International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 05 | May -2017 www.irjet.net p-ISSN: 2395-0072

Cost Effective Method for Automatic Detection of Diabetic Retinopathy

Renu[1], Sachin Kumar[2], Sumita Mishra[3], Pragya[4]

[1]Mtech,Dept of Electronic & Communication Engineering, Amity University Lucknow, Uttar Pradesh, India
[23]Professor,Dept of Electronic & Communication Engineering, Amity University Lucknow, Uttar Pradesh, India
[4]Professor,Dept of Science, Mahila Vidyalaya PG College, Aminabad, Lucknow, Uttar Pradesh, India .

Abstract - *Diabetic retinopathy is a condition occurring in persons with diabetes, which causes progressive damage to the retina, the light sensitive lining at the back of the eye. It is a serious sight threatening complication of diabetes. Over time, diabetes affects the circulatory system of the retina. Diabetic retinopathy is the result of damage to the tiny blood vessels that nourish the retina. These vessels leak blood and other fluids that cause swelling of retinal tissue and clouding of vision. The condition usually affects both eyes. If left untreated, diabetic retinopathy can cause blindness. So the early detection and diagnosis of DR is necessary to preserve the vision. This paper presents a generalized system model for detecting DR, the proposed model consist of camera, Raspberry pi. Further it also summarizes various DR detection techniques that have evolved during last decade.*

Key Words: optic disc, exudates, fundus images, blood vessel, Retinal images.

1. INTRODUCTION

Diabetic retinopathy is a disease that arises in person who has diabetes. It causes gradually damage to the retina, the light sensitive lining at the back of the eye. DR is severe light menacing complication of diabetes. Diabetes is the disease characterized excessive sugar in the body, which can cause damage all over the body, including the eyes. Long time, diabetes damages the blood vessels in the retina. DR occurs when these very small blood vessel leak blood and other fluid [1]. This causes the retinal tissue to swell resulting in blurred or cloudy vision. The disease commonly influences both eyes. The longer person has diabetes, the more likely they will develop diabetic retinopathy. If it leaves untreated, diabetic retinopathy can cause blindness.

Diabetic Retinopathy is dividing in two types:-

Non proliferative diabetic retinopathy (NPDR) is the first stage of the disease in which symptoms will be mild or nonexistent. In NPDR, the blood vessels in the retina are weekend. Small bulges in the blood vessels, known as microaneurysm (MAs), may leak fluid into the retina. The leakage may lead to swelling to the macula.

Proliferative Diabetic Retinopathy PDR is the leading condition of the disease. At this stage circulation problems deprive the retina of the oxygen. As a result new weak blood vessel can start to arise in the retina and into the vitreous, the gel like fluid that fills the back of the eye. The new blood vessel may leak blood into the vitreous, cloudy vision [2].

Globally, the number of people with DR will grow from 126.6 million in 2010 to 191.0 million by 2030 and we estimate that the number with vision-threatening Diabetic Retinopathy will increase from 37.3 million to 56.3, if prompt action is not taken [3].India is set emerge as diabetic capital of the world. According to WHO, 31.7 million people were affected by diabetes mellitus in India year 2000. This figure is estimated to rise 79.4 million by 2030, the largest number in any nation in the world. Almost two- third of all type2 almost all type1 diabetes are expected to develop diabetic retinopathy [4].

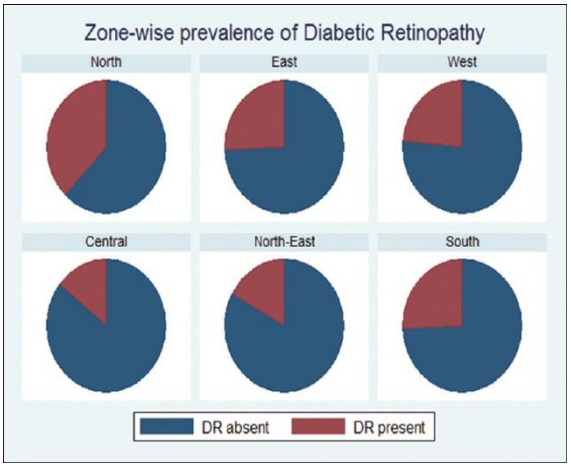

Fig:-1 Zone-wise prevalence of Diabetic Retinopathy

The early detection and treatment of diabetic retinopathy is necessary. The diagnosis and treatment of this disease can be done with the help of fundus images taken by the fundus camera [5]. As shown in fig 2 that zone-wise prevalence of diabetic retinopathy in India.

