DIABETIC RETINOPATHY DETECTION

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Abstract

A great challenge in the biomedical engineering is the non-invasive assessment of the physiological changes occurring inside the human body. Specifically, detecting the abnormalities in the human eye is extremely difficult due to the various complexities associated with the process. Retinal images captured by digital cameras can be used to identify the nature of the abnormalities affecting the human eye. Conventional disease identification techniques from retinal images are mostlydependent on manual intervention. Human observation is highly prone to error, the success rate of these techniques is quite low. Diabetic Retinopathy is one such disease of retina which occurs in people suffering from long standing diabetes. It is a multistage progressing disease namely NDPR and PDR. Microaneurysms, haemorrhages and exudates are the abnormal features commonly observed in the retinal image of a person affected by diabetic retinopathy. Image processing techniques are used to pre-process the fundus image, which is followed by segmentation of anomalies. Feature extraction is done and the detected features are used to classify the different stages of diabetic retinopathy. The classification technique used is Random Forest.

INTRODUCTION

1.1 OVERVIEW

Diabetic Retinopathy (DR) is a complication of Diabetes which affects the eye. It is caused by damage to the blood vessels of the retina – the light-sensitive tissue at the back of the eye. At first, diabetic retinopathy may cause no symptoms or only mild vision problems. Eventually, it can cause blindness. It is one of the leading cause of blindness in the world. Around 80 percent of population having diabetes for more than 10 or more years has some stage of the disease. Almost two-third of all Type 2 and almost all Type 1 diabetics are

Non-proliferative diabetic retinopathy (NPDR) is the early stage of the disease in which symptoms will be mild or nonexistent. In NPDR, the blood vessels in the retina are weakened. Tiny bulges in the blood vessels, called microaneurysms, may leak fluid into the retina. This leakage may lead to swelling of the macula.Proliferative diabetic retinopathy (PDR) is the more advanced form of the disease. At this stage, circulation problems deprive the retina of oxygen. As a result new, fragile blood vessels can begin to grow in the retina and into the vitreous, the gel-like fluid that

a b

Figure 1.1 Vision Affected by Diabetic Retinopathy. a. Normal Vision b. Vision affected by Diabetic Retinopathy

Figure 1.1 shows the difference between normal vision and diabetic retinopathy affected vision.

Other complications of PDR include detachment of the retina due to scar tissue formation. In PDR, new blood vessels grow into the area of the eye that drains fluid from the eye. This greatly raises the eye pressure, which damages the optic nerve. If left untreated, PDR can cause severe vision loss and even blindness.

Fundus Image

It is the image of the internal structure of the eye captured using specialized fundus cameras that consist of an intricate microscope attached to a flashed enabled camera. The main structures that can be visualized on a fundus image are the central and peripheral retina, optic disc and macula.

Retinal abnormalities

The common abnormalities found in the human retina are Microaneurysms, Haemorrhages and Exudates as shown in Figure 1.2.

- **Microaneurysms**

A small swelling that forms on the ends of tiny blood vessels. These small swellings may break and allow blood to leak into nearby tissue. The earliest visibility of diabetic retinopathy is the microaneurysms.

- **Haemorrhages**

Retinal hemorrhageis a disorder of the eye in which bleeding occurs into the retina. Retinal hemorrhages that take place outside of the macula if left undetected for many years, and may sometimes only be picked up when the eye is examined in detail by ophthalmoscopy or fundus photography. Some retinal hemorrhages can

cause severe impairment of vision.

