

Diabetic Detection using Tongue Images Based on ANNClassification

E.Srividhya, A.Muthukumaravel

Abstract: In this work, we proposed an automatic technique to research and detect and examine diabetes through the usage of tongue pix analysis based on Artificial Neural Network (ANN) classifier. There is a sturdy association in between the characteristics of tongue and human health analysis. ANN with a few unique features is used to establish a dating among diseases like diabetes and traits of tongue. Features like Area, Perimeter, Width, Length, Smaller 1/2-distance, Circle Area and Square Area were measured for each tongue. Apart from these Gabor texture features, Hough shape capabilities and color capabilities also extracted. Tongue segmentation is carried out by using the use of vicinity of hobby with shade segmentation. Edge features also extracted the usage of canny facet detection. To compare the overall performance of our proposed approach, we behavior experiments on tongue datasets, wherein ANN technique is applied to classify tongue photographs. The proposed approach is compared with SVM classifier. As the experiment's consequences proven, our proposed method improves the type accuracy by means of 4.99% on common and achieves 99. Ninety-nine% charter category accuracy.

Keywords: Gabor texture features, tongue images analysis, diabetic analysis, ANN, SVM.

I. INTRODUCTION

A tongue is AN organ that reflects physiological and clinic pathological circumstance of one's body. each a section of the tongue is said to corresponding inner organs. [1] notably, the visible statistics is employed in tongue prognosis. The shade, the form, and so the movement of a tongue, tongue substance, and tongue coating area unit foremost elements for the prognosis. The geometrical sort in addition permits to diagnose one's fitness, whose methodology diagnoses the contamination by victimization gazing the trade of the tongue frame like thickness, size, cracks, and teeth-marks. The tongue coating, protected on a tongue like nonvascular plant is that the foremost crucial issue, trying forward to shade, degree of standing, thickness, shape, and allotted vary to settle on a patient's grievance and body circumstance. it's classed by its shade – white, yellow, grayish, black, homogenized shade, then forth. though a tongue identification is convenient and noninvasive, it is the hassle of objectification and standardization. The exchange of the examination state of affairs variety of a mild offer impacts the tip results tons. Moreover, as a result of the analysis depends on doctor's relish and talent, it's manner strong to urge an even outcome. Recently, many researches area unit being distributed to remedy those problems.[2] [4].

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In practice, assessment effects are inspired by numerous elements together with the medical practitioner's tactile feel, shade sensitivity or viewing surroundings in addition to their interpretation dispositions based totally on revel in or different medical statistics. In addition, medical practices range amongst physicians in one-of-a-kind international locations. Thus, a method to objectify tongue shade prognosis the usage of optical methods under strong conditions is suitable [5], [6], [7]. A color quantification technique that could differentiate shades reliably will strengthen the field of traditional medicinal drug. Texture analysis describes the symptoms of sicknesses and so its miles considered to be an important criterion in disorder analysis. The roughness or bumpiness refers to distinction inthe intensity values,or gray degrees.Inflammation lesions or ulceration and deteriorationrelated to frame element talked about by using dark purple in tongue. White designates stagnation of blood.

The colour of the affected person's tongue colour presents records approximately his/her health repute. For example [10], dark crimson coloration will counsel inflammation or ulceration, whereas a white tongue shows cold attack, secretion deposits, or a liability among the blood resulting in such conditions as anemia [9]. Moreover, a yellow tongue factors out a ill of the liver and bladder, and blue or purple implies stagnation of blood stream and a severe weakening of the a part of the organic process gizmo that corresponds to the realm of the tongue during which the colour seems. The coating on the tongue is discriminated by means that of not simplest its presence however in addition its color. The shade may well be yellow, white, and completely different colours. However, the coloration in photograph isn't the precise actual color of the tongue. To properly establish the colour of the tongue coating, we have a tendency to administered the mirrorlike component technique provided in our previous work on tongue detection and analysis [8]

II. RELATED WORK

XingzhengWangaet al. [11] mentioned Several essential overall performance signs, together with brightening consistency, framework duplicability and exactness, are in an intricate way analysed. Test results demonstrate that caught photographs are in over the top wonderful and keep up stable though acquisitions are enduring.