2. SYSTEM MODEL

Fig 3 depict generalized block diagram for detection of diabetic retinopathy. The proposed system model consist camera, raspberry pi, ardino board, led etcs.

CAMERA - For taking fundus images, required a fundus camera, TOPCON TRC- 50IX tria functional camera using ICG infrared fluoresceine angiography. For imaging with tiff compression, digital camera was set to the highest quality. Images were 1032 X 1320 pixels and 8 bit grey scale [6].

RASPBERRY PI – It is a dynamic microcontroller that is capable of just anything a computer is. It runs with a python programming language. The raspberry pi is interface with camera by USB connector. In our system order use latest version of raspberry pi that is raspberry pi 3 models B, having operating system raspbian, centos, fedora, ubuntu mate, window 10. CPU is 1.2 GHz 64/32 bit quad core ARM cortex-A53. Memory is 1 GB LPDDR2 RAM at 900 MHz also having micro SDHC slot from storage and 1.5 Watt (average when idle) to 6.7 Watt (maximum under stress) power[7].

CONTROL UNIT (ARDUINO) - arduino is prototype platform (open source) based on an easy to use hardware and software. It consists of a circuit board which can be programmed (referred to as a microcontroller) and ready-made software called arduino.In your system order use arduino UNO R3 board, operating on 5V clock speed 16 MHz, digital i/o pin 16, analog input 6, PWM 6 and 1Uart, programming interface is done via ATmega 16U2[8]. There is a device called ponte which act as a bridge between raspberry pi and arduino or its shield. It use as a link between arduino and raspberry pi or use it to connect arduino shields directly to your raspberry pi [9].

LCD-(liquid crystal display) is the technology used for display in notebook and other smaller computer. In this paper, we used arduino board so used display which is compatible for arduino like TFT LCD display, TFT LCD touch, dot matrix etc. in our order system used TFT LCD Display colorful image or graphic. This module has a resolution of 480 X 320. This module includes SD card socket and SP, FLASH circuit [10].

SOFTWARE DESIGN - In the software system design, the required images go through image processing technique, firstly pre processing the images. Next step is normalization and thresholding, where normalization is used to remove the effect of any intensity variation and thresholding is a process used for effective way of partitioning of image into foreground and background, i.e. to convert the gray image into binary image auto threshold is applied. Morphological technique is used to remove isolated pixels than finally feature extraction is done. The result is shown on LCD show which type of diabetic retinopathy is occurring in the patient or eye is diabetic or non diabetic retinopathy.

