International Journal of Innovative Research in Computerand Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

||Volume 8, Issue 5, May 2020||

Diabetic Retinopathy System using Image Processing

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ABSTRACT: Nowadays, In today's age, Diabetic retinopathy is the disease that is a major reason behind the cause of blindness. There have been a lot of discussions and surveys on the following topic indicating that blindness nowadays is primarily caused due to diabetic retinopathy. This project is a step to develop an application that can detect the disease automatically during its early stage. Here we are going to categorize the collected set of images into the five classes using the supervised learning methods. To carry out this design we are going to use different types of filtering and image processing techniques to enhance the quality of the collected images such that the application can successfully detect and precise how severe is the disease and it's on which stage using the neural engine.

KEYWORDS : Diabetic Retinopathy, Blood Vessels, Image Separation, Feature Extraction, Morphology

I .INTRODUCTION

Long term diabetes to an individual can lead him/her to Diabetic Retinopathy. It's an eye disease that can be developed in a person having diabetes for more than 10 years. Longer the person having diabetes more are the chances of getting diagnosed with this problem. 80% of the population having diabetes for more than 10 years gets diagnosed with this disease. Researches and surveys show that it contributes 5% to the total cause of blindness. The reports by World health organization shows that approximately 347 million people in the world are having diabetes out which 40% are diagnosed with the disease. This disease is affected by various factors such as pregnancy, poor control, age of diabetes. However, doctors say that DR can be treated and taken care of if it is detected in its early stage.

Lots of people are suffering from this disease, but still people are not aware of this. Even people who are aware of this their testing for stage 1 is done manually by trained professionals which is a long and time taking process. Sometimes due to miscommunication and eventually delayed results of the test, treatment can't be done in time. Sometime people due to miscommunication ignore it as well. Therefore the aim of this project to build a system/application that will be an automated system which can easily detect the case of Diabetic retinopathy using appropriate image processing and pattern recognition. In this way DR can be detected in its early stage so that treatment can be provided in time and damage toeyes will be minimal.

Figure 1:DR Affeccted Eye

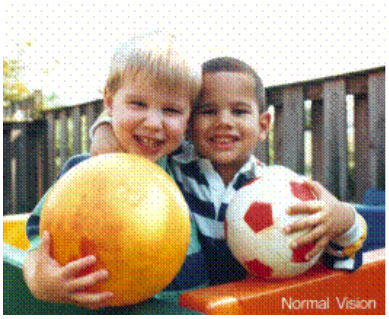

Figure 2: Normal Eye

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II. MOTIVATION

We have selected this topic for our major project because we are living in a country where there will always be requirement of resources to overcome different problems. Since we are living in a developing country with more than 320 million population are suffering from diabetes. We mostly treat any disease by having a full body check up and most of the people didn't even know that diabetes can damage the eyes. With the help of this work we wanted to make people aware of this disease and give them a tool to easily detect if they are affected by this disease or not. If they are affected than at what stage they are affected, so that it can be easily treated with the proper medication.

Using Image processing and filtering we want to aid the people and medical facilities so that they can easily detect the DR and none of the patient would be effected. We are going to use deep learning to train our system using the collected data sets so that the best possible outcome can be achieved. In this modern world everything is getting digitized so we want to use computer science in the medical field to help people.

III .LITERATURE REVIEW

Research Gap

Over the past decades, diabetic retinopathy diagnosis is increasing the role of ultra-wide field fundus fluorescein angiography. The Importance of imaging the peripheral retina in the patient with diabetic retinopathy was recognized for years, but still the error measured in past decades is increasing which results into the unwanted fear in patient of diabetic retinopathy.

There have been constant efforts to read the genetics of diabetic retinopathy of the past generation, but still the genetic is not the only reason of the disease where there are other factors which affect the patient too. The genetic association proves helpful in searching the high risk in patient developing diabetic retinopathy, while consuming fruit have reduced the high risk of diabetic retinopathy in many patients. The high fruit-vegetable result in high risk of patient into the disease, this was result in a gap in research of the daily consumption of the patient about the diet hence the ordinary grain is considered to be safe and not fruits.