Sway Zhang et.Al [12] proposes a non-intrusive system to watch DM and Non-proliferative Diabetic Retinopathy (NPDR) the primer degree of DR put together generally completely with respect to three groups of abilities removed from tongue previews.

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They spread shading, surface and unadulterated arithmetic. A non-obtrusive catch instrument with introduction remedy first catches the tongue depictions. A tongue shading array is mounted with twelve shades speaking to the tongue shading capacities. the vibe estimations of eight squares deliberately situated on the tongue floor, with the additional mean of all 8 blocks is used to represent the 9 tongue texture functions.

Jianfeng Zhang et.al [13] develops a diagnostic technique of diabetes primarily based on standardized tongue photo the use of assist vector gadget (SVM). Methods. Tongue images of 296 diabetic toimages and 531 no diabetic toimages had been amassed by means of the TDA-1 virtual tongue instrument. Tongue body and tongue covering were isolated by means of the division consolidating strategy and chrominance-limit procedure. With separated shading and surface choices of the tongue photo as info factors, the symptomatic variant of polygenic ailment with SVM become instructed. when streamlining the blend of SVM portion parameters and info factors, the impacts of the combos at the adaptation had been examined.

Ramachandran Sudarshan et.al [14] provides the more recent class for fissured tongue, its sample, and frequencies of sample, associated signs, and coexisting systemic issues. The affiliation of fissured tongue with several systemic disorders needs to be significantly studied in a larger populace to validate its precise relation with systemic illness. Genetic preponderance of fissured tongue needs to also be drastically investigated.

Dan Meng et.al [15] proposes a singular function extraction framework referred to as confined high dispersal neural systems (CHDNet) to remove fair-minded capacities and scale back human work for tongue anticipation in TCM. Past CNN designs have essentially trotted on discovering convolution channels and adjusting loads between them, yet these models have chief issues: excess and lean common sense in overseeing uneven examining. we will in general present over the top dispersal and neighbourhood response institutionalization activity to deal with the matter of repetition.

Chuang-Chien Chiu et al. [16] proposed computerized tongue exam system (CTES) based on electronic picture examination for the explanation behind quantizing the tongue homes in run of the mill Chinese clinical diagnosing. The CTES is useful to supply the doctors a logical and objective indicative across the board for the tongue forecast inside the logical apply and investigation.

Bo Pang a et al. [17] were proposed Computerized tongue inspection technique intention to image out and analysis the diseases earlier. First, varieties of quantitative features, chromatic and textural measures, are extracted from tongue images.

III.EXISTING METHOD

Support Vector Machines (SVMs) could be a reasonably classifier that are heaps of connected directed learning methods utilized for characterization. SVM can fabricate associate degree uninflected hyperplane within the region, one that amplifies the sting among the two certainties units. to choose the sting, two parallel hyper planes are built, one

on each facet of the isolating hyper plane, that are “driven up towards” the two records units. In present system, SVM has downside for massive features and characteristics of image makes the detection of ailment difficult.

IV.PROPOSED METHOD

In this approach ANN primarily based category is implemented. The advantage of this is, it is straightforward to enforce and convergence to minimal mean squared errors answers.