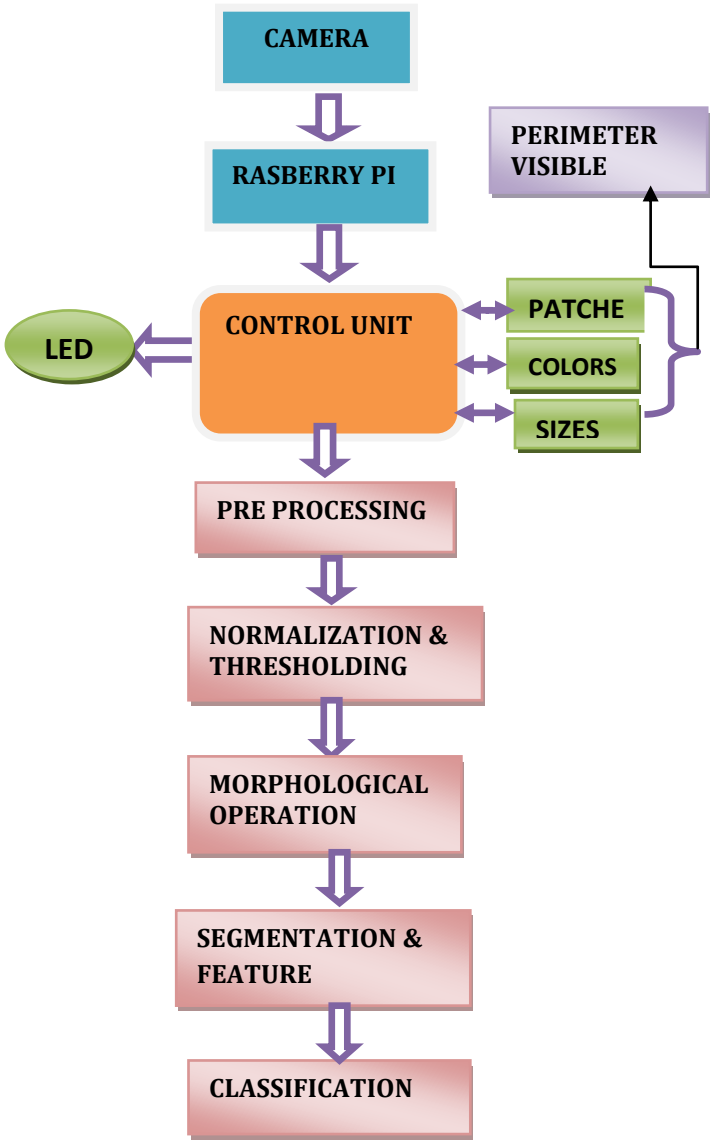

Fig: - 3 Generalized block diagram of system

HARDWARE DESIGN-In hardware system design color, size and patches are extracted from the images which are taken by the fundus camera. The data collected by the images is transferred to using zigbee to control unit i.e. arduino board. Then we get a required parameter which is used to determine whether the eye is diabetic or not.

3. RELATED STUDY

There has been a lot of work done in the area of diabetic retinopathy detection and diagnosis. Over the period diversified methods have been employed for early detection of diabetic retinopathy is summarized in Table 1.

Rathod et al (2014) given a technique for the localization of optic disc decomposition technique is employed. HRF databases are used for the assessment of conclusion with

receiver running characteristic ROC curve and the accuracy is achieved for the localization of optic disc is 95% [11]. Trucco et al (2013) is used binary vessel mask are developed with VAMPIRE S/W [12]. Sarkar & Nagaranjan et al (2012) used optic disc localization on clustering histrogram approach, the technique is determined with MESSIDOR dataset which illustrates that it can localize the optic disc properly [13].Lu & Lin et al (2011) applied circular transform line operator, line operator is tolerant to normal optic disc detection. Many sort of lesion in retinal imaging obtaining with an acquirement of 97.4% accuracy [14]. Acharya et al (2012) a new algorithms is suggested for the segmentation of optic disc in images of retina while making use of Atanassov intuitionistic fluzzy Histon based segmentation method [15].Annunziata et al(2016) used technique multi scale hessian approach with databases stare hrf attain the accuracy 95.62% [16] . Kaur and Mittal et al (2015) given a technique which demonstrated on various images of the retina and result illustrate that the process does better than the previous proposed method [17]. Rokade et al (2015) suggested a technique for the hard exudates segmentation, HAAR wavelets transform is used followed by K- nearest classification method [18]. Jaya et al (2015) a new method is suggested for the invention of bright lesions in color retinal image. Intellectual decision support system is utilized for diabetic retinopathy detection [19]. Soman et al (2014) presented a novel method is suggested for automatic invention of human image by the compliance of digital signal processing circular bit place slicing and hough transform are applied. It has a sensitivity 93.62 % and accuracy of 88% [20]. Ding & Ma et al (2014) presented the dynamic multi-