- **Exudates**

As Diabetic Retinopathy progresses, a fluid rich in protein and cellular elements that oozes out of blood vessels due to inflammation and is deposited in nearby tissues. Exudates are manifested as spatially random yellowish or whitish patches of varying sizes, shapes and locations. These are the visible sign of DR and a major cause of visual loss in Non- Proliferative forms of DR

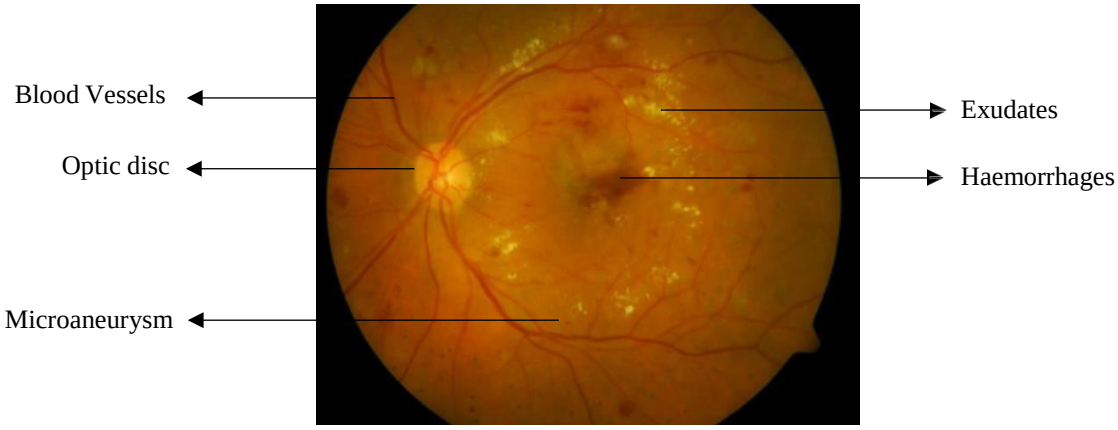


Figure 1.2 Fundus image with abnormalities

Figure 1.2 Fundus image with abnormalities

1.2 MOTIVATION

Diabetic Retinopathyhas become one of the leading causes of blindness, but it can be cured if diagnosed at an early stage, this requires regular eye examinations. Currently the examinations are done by ophthalmologists or optometrists manually. People from low income backgrounds and rural areas may not be able to afford these regular checkups. Setting up mass screening centers with automated systems can eliminate unnecessary visits to the ophthalmologist. This will also eliminate human intervention and thus reduce the cost.

The automated system will grade the images on the level of severity and refer only those patients who need medical attention to the Ophthalmologist. This will also relieve the burden on the doctor who would otherwise have to go through a lot of images which will come from the mass screening camps.

1.3 RELATED WORK

7]Retinal Fundus images like DRIVE,EYE PACS,APTOS,STARE, DIARETDB,ROC,MESSIDOR,DDR,etc 9 sets are used for comparing DR classification techniques.

[11].these Classification of DR using multifracted geometry and lacunarity parameters with the usage of support vector algorithm to obtain an accurate single decision

[12].our primary focus and motivation in this study to develop a fully automatic algorithm using unsupervised and supervised learning to detect red lession

[8].these tech extracts deep features from Resnet-50and DenseNet pooling layer merges them and then send them to adaboost for Classification using retinal Fundus (RF)

[13]. Analysis has performed and show the proposed method outperformed the state -of -artmodels in the terms of both classify problem in different dataset

[9] . Train the model by designing two classifiers for adversarial purpose to improve the robustness of model and also to improve classification to performance of model

[6] . Execute region growing if d<t on four adjacent pixels and add all they aren't included before in the region and save the coordinate of new pixel

[10] . GCA mechanism is proposed to update the attention weight of the different channels of feature map with model training process.

[1].Managing diabetes goes a long way to managing diabetic retinopathy. Diabetes management includes controlling blood pressure, blood glucose and lipid levels. This can be achieved by encouraging a healthy lifestyle and medication as required. Improved control can slow the progession of eye disease, especially when initiated soon after diabetes is diagnosed.

[2].Diabetic retinopathy is divided into two types: non-proliferative and proliferative. Non-proliferative DR is divided into three stages: mild, moderate, and severe . Only microaneurysms are present in mild non-proliferative DR, while exudates characterize moderate and severe stages, along with microaneurysms.

