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Analysis of Fundus images of Retina for Automated Diagnosis and Grading of Diabetic Retinopathy.

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ABSTRACT- *India has an estimated 77 million people with diabetes, which makes it second most affected in the world, after China. The number is projected to grow by 2045 to become 134 million by the International Diabetes Federation. Diabetic Retinopathy is one of the many side effects of Diabetes. Up to 21% patients with the type 2 Diabetes have retinopathy at the time of first diagnosis of Diabetes, and most develop some degree of retinopathy over time. Diabetic Retinopathy is a complication of Diabetes that affects the eyes. It is caused by the damage of the blood vessels in the tissue at the back of the eye(retina). It is generally observed, especially in the rural areas, that people consult the doctor only after their vision become blurred and they start to experience blindness, which is the third or fourth stage. At this stage, it becomes difficult to treat the patient after the retina has fully damages. This paper will provide all the guidelines for detecting DR of any fundus image.*

Keywords*:* *Diabetic Retinopathy, Microaneurysms, Hemorrhages, Exudates, Support Vector Machine.*

1. Introduction:

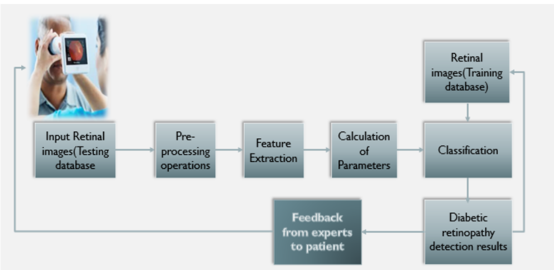
Diabetes is a widespread disease in the world. Diabetic Retinopathy (DR) is an eye disease caused by long-standing diabetes. After 15 years of diabetes, about 10% of people become blind and approximately 2% develop severe visual impairment. Basically, DR affects blood vessels in the light-sensitive tissue (i.e., retina). DR, a silent disease which comes in light only at its last stage where treatment is very difficult and, in some cases, impossible. It can be treated effectively only in its early stages and thus its early detection is very important.

In this work, we propose a new method of extracting various feature to be extracted from the retina images. These images are mainly taken by using a high-resolution camera. The objectives of this work are: (i) Detection of Exudates (hard & soft), (ii) Detection of haemorrhages, (iii)Detection of microaneurysms, and (iv) classification of these samples as Healthy, Background Retinopathy stage, Pre proliferative stage and Proliferative stage.

The paper is organised in the following way: Section 2 discusses about the methodology of the project and the various feature extraction techniques used as well as the algorithms used in this work. Results obtained by the algorithms implemented are shown in the next section i.e., in section 3 followed by classification of the testing samples and conclusions in section 4.

2. Proposed System Block Diagram:

Fig. shows the block diagram of the wireless patient monitoring system. The system architecture is three-tier comprising (1) a patient interface, that is, Fundus camera (2) Processing Unit for Preprocessing, noise removal and parameters extraction, and (3) A Classifier and display unit for doctors which acts as a feedback unit.



I. Dataset Collection:

Collecting a dataset which is accurate as well as reliable was a difficult task. After exploring a lot of datasets, we finally downloaded a dataset from **Messidor** website [2].

The dataset consists of approximately 1200 fundus images with few duplicates. In machine learning, we have an 80:20 rule, in which 80% of the dataset is used for training the module and remaining 20% is used for testing.

Therefore, we divided 712 samples from our dataset for training and 475 samples for testing. The 475 samples are further divided into 2 classes of 237 and 238 for testing and validation respectively.

II. Preprocessing:

The images obtained had to be converted in a proper format with the desired contrast and enhanced features. We have developed the algorithm in such a way that we can detect the contours of our images and crop the image to obtain consistency in all types of databases. The images are resized at a standard pixel size. The image is split into R, G and B to observe contrast variations. This is followed by adaptive histogram equalization and edge detection.