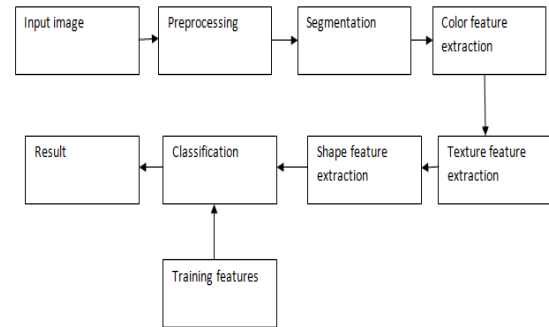


Fig 1 Block diagram of proposed method

Explanation of blocks given in Fig 1

- 1.Input photo is chosen from tongue photograph database.
- 2.Preprocess the photo to do away with noise
- three.For shade features,
 - 12 colours are extracted & converted to corresponding LAB values.
 - The Euclidian distance is calculated
 - Mean, average & preferred deviation is calculated.
- Four. For texture capabilities,
 - The tongue photograph is split in 8 blocks strategically positioned on tongue.
 - Gabor filter is used for texture characteristic extraction of each block
- 5.For matching,
 - Divide the database into schooling and checking out set.
 - SVM is used for schooling and class
 - Determine whether the enter photo is diseased/Healthy.
- 6.Result

V. FEATURE EXTRACTION FRAMEWORK

Gabor texture feature

Gabor filter out, Gabor filter out financial institution, Gabor rework and Gabor wavelet are broadly implemented to picture processing, computer vision and sample reputation. A the middle of Gabor filter out based totally function extraction is the 2D Gabor filter out function

$$\psi(x, y) = \frac{f^2}{\pi\gamma\eta} e^{-\left(\frac{f^2}{\gamma^2}x^2 + \frac{f^2}{\eta^2}y^2\right)} e^{j2\pi fx'}$$

$$x' = x \cos \theta + y \sin \theta$$

$$y' = -x \sin \theta + y \cos \theta .$$

[18]

In the deliberation space the Gabor separate out could be a troublesome art wave (a 2D Fourier establishment include) expanded by exploitation Associate in Nursing establishment concentrated Gaussian. F is that the fundamental recurrence of the channel, θ the turn point of view, γ sharpness (transfer speed) on board the Gaussian basic pivot, and η sharpness on the hub (opposite to the wave). inside the given kind, the part size connection of the Gaussian is η/γ . This trademark has the consequent systematic structure inside the recurrence space

$$\Psi(u, v) = e^{-\frac{\pi^2}{f^2}(\gamma^2(u'-f)^2 + \eta^2 v'^2)}$$

$$u' = u \cos \theta + v \sin \theta$$

$$v' = -u \sin \theta + v \cos \theta .$$

Gabor choices, raised as Gabor fly, Gabor foundation or multi-goals Gabor include, are involved reactions of Gabor channels in by means of the usage of a couple of filters on numerous frequencies f_m and orientations θ_n . Frequency in this example corresponds to scale facts and is hence drawn from

$$f_m = k^{-m} f_{max}, \quad m = \{0, \dots, M - 1\}$$

In which f_m is that the m th frequency, $f_0 = f_{max}$ is that the highest frequency most well-liked, and okay > one is that the frequency scaling part. The filter orientations are drawn from

$$\theta_n = \frac{n2\pi}{N}, \quad n = \{0, \dots, N - 1\}$$

Where in θ_n is the n th orientation and N is that the general shift of directions. Sizes of a different bank are browsed exponential (octave) dividing and directions from straight dispersing.

Shape feature extraction

The Hough Transform (HT) is an automatic analysis approach used for detection of linear capabilities in a diffusion of packages. This rework detects analytic curves, whilst a generalized HT may be used to discover arbitrary shaped templates. Also, it uses a parametric technique to describe capabilities of hobby and can detect any function that may be parameterized. Linear functions in picture area are converted into unmarried factors inside the parameter space. Successful detection of linear functions the usage of the HT requires pre-processing to limit the enter picture into parallel layers. points of interest of the HT are that it recognizes strains with some discontinuity and it's genuinely unaffected by exploitation arbitrary clamor [19].