[3].(PCA) is used to extract the most significant features in the dataset. Further, Firefly algorithm is implemented for dimensionality reduction. This reduced dataset is fed into a Deep Neural Network Model for classification. The results generated from the model is evaluated against the prevalent machine learning models and the results justify the superiority of the proposed model in terms of Accuracy, Precision, Recall, Sensitivity and Specificity.

[4].Hand gesture recognition research has gained a lot of attentions because of its applications for interactive human-machine interface and virtual environments. Most of the recent works related to hand gesture interface techniques has been categorized as: glove-based method and vision-based method. There are many vision-based techniques, such as model-based and state-based.for locating objects and recognizing gesturers. Recently, there have been an increasing number of gesture recognition researches using vision-based methods. This paper introduces

[5].We compared the performance of seven automated AI-based DR screening algorithms (including one FDA-approved algorithm) against human graders when analyzing real-world retinal imaging data.

1.4 PROBLEM STATEMENT

Diabetes effects the circulatory system of a person, including that of the retina, which leads to DR. The oxygen supply to the visual system is reduced to a huge extent and it causes swellings on the retinal vessels. Also retinal lesions are formed which includes haemorrhages, microaneurysms and exudates. These are the symptoms for the disease, which will not be visible in the initial stages of the disease. Therefore, unless the patient takes regular examination of the disease, it cannot be identified and thus not cured

For a given collection of retinal fundus images (1…N), where N is greater than 100,

the purpose is:

(i) Precise classification of input images into ***normal, mild, moderate, severe***.

To increase classification accuracy and analyze the efficiency of the proposed work with the existing algorithms.

3.1 FEASIBILITY STUDY

A feasibility study is carried out to select the best system that meets performance requirements. The main aim of the feasibility study activity is to determine whether it would be financially and technically feasible to develop the product. The feasibility study activity involves the analysis of the problem and collection of all relevant information relating to the product such as the different data items which would be input to the system, the processing required to be carried out on these data, the output data required to be produced by the system as well as various constraints on the behavior of the system. The key objective of the feasibility study is to weigh up three types of feasibility. They are:

a) Operational Feasibility

b) Technical Feasibility

c) Economic Feasibilit

- **Operational Feasibility:**

This is mainly related to human organizational and political aspects. The points to be considered are:

- What new skills will be required? Do the existing staff members have these skills? If not, can they be trained in due course of time?
- What changes will be brought with the system?

The proposed system will provide an automated system for the detection of the disease.

The technicians will have to learn how to feed the images to the system.

- **Technical Feasibility:**

Technical feasibility analysis makes a comparison between the level of technology available and that is needed for the development of the project. The level of technology

consists of the factors like software tools, machine environment, and platform developed and so on. It is also concerned with specifying equipment and software that will successfully satisfy the user requirement. The technical needs of the system may vary considerably.

- **Economic Feasibility:**

This is the most important part of the project because the terms and conditions for

implementing the project have to be economically feasible. The risk of finance does not exist as the existing hardware is sufficient and the software is free of cost. The system is economicallyfeasible.

Hardware Interface:

Describes the logical and physical characteristics of each interface between the software product and the hardware components of the system. This may include the supported device types, the nature of the data and control interactions between the software and the hardware, communication protocols to be used.

Software Interface:

Describes the connections between this product and other specific software components (name and version), including databases, operating systems, tools, libraries, and integrated commercial components. Identify the data items or messages coming into the system and going out and describe the purpose of each. Describe the services needed and the nature of communications.

Objective of Software Project Planning

The objective of software project planning is to provide a frame work that enables the reasonable estimation of resources, cost and schedule.

Software Scope

The first activity in software project planning is the determination of software scope. A software project scope must be unambiguous and understandable at the

management and technical levels. The software scope means the actual operation that is going to be carried out by the software and its plus points and limitations.

