An Image Processing Algorithm To Detect Exudates In Fundus Images

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Abstract: Diabetic Retinopathy is often noticed in individuals suffering from diabetes. The major characteristic of this disease is the presence of exudates in the retinal area. These exudates can be scanned using fundus imaging. The aim of the project is to develop an algorithm that can identify exudates in fundus images, and based on the area, prescribe medication using the concept of content-based image retrieval. The algorithm will be developed on MATLAB and also be downloaded on a Spartan 3e FPGA.

Keywords: Diabetic Retinopathy; Exudates; Fundus images

I. INTRODUCTION

Diabetes can also be called Diabetes mellitus (DM). It causes high blood sugar in a human body in which the body does not properly process food for the energy in the human body which we can say this as a metabolic disease. In our body most of the food which we eat is turned into glucose, or sugar, for our bodies to use as energy. In a human body an organ, that is a pancreas which lies near the stomach, makes a hormone called insulin in order to help glucose get into the cells of our bodies. Due to diabetes, our body either doesn't make enough insulin or can't use its insulin as well as it should. And due to this it causes sugars to build up in our blood. By which many people refer to diabetes as “sugar”. However, symptoms are caused by rising blood sugar. This also causes serious health complications like heart disease, blindness, kidney failure and lower-extremity amputations. The different types of diabetes are:

Type1 diabetes is an autoimmune disease where the immune system attacks and destroys cells in the pancreas (where insulin is made). It’s doubtful what would cause this attack and also about 10 percent of people with diabetes have this type1 diabetes.

Type2 diabetes is which occurs when our body is unaffected by insulin, and the sugar builds up in our blood.

Prediabetes is also which occurs when our blood sugar is higher than normal, but it’s not good enough for a diagnosis of type2 diabetes.

During pregnancy if a patient suffering with high blood sugar is called Gestational diabetes. This is caused by Insulin-blocking hormones produced by the placenta. One of the exceptional conditions called Diabetes insipidus (DI) is not related to DM, even though it has a similar name. DI is a condition in which the kidney removes too much fluid from our body. Each and every type of diabetes has their unique symptoms, causes, and treatments.

In Diabetes one of the disorders associated is Diabetic Retinopathy (DR). DR summarizes the abnormalities caused by irregular glucose levels in blood in the retina of the eyes. Diabetic retinopathy can be classified as non-proliferative (NPDR) and proliferative (PDR). There are different levels of hardness in each kind of diabetic retinopathy and each is related with different issues that can affect the vision. If there is any mild diabetic damage to the retina which may go unnoticed because early symptoms can be indefinite, and would tend to get worse over the years.

One of the traits indicating the existence of DR is the existence of exudates in the retina. The retinal blood vessels tear and the lipids that are carried by these vessels tend to accumulate in the posterior pole of the fundus image. These accumulations have coined the term Exudates. These exudates may leak from cuts or areas of infection or inflammation can also be called pus which is a fluid rich in protein and cellular elements that leaks out of blood vessels due to inflammation and is deposited in nearby tissues. Exudates can be easily detected in colour images due to their sharp edges and variation from the typical red-orange fundus background. However, it is important to differentiate between the sign of retinopathy

from other yellowish features, such as the optic tract which may be confused with it.

Exudates can be classified into two categories – hard exudates and soft exudates. Soft exudates are usually harmless. Hard exudates, however, can cause blurred vision. If they are left untreated or ignored, it may lead to permanent blindness. These abnormalities can be noticed in fundus images of an eye. The objective of this project is to automatically detect the existence of exudates and measure their spread using the image processing technique. Also, using CBIR (Content-based image retrieval) this algorithm has to be applied on database images so that further diagnosis and medication can be suggested by doctors.

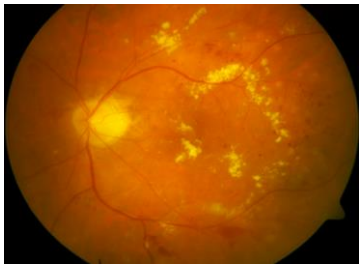

Fig 1. Fundus image in an RGB colour model

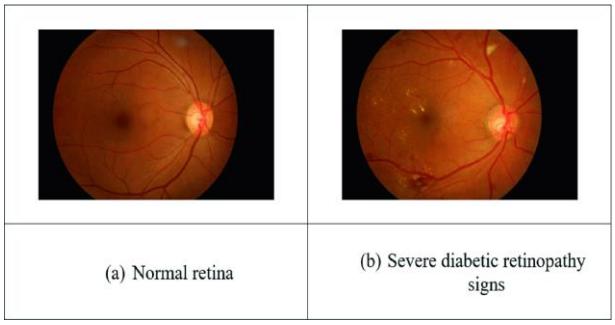

Fig 2. Differentiation of the human retina between normal and affected

II. LITERATURE SURVEY

The literature survey shows the text of the research paper it provides present module, including significant findings and also theoretical and methodological contributions to a particular topic. It shows us the use of reference sources and does not report new or real experimental work. In order to write any paper or develop any software, it is necessary to know about the existing system, advantages, and drawbacks of the system.