In this remodel picture area (x, y) is converted into a (ρ, θ) parameter area. The factor (x, y) may be represented in polar coordinates as (r, α) . That is:

$$x = r \cos \alpha \text{ and } y = r \sin \alpha.$$

$$\rho = x \cos \theta + y \sin \theta$$

Color Feature Extraction

In bodily kind 5-magnificence category trouble, the tongue frame coloration functions and the tongue coating colour functions were extracted, considering physical type

additionally depends on tongue coating coloration features. 3 color spaces are carried out to demonstrate tongue color capabilities. They are RGB, CIE Lab and XYZ. For every coloration space, there are 3 color channels. So, there are nine coloration channel values, it is also known as nine measurement coloration functions, to specific each divided a part of tongue photograph.

Color segmentation

Region of interest and colour picture segmentation is used to section the tongue. Initially the given image is splitted into R, G and B coloration channels. Then the colour is adjusted. After that RGB photograph is reconstructed through the use of 3 splitted channels.

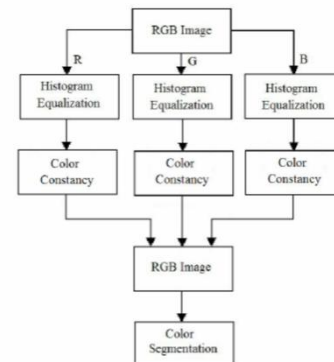


Fig 2 color image segmentation

Artificial neural network

The simple ANN might be a three-layered structure spoke to as; the primary layer is that the information layer, a center concealed layer and subsequently the yield layer at remaining. It is enormous, parallel and intensely associated spec. Back proliferation organizes (BPN) rule is on the total want to instruct MLP. It utilizes an inclination plunge way to deal with limit the mix-ups made at some reason for tutoring. The means for training ANN is gave underneath:

- 1: Initialize the combination loads and inclinations with irregular qualities.
- 2: Load the instruction records. For the j th design,
- three: data superhighway enter at the concealed layer is determined as

$$net_h^j = \sum_{n=1}^N x_n w_{1,h,n} + b_{1,h}, \quad h = 1, \dots, H$$

Where $w_{1,h,n}$ is that the weight among information physical cell 'n' and concealed neuron 'h', N and H are the extents of information and shrouded layers, severally, and $b_{1,h}$ is that the partiality estimation of concealed substantial cell 'h'. The concealed layer yield is determined as

$$O_h^j = \text{sigmoid}(net_h^j) = \frac{1}{1 + e^{(-net_h^j)}}$$

- 4: Calculation of net input using at output layer is done as

$$net_m^j = \sum_{h=1}^H O_h^j w_{2,m,h}$$



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Where w_{2m} , h is that the weight between shrouded vegetative cell 'h' and yield neuron 'm', b_{2m} is that the shamefulness worth of yield vegetative cell 'm'. M is that the measure of yield hubs. The system yield is determined beneath

$$y_m^j = f(\text{net}_m^j)$$

5: The differentiation between the objective yield and system yield offers the mistake worth, that is determined the work of the following condition:

$$E^j = \sum_{m=1}^M (T_m^j - y_m^j)^2$$

In which T_{jm} and y_{jm} are the target output and community output, severally.

6. the load and bias values are up to now.

7. Repeat from steps a pair of to 6, for all coaching records until the error is decreased, that indicates the of completeness of the coaching procedure.