parameter template matching method is execute for the determination of MAs [21]. Datta et al (2013) presented the technique to enhance contrast of images for the analysis of lesion by using contrast limited adaptive histrogram equalization (CLAHE) [22]. Adal et al (2013) proposed a technique Contrast enhancement technique, Hessian based candidate selection algorithms & SVM Classifier, by 44.64 % of sensitivity [23]. Roy et al (2013) presented a technique Canny edge detection, acquire a sensitivity and specificity is 89.5% & 81.1 % is respectively [24].Krishna et al (2013) using a technique ensemble- based microaneurysms detector using Messidor databases [25]. Yin et al (2015) proposed a brief technology is imported segmenting the retinal vasculature in color fundus images [26]. Hou et al (2014) Multi scale line detector and multidirectional morphological top-hat transform with rotating structing element are used for blood vessel diagnosis [27]. Shami et al (2014) for detecting blood vessel tree morphological operator are utilized. Nikookari database are used for taken experimental result, which is consisting of 40 fundus images. The technique acquires 85.82% average sensitivity and 99.98% average specificity [28]. fraz et al (2013) proposed an ensemble system of boosted decision tree, using as feature vector based on orientation analysis of gradient vector field, gabor filter responses, line measures, and morphological transformation. To handle the pathological retinal image, the feature vector encodes information [29]. For the segmentation of blood vessels, an automatic method is suggested. The submitted method is based on the fact that, by varying the length of a basic line detector, line detectors at continuously changing scales are achieved. In order to perform final segmentation for every image of retina, line responses are linearly combined at varying scales so that the strength and drawback eliminination of each line detector are maintained.

Algorithms (year)	Image Processing techniques	Database	Color Space	Accuracy	Specificity	Sensitivity
OPTIC DISC						
Rathodet.al (2014)	multilevel2D wavelet	HRF	Green Channel	95%	-----	-------
Trucco et.al (2013)	Binary Vessel mask are developed within VAMPIRE S/W	HRIS,VDIS	Gray Scale	95.7% 92.1%	------	------
Sakar &Nagaranjan et.al (2012)	OD localization on clustering a histogram approach	Messidor	RGB	99.58%	------	------
Lu & Lin et.al. (2011)	Circular transformation line operator	DIARETDB 0 DIARETDB 1 DRIVE STARE	CIELAB	97.4%	-------	------
Acharya et.al (2012)	Ostu, Gradient vector flow (GVF) shake, Atannasov Intuitiontic	Kasturba Medical College	-------	100%	-------	------

	Fuzzy Histon					
EXUDATES						
Annunziata el. al. (2016)	Multiscale Hessian approach	STARE , HRF	Green Channel	95.62%	____	_____
Kaur & Mittal et. al. (2015)	Dynamic region growing method	SGHS hospital	Gray Scale	98.65%	____	___
Rokade & manza et. al. (2015)	HAAR Wavelet transformation, KNN Classifier	MISP, DIRETDB0 DIRETDB1 STARE	Green channel	_____	___	37.14% 21.87% 12.50%
Jaya et. al. (2015)	Morphological	Private Hospital	____	___	90.0%	94.1%
Soman et. al. (2014)	Circular Hough transformation & bit plane slicing Morphological operation	Standard Channel	____	88%	___	0.936
MICROANEURSYM						
Ding & Ma et. al. (2014)	Dynamic multipara meter Template matching scheme	ROC	____	____	___	96%
Datta et. al. (2013)	Contrast limited adaptive histogram equalization, median filter & image catenation	Private data	Green Channel	99.98%	82.64%	____
Adal et. al. (2013)	Contrast enhancement technique, Hessian based candidate selection algorithms & SVM Classifier	ROC	Green Channel	____ .	44.64%	____
Roy et. al. (2013)	Canny edge detection	DIRETDB1	Green Channel	___	82.1%	89.5%
Krishna et. al. (2013)	Ensemble-based microaneurysms klein and CLACHE	Messidor	Gray Scale	___	____	
BLOOD VESSEL						
Yin et. al. (2015)	Spectral Clustering technique based on features, Hessian Matrix	DRIVE REVIEW	Green Channel	Above 94%	___	____
Hou et. al. (2014)	Multidirectional top-hat transform, rotating		Green	0.94	0.96	0.73%

	structuring element	DRIVE , STARE	Channel	0.93	0.96	0.738%
Shami et. al. (2014)	Morphological operation	Nikookari	Green Channel	___	99.98%	85.82%
Fraz et. al. (2013)	Multiscale line detection method Gabor Filter	DRIVE STARE Messidor	Gray Scale	0.94 0.95 0.96	0.97 0.97 0.98	0.73% 0.73% 0.77%
Nguyen et. al. (2013)	Vessel segmentation based on the line detector at varying scale	STARE DRIVE	Green Channel	0.93 acc. 0.93 acc.	___	____