In Paper [1], "Diabetic Retinal Exudates Detection Using Machine Learning Techniques" the author of paper [1] is P.R Asha, M Phil research scholar which was reported in the year 2015. In this, they built the model using Extreme Machine Learning which outperforms the other two models and effectively detects the existence of the exudates in the retinal image.

In Paper [2], "Automated Classification of Exudates from Digital Fundus Image" the author of paper [2] is Ravitej Singh Rakhi which was reported in the year 2017. Here the need for the automatic algorithms that can be an aid in detecting these conditions by identifying and segmenting the hard exudates, if present in the fundus image of the eye.

In Paper [3], "Automatic Detection and Evaluation of The Hard Exudates Based on Deep Bayesian Learning" the author of paper [3] is Yunpu Wu, Weidong Jin, Shenzhen chai which was reported in the year 2018. Here, we can see a high-reliability scheme for detecting and evaluating hard exudates is developed based upon the Bayesian deep learning and discriminant analysis. The diabetic retinopathy dataset confirms that developed the method that can provide lower error and uncertainty evaluation for diagnosing/examination.

In Paper [4], "Exudate Extraction from Fundus Images" the author of paper [4] is Vasanthi Satyananda, Narayanaswamy K Karibasappa which was reported in the year 2019. In this proposed technique, the optic disc and exudates are identified correctly based upon the area, as the optic disc is beyond exudates.

In Paper [5], "Detection of The Hard Exudates in Retinal Fundus Image Using Deep Learning" the author of paper [5] is Avula Benjamin, Chandan Chakraborty which was reported in the year 2018. Here, they initialized the fundus image and then eliminated the optic disc, blood vessels and then by a mixture of morphological operations like a top hat, bottom hat and reconstructed the operations hard exudates are segmented.

In Paper [6], "Hard Exudate Detection Using Linear Brightness Method" the author of paper [6] is Aishwarya k Dixit which was reported in the year of 17th & 18th, May 2019. Here, the history transformation is applied to each pixel which modifies the lower intensity pixels in the image, making it easier to detect the exudates.

In Paper [7], "Automated Detection of Exudates in The Retinal Image" the author of paper [7] is Dulanji Lokuarachchi, Kasun Gunaratna, Lahiru Muthumal which was reported on 9th, march, 2019. In this, they performed the removal of the optic disc which was necessary when using the image processing technique to detect exudates.

In Paper [8], "Hard Exudate Extraction from Fundus Images Using Watershed Transform" the author of paper [8] is Vasanthi Satyananda, k v Narayanaswamy, karibasappa which was reported in the year 5th, Sept 2019. Here the brightness is sufficiently uniform and the colour of the fundus images of the eye is either in the bright shades of yellow or orange. They also observed that the soft exudates are eliminated by the averaging filter to smoothen the area.

In Paper [9], "Detection of The Exudates for Diabetic Macular Edema Classification" the author of paper [9] is Dhan Shree thulkar, Rohin Daruwalla which was reported in the year 2019. Here, the initial techniques were discussed in the paper to impressively detect the bright lesion on the retinal surface. The feature selection from the acquired feature set helped in significant growth of

the accuracy. Artificial Neural Networks (ANNs) have been an effective way to feature learning and classification.

In Paper [10], "U-net Base Method for Automatic Hard Exudate Segmentation in Fundus Images Using Inception Module and Residual Connection" author of paper [10] is Yangshuo zong, Jinling Chen which was reported in the year 2020. Here to obtain the final part results, they splice the neighbouring prediction results of the patch together in order to complete the image. During which they took the expected value of the overlapped areas and set the threshold value.

In Paper [11], "A Novel Approach for Blood Vessel Segmentation with Exudate Detection in Diabetic Retinopathy" the author of paper [11] is Pradip Dhal which was reported in the year 2020. Here the idea is about the multiscale that is to extract the blood vessels at different geometric shapes at different scales of image. The main detriment of this method is that it is unable to extract blood vessel structures in the retinal images in the existence of the exudates and also cases of haemorrhages as well. So, if it is capable of extracting these pathological cases then it will be the most powerful method of blood vessel extraction.

III..METHODOLOGY

Firstly, the video processor is fed by fundus images. For detecting exudates, the algorithm of imaging is housed in a video processor. Image acquisition concepts are present in this algorithm. Colour models which are suitable will be selected by fundus image. Exudates will be distinguished clearly from the background that is to perform segmentation for extracting exudates. Unfortunately, colour and texture of both exudates and optic disc matches. So optic disk will also get extracted along with the exudates. By using morphological noise removal methods like erosion as well as dilation optic discs will be removed. The area of spread will be estimated after retrieving exudates. Then area parameters will be fed to CBIR (Content-Based Image Retrieval) for restoring images having the same parameters.