VI. RESULTS AND DISCUSSION

We have implemented our proposed approach the usage of MATLAB and the results showed that the approach produces higher results in tongue segmentation and category techniques. Let us have a detailed look with the one-of-a-kind tongue picture samples. In classification 3 sorts of operations are achieved. First the diabetic and non-diabetic persons are diagnosed. If diabetic is showed then it'll classify the individual belongs to male or lady class. If the man or woman is woman then if the ailment level is diagnosed. If the degree is type 1 then its miles diagnosed as excessive. If it's far type 2 then it's far diagnosed as medium. In this phase, we as compared the performance of our proposed system the use of ANN category version with SVM. We evaluated the overall performance of schooling the classifier fashions the use of the set of features extracted from the entire tongue image. Fig three indicates the input picture taken for processing. Fig 4 is the gray scale photograph that is obtained by way of converting RGB into Gray scale. Fig five is the histogram plot of enter image. Fig 7 is the histogram plot of equalization and the corresponding equalized image confirmed in Fig 6. The segmented tongue picture confirmed in Fig 8. Fig nine to Fig 14 showed exceptional colours of tongue. Fig 15 is a Magnitude reaction of Gabor clear out and Real elements of Gabor clear out showed in Fig sixteen. Fig 17 shows the Edge detection end result. The output end result of Hough transformation showed in Fig 18. The edge features and Hough features gives the first-rate features as a input to a classifier to acquire the detection efficiency.