III. Feature extraction:

After study of the collected dataset, we finally shortlisted some of the important features of a retinal image which has an impact on the eye and show early signs of Diabetic Retinopathy.

a) Exudates:

- SOFT EXUDATES: Cotton-wool spots are greyish-white patches of discoloration in the nerve fibre layer which have indistinct (fluffy) edges. Cotton-wool spots are common and one or two do not require intervention. However, multiple cotton wool spots indicate a pre-proliferative state [1].

- HARD EXUDATES: Hard exudates are distinct yellow-white intra-retinal deposits which can vary from small specks to larger patches and which may evolve into rings known as circinate [1].

b) Hemorrhages: Haemorrhage can give rise to profound loss of vision if the macula is obscured. Only a small amount of bleeding is required since blood dissolved in the vitreous produces a haze effect which impairs vision [1].

c) Microaneurysms: Microaneurysms are the earliest clinically visible changes of diabetic retinopathy. They appear as small red dots which are often in clusters but may occur in isolation. They do not affect vision [1].

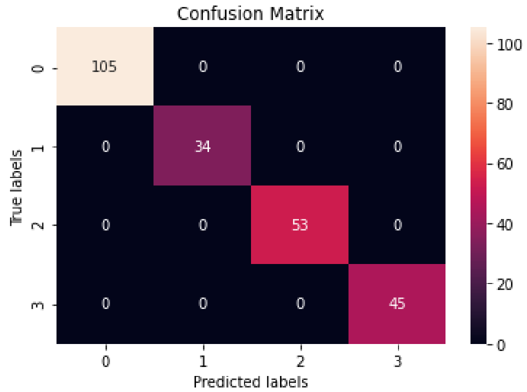
IV. Classification:

After successfully extracting all the features of the samples, area of all the features were calculated. As the images are binarized, Area could be found by simply calculating the white pixel values. Thus, six features- area in each R, G, B components of the exudates, hemorrhages and microaneurysms are determined pixel by pixel. For classification purpose, we implemented **Support Vector Machine** Classifier [3]. This gave us appreciable results given as follows:

Training accuracy = 97.75%

Validation accuracy = 97.47%

Testing accuracy = 97.64%



3. Obtained results:

Fig. 1 shows how microaneurysms extraction looks along with the original image. Similarly, Fig.2 and Fig. 3 shows extraction of Hemorrhages and Exudates respectively.

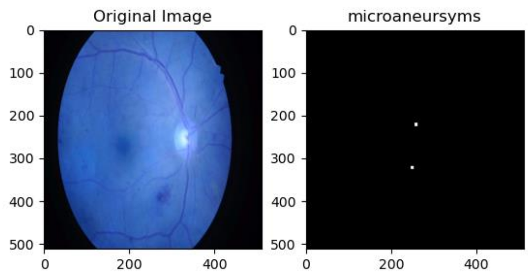


Fig. 1

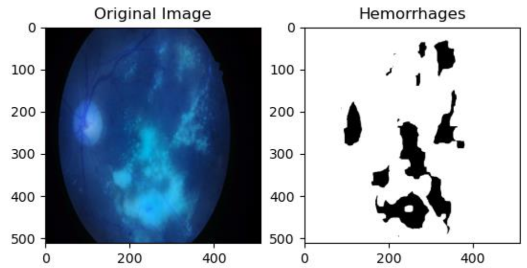


Fig. 2

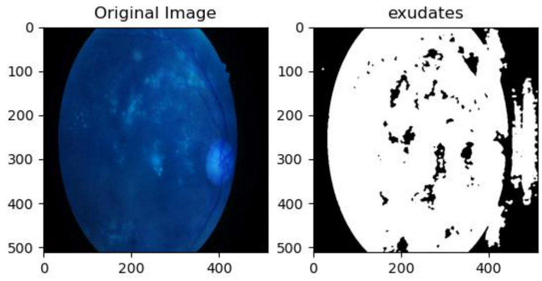


Fig. 3

4. Conclusion:

Here, we first tried to classify the model using only features like Microaneurysms and Haemorrhages. Accuracy obtained was around 90%. After that we considered one more feature i.e., exudates. The parameters obtained are Accuracy as 97.64%. Thus, we can conclude that accuracy is directly proportional to Number of Features.

5. Acknowledgment:

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