Problem statement and objective

Diabetic Retinopathy is the main cause of blindness among the adults aged from 20 – 74 years. Patients with one type of diabetes and 60% of the patients with two type of diabetes has diabetic retinopathy. In the other older group other eye disease was a common disease in patients where one- third of the cases has the blindness caused due to diabetic retinopathy.

Vision is threatening in type 1 diabetes patients, which include the young age patient in 3 – 5 year or before the puberty. During the past decade, all type 1 patients have diabetic retinopathy. The problem such as blindness in age less than 21 years began which has a major effect on a person's personal life and it can also ruin the eyesight of the patient.

The main purpose of the project is to recognize diabetic retinopathy using technology to reduce the error that was made in the past and to overcome the gap that were seen.

Scope

Diabetic retinopathy is a potentially blinding complication of diabetes mellitus. In patients with diabetes, regular retinal exams are essential. While laser photocoagulation is effective, if performed in time, advanced stages of diabetic retinopathy need to be treated by vireo-retinal surgery and have limited visual prognosis. Even though new therapeutic options such as intravitreal medical therapy and suture less pars-plana vitrectomy have improved ophthalmic care of patients with diabetes, interdisciplinary care of these patients is essential. Good metabolic and blood pressure control is indispensable for reducing the risk of ophthalmic complications.Probability of retinal complications increases with increasing duration of disease. In up to 50% of patients with type 1 diabetes and 30% of those with type 2 diabetes potentially vision-threatening retinal changes develop over time, while early retinal changes are not noticed by the patients.

IV. RELATED WORK

During our research on this topic we have found out that there were have people who have done work related to this topic. In Reference Point [10] Using Naive Bayes they have extracted the features such as area of blood vessel and classify them in different stages thereby detecting Microaneurysms. In [11] they mainly focused to keep track of the changes in a patient's eye such as hard exudates, haemorrhageetc, soft exudates, microaneurysms etc. They want to

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

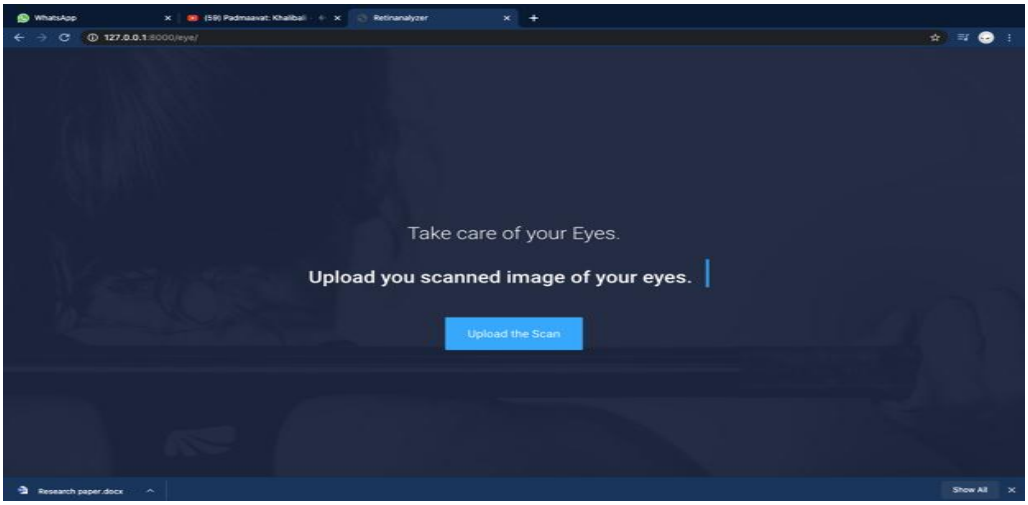
||Volume 8, Issue 5, May 2020||

monitor the continuous changes and thereby conclude if the patient has the condition of diabetic retinopathy. In Reference [12] they have used the different approach toward the project. First blood vessels were detected using algorithms and they were enhanced. Thereafter to equalize the image curvlet transformation was applied, which help in the better extraction of the blood vessels. In [13] SVM classifier was used to classify the severity of lesions. Here color fundus was detected and thereby classified. In Reference [14] they also executed similar type of work as it was done in [13] but here they have used ANN classifier for classification instead of SVM classifier. In [15] they first did the segmentation of retinal vasculature and localize the optic disc. Thereafter they localize fovea and macula. At the end they were able to segment the DR and localize it.