Fig 3 Input image

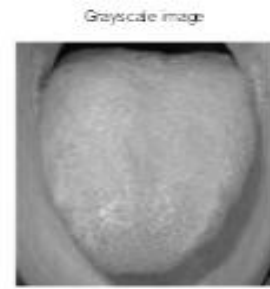


Fig 4 Grayscale image

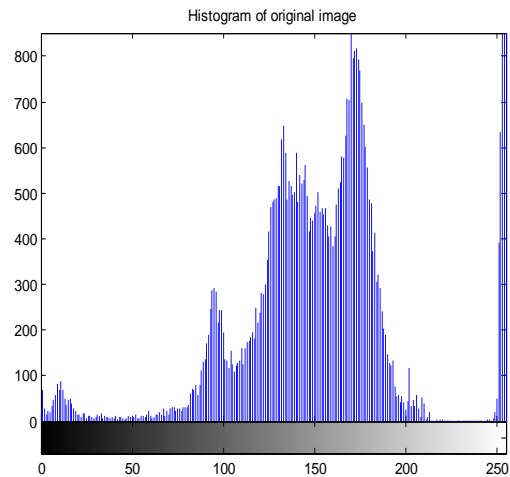


Fig 5 Histogram of input image



Fig 6 Equalized image

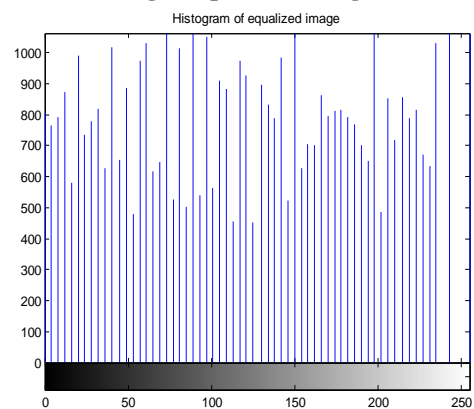


Fig 7 Histogram of equalized image

Segmented Image

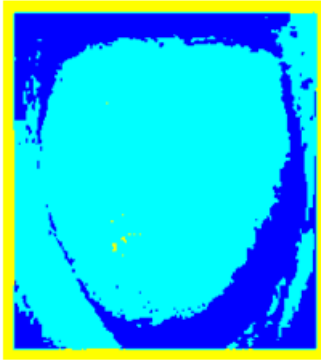


Fig 8 Segmented Tongue

Red

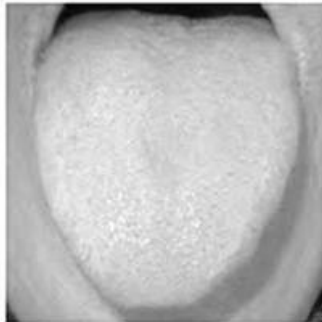


Fig 9 Red plane

Green



Fig 10 Green plane

Blue



Fig 11 Blue plane

Lightness



Fig 12 Lightness

Green-red



Fig 13 Green-Red

Blue-yellow

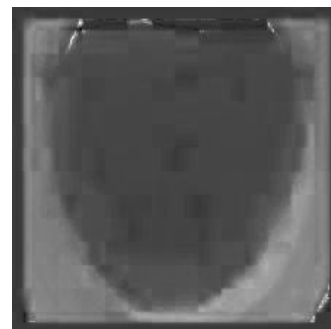


Fig 14 Blue-Yellow

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Magnitudes of Gabor filters

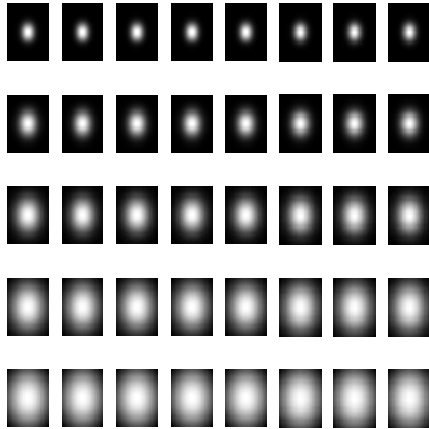


Fig 15 Magnitude of Gabor Filter

Real parts of Gabor filters

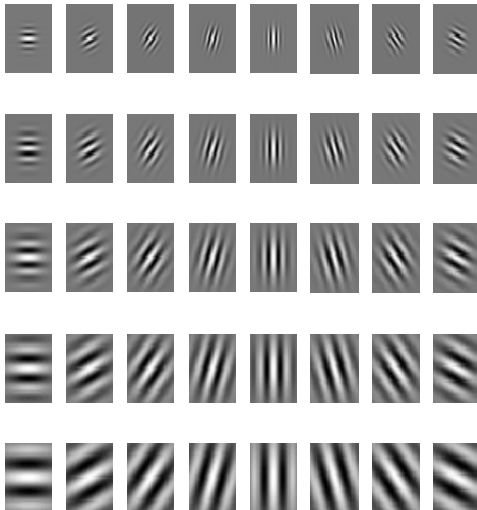


Fig 16 Real parts of Gabor Filter

Edge detection



Fig 17 Edge Detection

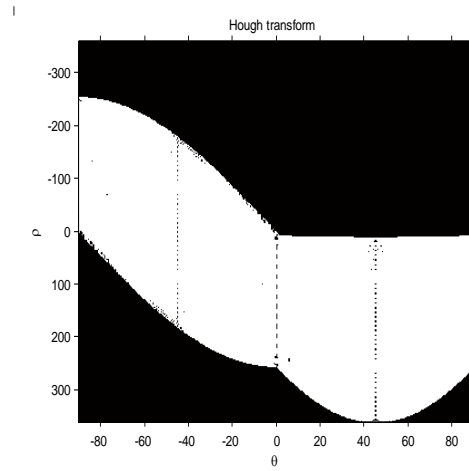


Fig 18 Hough Transformation

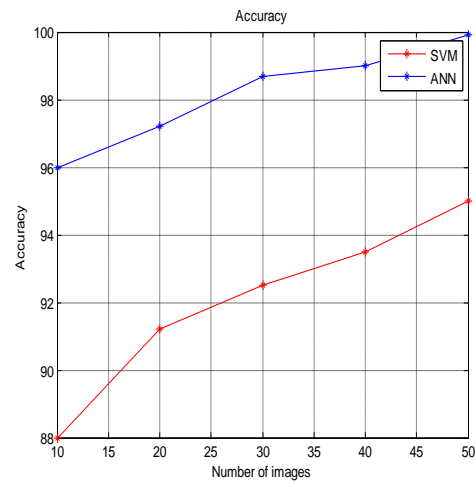


Fig 19 Accuracy comparison

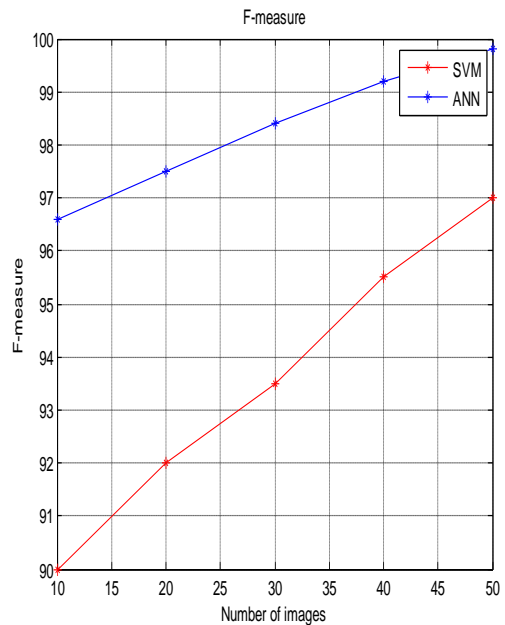


Fig 20 F-measure comparison

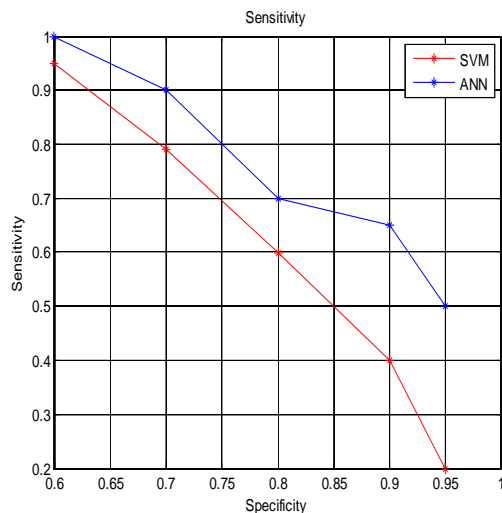


Fig 21 sensitivity comparison

VII. CONCLUSION

In this painting, we layout a tongue snap shots constitution popularity framework, including pics acquisition, detection, segmentation and category to obtain accurate,rapid and green constitution recognition. We introduce ANN technique that divides records into two subsets in keeping with their complexity at person level after which approaches them separately. The experimental consequences demonstrate that, as compared to the SVM, our proposed technique can efficiently improve the overall performance of tongue pics constitution recognition. The experimental results show that the satisfactory category accuracy our technique received is99%, Our proposed framework and method can provide important assist for medical doctor’s prognosis. In the destiny, we plan to further discover the performance of our proposed technique, e.g., for one of a kind complexity of the samples, the usage of unique function extraction methods or the use of one-of-a-kind pre-process strategies.