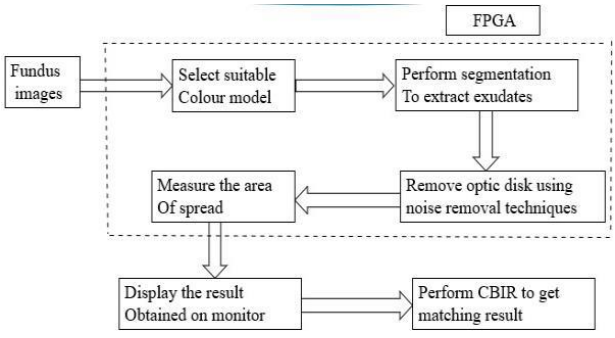

Fig 3. Block diagram

In such a way we can detect Exudates in the fundus images. Using the proposed block diagram, we will be overcoming the issues explained in the literature survey.

"Content-based" means that the search analyzes the contents of the image rather than the Process in which for a given query image, similar images are retrieved from a large image database based on their content similarity. The term "content" in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. Here we work with 2 segments: Live part - the image for which medicine/treatment has to be prescribed .CBIR part – contains the medications already given to patients who have exudates.

A. Steps involved:

1. Calculate area of exudates in live image
2. Calculate area of exudates in every image present in dataset
3. Find out which images in dataset have similar area of exudates to that of live image
4. Display the text files which have similar areas so that those can be considered to prescribe medicines for the live image.

III. RESULTS

Working of CBIR output is shown in figure below from database in 61 images the algorithm was satisfied on about 57 images. The success rate of the algorithm is 93%.

Fig 4. CBIR output

IV. CONCLUSION

This helps in automated detection of exudates, and hence this system can be installed in rural areas as well to help people. Thus, we can conclude that using our project, we can identify exudates in fundus images, and based on the area, prescribe medication using the concept of content-based image retrieval and help the needy.

V. FUTURE SCOPE

Here we diagnosed only on the exudates and further it can also be worked on other eye related disease such as Haemorrhages , Microaneurysms , Neovascularization detection can also be combined with this algorithm and The whole system can be dedicated for the fundus of an eye.

REFERENCES

[1] P.R. Asha and S. karpagavalli," diabetic retinal exudates detection using machine learning techniques,"2015vinternational

conference on advanced computing and communication systems (ICACCS-2015), Jan 05-07, 2015, Coimbatore INDIA.

[2] Ravitej Singh Rakhi, Ashish Isaac, Malay Kishore Dutta amity university, Noida, India Carlos M. Travieso signals IDeTIC university of las palmas de gran Canaria," Automated classification of exudates from digital fundus images"2017 IEEE.

[3] Yunpu Wu, Weidong Jin, Zhenzhen chai," Automatic Detection and Evaluation of Hard Exudates Based on Deep Bayesian Learning" Proceedings of the 37th Chinese Control Conference July 25-27,2018, Wuhan, China.

[4] Vasanthi Satyananda, K V Narayanaswamy, Karibasappa"4. Exudate Extraction from Fundus Images",2018. @2019 IEEE.

[5] Avula Benzamin, Chandan Chakraborty.: Detection of Hard Exudates in Retinal Fundus Images Using Deep Learning"2018, 2nd International Conference on Imaging.

[6] Aishwarya. Dixit "Hard exudate detection using Linear Brightness method",2019 4th International Conference on Recent Trends on Electronics & Technology (RTEICT-2019), MAY 17th & 18th 2019.

[7] Dulanji Lokuarachchi, Kasun Gunaratna, Lahiru Muthumal "Automated Detection of Exudates in Retinal Images".2019 IEEE 15th international colloquium on signal processing & its applications (CSPA 2019),8-9 March 2019, Penang, Malaysia.

[8] Vasanthi Satyananda, K V Narayanaswamy, karibasappa," Hard exudate extraction from fundus images using watershed transform" sept 5, 2019.Indonesian Journal of electrical engineering and informatics (IJEEI)vol.7, no.3, Sep 2019, pp.449~462.

[9] Dhan Shree thulkar, Rohin Daruwalla "detection of exudate for diabetic macular Edema classification", 2019,2019 5th international conference on science and technology (ICST), Yogyakarta Indonesia.

[10] Yangshuo zong, Jinling Chen," U-net base method for automatic hard exudate segmentation in fundus images using inception module and residual connection" in 2020.

[11] Pradip dhal "A novel approach for blood vessel segmentation with exudate detection diabetic retinopathy "2020, international conference on artificial intelligence and signal processing (AISP).

[12] Mohammed Shafeeq Ahmed and Dr.B. Indira, "Morphological technique for detection of microaneurysms from RGB fundus image", ID: j-16-11-160, to be published in the journal of electrical engineering and technology, Korea,2017.