Resources

The second task of software planning is the estimation of resources required. Each resource is specified with the following characteristic. Resource descriptions, details of availability, when it is required, how long it is required.

- Human Resource
- Hardware Resource
- Software Resource

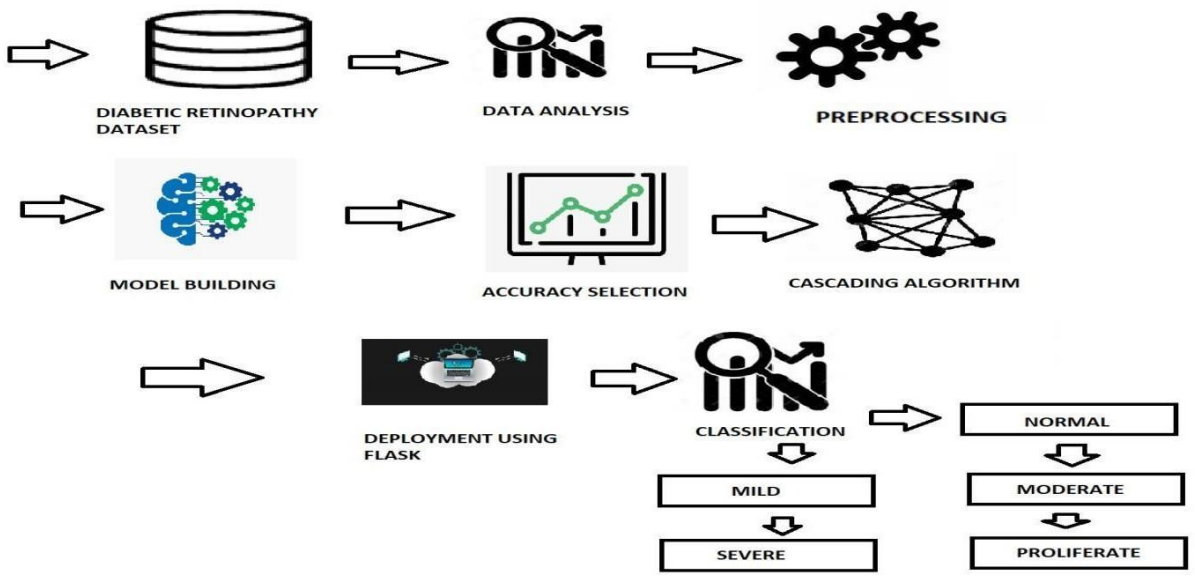
3.2 EXISTING SYSTEM

All the existing systems are concentrating on segmenting the primary anomalies responsible for initial stage of the disease. Their proposed method is also database dependent and would work only for that specific database. There is no single approach or method for segmenting all the anomalies. Building an optimal feature set is needed as this disease is vision threatening and high benchmarking results need to be achieved. Many classification techniques are proposed with different and novel approaches of pre- processing. All these surveyed papers achieve an average of 85% accuracy which still need to be improved. Researches throughout the world are trying to propose better classification algorithms by building significant feature set. Limitations of the existing systems are defects that arise due to DR compliances which cannot be extracted using single method. Hence there is a need to developed system will overcome and able extract all features using single platform.

3.3 PROPOSED SYSTEM

The Proposed system is a multistage classifier of Diabetic Retinopathy. This system overcomes the drawbacks of the existing system by classifying the disease in to four stages, namely, Normal, NPDR 1, NPDR 2 and PDR. This multistage classification is important because the disease itself progresses in multiple stages. The reoccurrence of the disease depends on the stage in which the treatment is provide, so it is not enough to classify the image as normal and abnormal.