4. CONCLUSION

"The eyes are the window to the soul". The human eye is the organ which gives us the sense of sight. Diabetic retinopathy is the leading cause of blindness in Indian population. In proliferative diabetic retinopathy by ordinary, antivasular endothelial progress factor medication injection may help in the fresh blood vessel contraction technique.non proliferative diabetic retinopathy is early stage of diabetic retinopathy and it is extremely critical to detect and diagnose DR at its initial stages. This paper presented a system model that intrgrates ideal parameter monitoring along with image processing algorithms for early detection and diagnosis of diabetic retinopathy.

ACKNOWLEDGEMENT

The authors are very grateful to respected Mr. Aseem Chauhan, Chairman, Amity University Lucknow, and Maj. Gen. K.K. Ohri, AVSM (Retd.), Pro-VC, Amity University, Lucknow Uttar Pradesh, India, for providing excellent research infrastructure facilities in the University campus. Authors also pay their best regards to Wg. Cdr. (Dr.) Anil Kumar (Retd.), Director Amity School of Engineering & Technology, Amity University, Lucknow, Prof. O.P. Singh, HOD, ECE, Amity University, Lucknow for giving their motivational support and help to carry out the present research work

REFRENCES

[1] www.mayoclinic.org
[2] www.aoa.org.
[3] www.iapb.org.>vision2020>DR
[4] www.who.int/mediacentre/factsheets/fs312/en/
[5] Prof.W.V.Patil, Dr. Prema Daigavane, "A Novel approach for the screening and the classification of Macular Ischemia caused by Diabetic Retinopathy Disease using Retinal Image Datasets" 2015 7th International Conference on Emerging Trends in Engineering & Technology, pp 62-67.
[6] N. S. Datta, R. Banerjee, H. S. Dutta, S.Mukhopadhyay, "Hardware based analysis on automated early detection of Diabetic-Retinopathy"; 2011 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of C3IT, pp 256-260.
[7] www.raspberrypi.org
[8] www.tutorial.com.>arduino
[9] www.raspberrypi.org/blog/raspberry-pi and-arduino/#
[10] Whatis.techtarget.com>definition.lcd
[11] D. D. Rathod, R. R. Manza, Y.. M. Rajput, M. B. Patwari, M. Saswade, and N. Deshpande, "Localization of optic disc and macula using multilevel 2-D wavelet decomposition based on haar wavelet transform," International Journal of Engineering Research & Technology IJERT, vol. 3, no. 7, 2014.
[12] E. Trucco, L. Ballerini, D. Relan et al., "Novel VAMPIRE algorithms for quantitative analysis of the retinal vasculature," in Proceedings of the 4th ISSNIP-IEEE Biosignals and Biorobotics Conference: Biosignals and Robotics for Better and Safer Living (BRC '13), pp. 1–4, Rio de Janerio, Brazil, February 2013
[13] G. B. Sekar and P. Nagarajan, "Localisation of optic disc in fundus images by using clustering and histogram techniques," in Proceedings of the IEEE International Conference on Computing, Electronics and Electrical Technologies (ICCEET '12), pp. 584–589, Kumaracoil, India,March 2012.
[14] S. Lu and J. H. Lim, "Automatic optic disc detection from retinal images by a line operator," IEEE Transactions on Biomedical Engineering, vol.58, no. 1, pp. 88–94, 2011.
[15] U. R. Acharya, C. K. Chua, L. C. Min, E. Y. Ng, M. M. Mushrif, and A. Laude, "Application of intuitionistic fuzzy histonsegmentation for the automated detection of optic disc in digital fundus images," in Proceedings of the In IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI '12), pp. 444–447, Hong Kong, January 2012.
[16] R. Annunziata, A. Garzelli, L. Ballerini, A. Mecocci, and E. Trucco, "Leveraging multiscale hessian-based

enhancement with a novel exudates inpainting technique for retinal vessel segmentation," IEEE Journal of Biomedical and Health Informatics, vol. 20, no. 4, pp. 1129–1138, 2016.