REFERENCES

1. Chiu C-C (2000) a completely unique approach supported computerised image analysis for ancient Chinese diagnosing of the tongue. *laptop ways and Programs in Biomedicine* 61:77–89.
2. Yue X-Q, Liu alphabetic character (2004) Analysis of studies on pattern recognition of tongue image in ancient Chinese medication by technology. *J. Chin. Integr. Med.* 2:326–329CrossRefGoogle Scholar
- 3 .Pang B, Zhang D (2004) computerised tongue designation supported theorem networks. *IEEE Trans. medicine Engineering* 51:1803–1810CrossRefGoogle Scholar
4. Zhang Hertz et al. (2005) laptop motor-assisted tongue designation system. *Proc. the 2005 IEEE Engineering in medication and Biology twenty seventh Annual Conference, Shanghai, China*, pp. 6754–6757
5. M. Kim, D. Cobbin, C. ZaslowskiTraditional Chinese medication tongue inspection: associate degree examination of the inter- and intrapractitioner responsibility for specific tongue characteristics *J. Alternat. Complement. Med.*, fourteen (5) (2008), pp. 527-536
6. K.A. O’Brien, S. BirchA review of the responsibility of ancient East Asian medication diagnoses,*J.Alternat. Complement. Med.*, fifteen (4) (2009), pp. 353-366
7. L.C. Lo, Y.F. Chen, W.J. Chen, T.L. Cheng, J.Y. ChiangThe study on the agreement between automatic tongue designation system and ancient Chinese medication practitioners,*Evid. based mostly Complement. Alternat. Med.*, 2012 (2012), 10.1155/2012/505063
- 8 .R. Kanawong, W. Xu, D. Xu, S. Li, T. Ma, and Y. Duan, “An automatic tongue detection and segmentation framework for computer-aided tongue image analysis,” *International Journal of purposeful scientific discipline and customized medication*. In press.