The pre-processing part of both the existing and proposed system remain similar, the difference comes in the segmentation and feature extraction stages. Existing system only segmented anomalies like microaneurysms, the problem with this is this anomaly occurs in the initial stage of the disease. Treatment cannot be given at this stage, hence this is a major drawback. The proposed system overcomes this by segmenting haemorrhages along with microaneurysms and also by considering a large feature set which includes the area and count of the segmented anomalies. The feature set also includes textural features like energy and correlation, and statistical features like mean and variance. This feature set is then used to classify the image into the respective severity. Figure 4.1 shows the system architecture of the proposed system.



Architecture Diagram

3.4 RESULTS

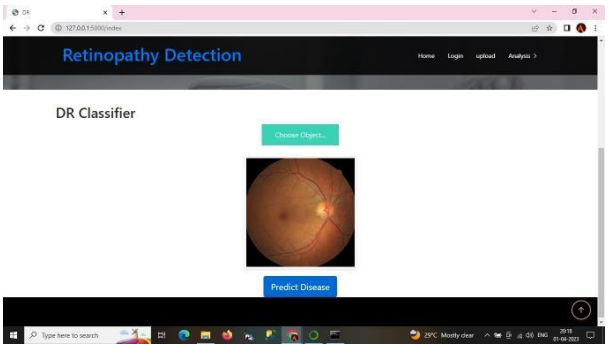


Fig .Uploading non affected Fundus Image

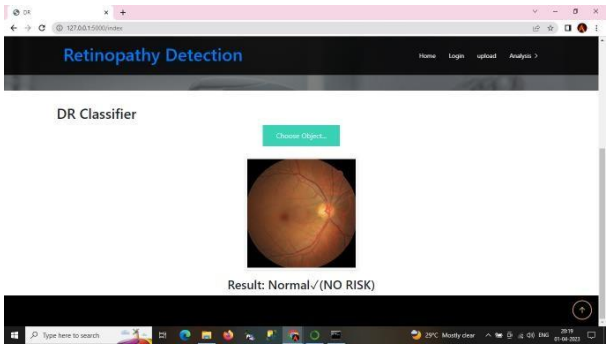


Fig Result normal

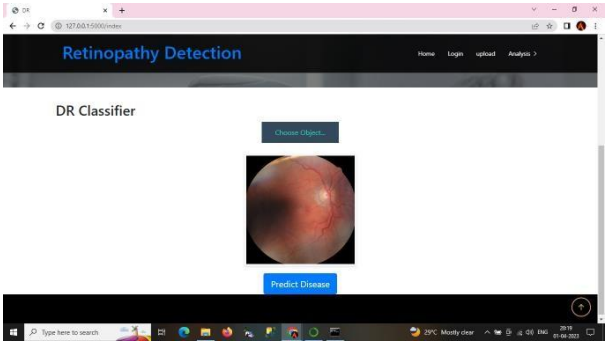


Fig Uploading Affected Fundus image

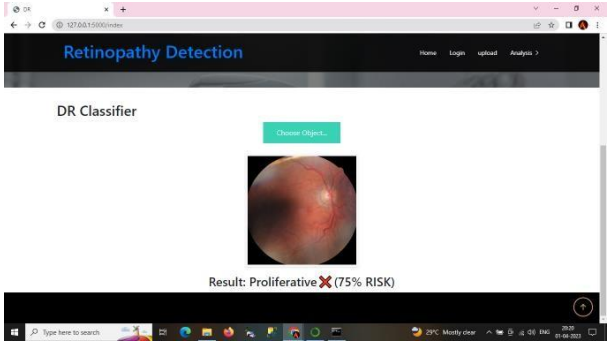


Fig Result proliferative

3.5 CONCLUSION

Diabetic Retinopathy is only possible if there is an effective method for segmenting the diabetic features in the fundus image.The proposed system presents a fast, effective and robust way of detecting diabetic features in the fundus images which can be used for classification of the images based on the severity of the disease. The retinal images are subjected to gray scale conversion, preprocessing and feature extraction steps and provide the result.

3.6 REFERENCE

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