V. METHODOLOGY

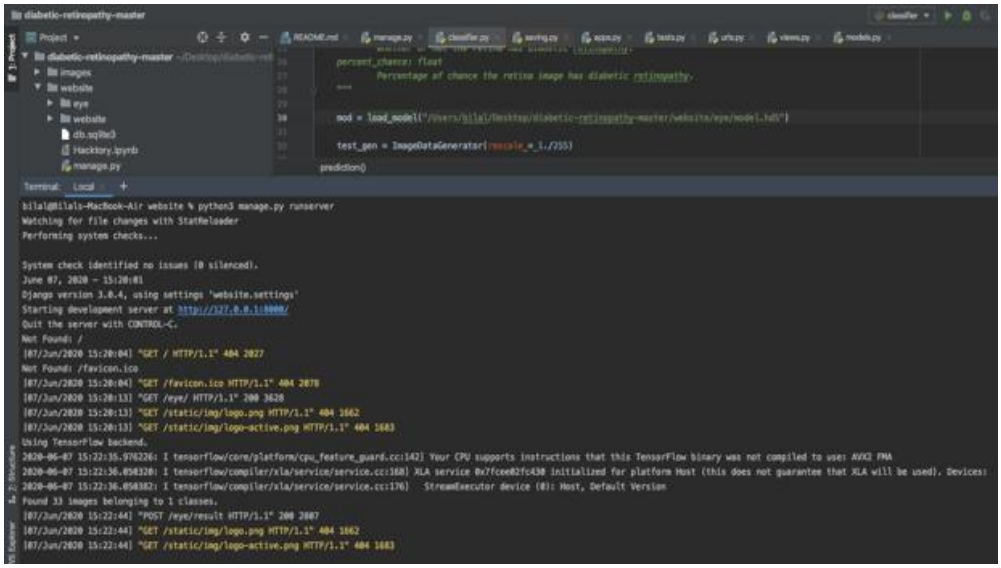
Project implementation here can be explained in two steps
• Image Processing and Feature Extraction
• Supervised learning

3.3.1 Image Processing and Feature Extraction



It is the first and an important part of the project as textures i.e. Data sets collected will be provided as the input to neural nets which will then classify the data sets in their respective classes for further processing.

3.3.1.1 Image compression



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The data set that we have collected would be in different sizes clicked by different camera having different camera quality. It would be of different resolution so our work will be to classify them into different classes. The problem that we will face here will be with the heterogeneity of the data. Therefore, we are going to compress all the test images into 512*512 format.

3.3.1.2 Layer separation

Further, we will go for layer separation where we are going to use 6 features for input and classify namely Blue layer of area, Green layer of area, Red layer of area, Blue layer of parameter, Green layer of parameter, Red layer of parameter so here all three layer of Red, Green and Blue are going to get separated.

3.3.1.3Equalization

Now, after the last operation there will be large variations in intensity of the image and we will be able to see eye features such as veins clearly. To make the intensity more accurate and clear we are going to apply the technique of histogram equalization to the dataset. It is the technique which increases the global contrast of the image by identifying the variations in the intensity. We will use both contrast limited adaptive histogram equalization and histogram equalization to observe which technique will provide the better and improved results to use in the further process.

Morphological operations

Here different morphological operations are going to be used to remove noise in the background of images and enhance the blood vessels as well. It will be used to improve the various features that are required. DR is majorly detected using the blood vessel rupture so it is important to remove the background noise and distinguish it from the background noise by effectively extracting it. Two types of structure will be used for different functions in this step:

•Disk like structure (to remove noise)

• Diamond like structure (for clearer veins)

Now we will use the morphological openings. first we are going to use disc SE with R=5 and then we will use diamond of R=2.