- 9 .C. C. Chiu, “The development of a computerised tongue designation system,” *medicine Engineering*, vol. 8, no. 4, pp. 342–350, 1996.
- 10 .C. H. Horng, “The principles and ways of tongue designation,” in *Tongue designation*, Lead Press, Taipei, Taiwan, 1993.
- 11 .“A prime quality color imaging system for computerised tongue image analysis “.XingzhengWanga, David Zhang b, a Shenzhen Key Laboratory of Broadband Network , school at Shenzhen, Tsinghua University, Shenzhen, China b Biometric center, Department of Computing, The city engineering school University, city professional Systems with Applications forty (2013) 5854–5866.
- 12 .Bob Zhang, B.V.K. Vijaya Kumar and David Zhang,” *police work DM and Non-Proliferative Diabetic Retinopathy Mistreatment Tongue Color, Texture, and pure mathematics Features*”, Copyright (c) 2013 IEEE.
13. Jianfeng Zhang,1 Jiatio Xu,1 Xiaojuan Hu,2 Qingguang subgenus Chen,3 Liping Tu,2 Jingbin Huang,1 and foreign terrorist organization Cui,” *Diagnostic methodology of polygenic disease supported Support Vector Machine and Tongue Images*”, *Hindawi BioMed analysis International Volume 2017*, Article ID 7961494, nine pages <https://doi.org/10.1155/2017/7961494>.
- 14 .Ramachandran Sudarshan,1 G. Sree Vijayabala,2 Y. Samata,3 and A. Ravikiran3,” *Newer organization for Fissured Tongue: associate degree medical specialty Approach*”, *Hindawi business Corporation Journal of Troimageal medication Volume 2015*, Article ID 262079, 5 pages,<http://dx.doi.org/10.1155/2015/262079>.
15. Dan Meng,1 Guitao Cao,1,2 Ye Duan,2 Minghua Zhu,1 Liping Tu,2,3 Dong Xu,2 and Jiatio Xu4,” *Tongue pictures Classification supported affected High spreading Network*”, *Hindawi Evidence-Based Complementary and practice of medicine Volume 2017*, Article ID 7452427, twelve pages <https://doi.org/10.1155/2017/7452427>.
16. “A novel approach supported computerised image analysis for ancient Chinese diagnosing of the tongue “.Chuang-Chien Chiu Institute of Automatic management Engineering, Feng Chia University, Taichung, Taiwan, mythical monster Received eighteen August 1998; accepted twenty five March 1999. *laptop ways and Programs in Biomedicine sixty one (2000) 77–89*.
17. “Computerized Tongue designation supported theorem Networks “.Bo Pang, David Zhang*, Senior Member, IEEE, Naimin Li, and Kuanqun Wang, Member, IEEE *transactions on medicine engineering*, no 10, vol. 51, October 2004.
- 18 .J.-K. Kamarainen, V. Kyrki, and H. Kalvi ainen, “Invariance properties ” of physicist filter based mostly options - summary and applications,” *IEEE Trans. on Image process*, vol. 15, no. 5, pp. 1088–1099, 2006.
19. Tara Ferguson, 2002, “Feature Extraction mistreatment the Hough Transform”, digitalcommons.usu.edu.

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