[17] J. Kaur and D. Mittal, "Segmentation and measurement of exudates in fundus images of the retina for detection of retinal disease," Journal of Biomedical Engineering and Medical Imaging, vol. 2, no. 1, pp. 27–38, 2015.

[18] P. M. Rokade and R. R. Manza, "Automatic detection of hard exudates in retinal images using haar wavelet transform," Eye, vol. 4, no. 5, pp. 402–410, 2015.

[19] T. Jaya, J. Dheeba, and N. A. Singh, "Detection of hard exudates in colour fundus images using fuzzy support vector machine-based expert system," Journal of Digital Imaging, vol. 28, no. 6, pp. 761–768, 2015.

[20] K. Soman and D. Ravi, "Detection of exudates in human fundus image with a comparative study on methods for the optic disk detection," in Proceedings of the IEEE International Conference on Information Communication and Embedded Systems (ICICES '14), pp. 1–5, Chennai,India, February 2014.

[21] S. Ding and W. Ma, "An accurate approach for microaneurysm detection in digital fundus images," in Proceedings of the 22nd International Conference on Pattern Recognition (ICPR '14), pp. 1846–1851, IEEE, Stockholm, Sweden, August 2014.

[22] N. S. Datta, H. S. Dutta, M. De, and S. Mondal, "An effective approach: image quality enhancement for microaneurysms detection of non dilated retinal fundus image," Procedia Technology, vol. 10, pp. 731–737, 2013.

[23] K. Adal, S. Ali, D. Sidibé, T. Karnowski, E. Chaum, and F. Mériaudeau, "Automated detection of microaneurysms using robust blob descriptors," in Medical Imaging 2013: Computer-Aided Diagnosis, vol. 8670 of Proceedings of SPIE, International Society for Optics and Photonics, March 2013.

[24] R. Roy, S. Aruchamy, and P. Bhattacharjee, "Detection of retinal microaneurysms using fractal analysis and feature extraction technique," in Proceedings of the 2nd International Conference on Communication and Signal Processing (ICCSP '13), pp. 469–474, Melmaruvathur, India, April 2013

[25] N. V. Krishna, N. V. Reddy, M. V. Ramana, and E. P. Kumar, "e communal system for early detection microaneurysm and diabetic retinopathy grading through color fundus images," International Journal of Scientific Engineering and Technology, vol. 2, pp. 228–232, 2013.

[26] X. Yin, B. W.-H. Ng, J. He, Y. Zhang, and D. Abbott, "Accurate image analysis of the retina using hessian matrix and binarisation of thresholded entropy with application of texture mapping," PLoS ONE, vol. 9, no. 4, Article ID e95943, 2014.

[27] Y. Hou, "Automatic segmentation of retinal blood vessels based on improved multiscale line detection," Journal of Computing Science and Engineering, vol. 8, no. 2, pp. 119–128, 2014.

[28] F. Shami, H. Seyedarabi, and A. Aghagolzadeh, "Better detection of retinal abnormalities by accurate detection of blood vessels in retina," in Proceedings of the 22nd Iranian Conference on Electrical Engineering (ICEE '14), pp. 1493–1496, Tehran, Iran, May 2014.

[29] M. M. Fraz, P. Remagnino, A. Hoppe et al., "An ensemble classi cation-based approach applied to retinal blood vessel segmentation," "An ensemble classi cation-based approach applied to retinal blood vessel segmentation," IEEE Transactions on Biomedical Engineering, vol. 59, no. 9, pp. 2538–2548, 2012.

[30] U. T. V. Nguyen, A. Bhuiyan, L. A. F. Park, and K. Ramamohanarao, "An effective retinal blood vessel segmentation method using multi-scale line detection," Pattern Recognition, vol. 46, no. 3, pp. 703–715, 2013