	4.2583	216.91..
Equivqlent diameter	216.58	216.58	236.72..	236.72..	3.5682	206.72..
Extrema	75000	24750..	75000	24750..	0.5000	239.50...
Filled area	36841	36841	44016	44016	10	33565

Table 1 Texture features

6.HEALTHY VERSUS DM AND NPDR CLASSIFICATION

Classification is performed using fuzzy logic.It is close to human thinking style because it uses linguistic terms.It

REFERENCES

[1] Detecting Diabetes Mellitus and Nonproliferative Diabetic Retinopathy Using Tongue Color, Texture, and Geometry Features, Bob Zhang∗, *Member, IEEE*, B. V. K. Vijaya Kumar*, Fellow, IEEE*, and David Zhang*, Fellow, IEEE,* ieee transactions on biomedical engineering, vol. 61, no. 2, february 2014

[2] *Prevention of Blindness From Diabetes Mellitus*, World Health Organization,Geneva, Switzerland, 2006.

[3] J. H. Hipwell, F. Strachan, J. A. Olson, K. C. McHardy, P. F. Sharp, and J. V. Forrester, "Automated detection of microaneurysms in digital redfree photographs: A diabetic retinopathy screening tool," *Diabetic Med.*, vol. 7, pp. 588–594, 2000.

[4] M. E. Mart´ınez-P´erez, A. Hughes, S. Thom, A. Bharath, and K. Parker,"Segmentation of blood vessels from red-free and fluorescein retinal images,"*Med. Image Anal.*, vol. 11, pp. 47–61, 2007.

[5] T. Spencer, J. A. Olson, K. C. McHardy, P. F. Sharp, and J. V. Forrester,"An image-processing strategy for the segmentation of microaneurysms

in fluorescein angiograms of the ocular fundus," *Comput. Biomed. Res.*, vol. 29, pp. 284–302, 1996.

[6] B. Huang, J. Wu, D. Zhang, and N. Li, "Tongue shape classification by geometric features," *Inf. Sci.*, vol. 180, pp. 312–324, 2010.

[7] B. Li, Q. Huang, Y. Lu, S. Chen, R. Liang, and Z. Wang, "A method of classifying tongue colors for traditional Chinese medicine diagnosis based on the CIELAB color space," in *Proc. Int. Conf. Med. Biometrics*, 2007, pp. 153–159.

[8] C. H. Li and P. C. Yuen, "Tongue image matching using color content,"*Pattern Recog.*, vol. 35, pp. 407–419, 2002.

[9] N. M. Li, "The contemporary investigations of computerized tongue diagnosis,"in *The Handbook of Chinese Tongue Diagnosis.* Peking, China:Shed-Yuan Publishing, 1994.