Feature extraction

This step is the final step of the image processing for this project. Here we will try to extract the area of all the layers.

•Canny edge detection ,Here we will use the canny edge detection technique to extract the perimeter of all the layers. Thereafter Gaussian filters will be used to detect the intensity variation part.

•Thresholding

Thresholding is implemented on the morphed images using the adaptive thresholding which gives the area of three layers. We will use both simple thresholding and Otsu's thresholding to deduce which will give the better outcome.

Table 1:Confusion Matrix

	class 0	class 1	class 2	Class 3	Class 4
class 0	170	53	20	14	0
class 1	41	69	14	6	1
class 2	18	26	25	4	0
class 3	3	8	5	8	1
class 4	0	2	6	2	4
	232	158	70	34	6

Classification

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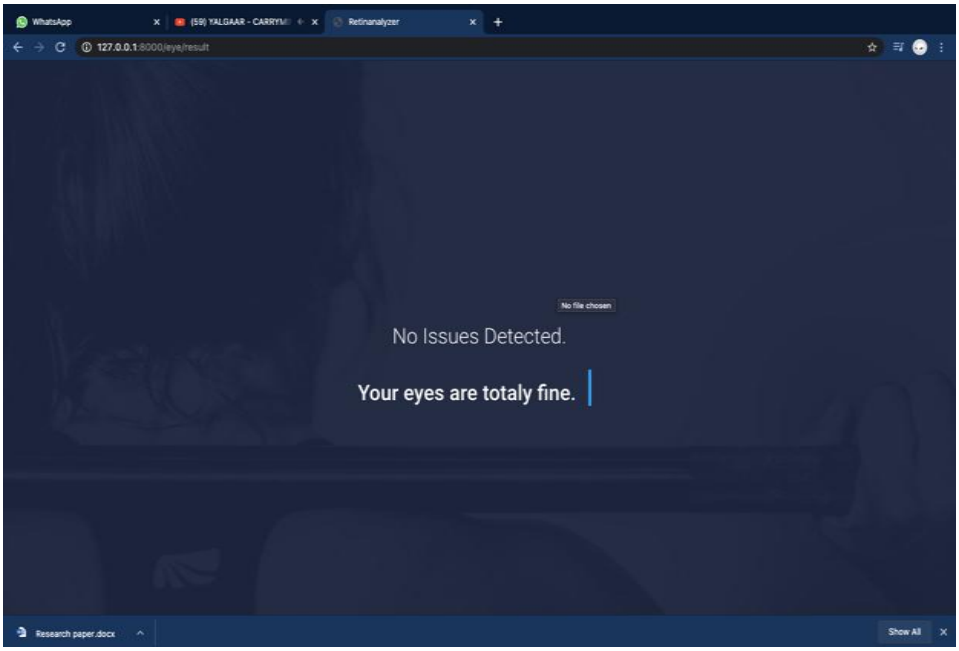
Classification is the last and final part of all process. Here we will use deep neural nets having three convolution layers. In this part images that have been produced in the process are used to create the balanced classes and thereafter they are passed down to neural nets as the inputs. We will use the Graph Lab provided deep neural net library.

V. RESULTS



By using more than 500 images in the initial training of the system and same number for the test, the application was able to successfully classify those images and provide the decent results based on the analysis. The system is providing with 83% accuracy in its first phase. The code for neural networks is taking somewhere around 5-6 hours.

VII. CONCLUSION

In our paper, we proposed a system that will be able to detect Diabetic Retinopathy by using the image of the patient. Using our proposed system, the doctor has to spend less time in detecting the disease and could take care of his/her patient more. However, we were not able to achieve the best accuracy but by using better GPU and large data set the accuracy level can be increased. Here in the paper, it is shown how the disease is classified on how severe they are using neural networks. So hopefully if we can integrate this system with medical science then many doctors will be able to detect the disease in less time and save the vision of their patients.

VIII. FUTURE WORK

For Further Versions in order to improve the efficiency and for the better outcome we would like to go with some of the following modifications:

- Implement neural nets in a better and efficient way
- To use better morphological analysis algorithms to get clearer features
- Increase the size of the data set

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