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Diabetic Retinopathy Detection and Classification

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Abstract: Generation has been evolving constantly and it is making our lives simple. With a quick-paced life all people these days is harnessing the advantages of generation besides some components of the society. One of the visual disease due to several other diseases are Diabetic Retinopathy, Cataracts, Glaucoma, etc. Diabetic Retinopathy (DR) is a typical complexity of the diabetes which is in-line with the retinal vascular damage which is brought by long standing Diabetics. Diabetic Retinopathy is a condition which relates to increased glucose level in blood. As there is increase in glucose levels, the veins in the retina changes. As glucose level increases, the person may start to lose his/her vision, leading to Diabetic Retinopathy. It is usually seen in moderately aged and older persons. In this paper, we use Fundus eye images and those features are extracted using a technique called Image Processing technique. These images are trained, tested and the severity of the disease is seen using K-Nearest Neighbor (KNN) algorithm.

I. INTRODUCTION

World is advanced based on our ability to see things. Without sight/vision, a lot of us in the globe would suffer to read, write, take part in any activity, find some job for leading life and lot more. Diabetic Retinopathy (DR) is a sever level of diabetes which is in-hand with retinal dis-function which is caused by long exposure of diabetes. DR have several reasons for visual damage and visual dysfunction around the globe, since 0.5 million occurrence of visual dysfunction and 2.6 million occurrence of extreme vision block in the year 2015. Henceforth, to avoid the vision misfortune, it is necessary to take early detection and treatment for the disease. The main issue that comes up in this particular disease is that the patient isn't aware of the illness until there is changes in the vision and in retina. At this stage the disease would have reached to a level where treatment will be less successful.

Diabetic Retinopathy is grouped into two categories, which are known as Non-Proliferative Retinopathy (NPDR) and Proliferative Retinopathy. The primary changes that happened in the eyes, are NPDR. Red spots which are present on the retina is called as Micro-aneurys, this is caused due to the expansion of blood vessels. As disease progress, veins clogs and there is absence of blood circularity. Extra veins are formed on the outer side of retina when attempting to make new ways for supply of blood. This process is called as neovascularization and this happens at Proliferative Diabetic Retinopathy.

In this project, we use fundus images (retinal images) and necessary features are extracted from these fundus images using the technique called Image Processing technique. Images are trained, tested and level of the disease is classified using K-Nearest Neighbor (KNN) algorithm.

II. LITERATURE SURVEY

PAPER I: "Diabetic Retinopathy Detection Using Ensemble Machine Learning" [IEEE Access, 2021]

They investigated an ensemble-based learning strategy, they merged a substantial selection of well-known classification algorithms in one advanced model. This algorithm achieved highest accuracy rates among all the other common classification algorithms.

PAPER II: "Machine Learning Approach for Detection of Diabetic Retinopathy with improved Pre-Processing" [IEEE Access, 2021]

The system aims to automate the process of detection using a combination of basic image processing steps with more focus on pre-processing to obtain clear image for feature extraction, further Machine Learning algorithms are applied for classification. Algorithms used are weighted KNN, Cubic SVM and simple tree. The accuracy obtained using different algorithms is quite satisfactory, the best accuracy of 88.6% is obtained using Simple tree which was better than the other classification algorithms used for detection. 87.2% for SVM and 85.8% for KNN.

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PAPER III: "Detection of Diabetic Retinopathy using Machine Learning Algorithm" [IEE Access, 2020]
In this paper, they proposed a robust automated system which detects and classifies the different stages of DR. The classification is done using Fuzzy classifier and CNN, for detecting different stages of DR. It is found that CNN classifier is more accurate with 90% accuracy and fuzzy classifier gives 82% accuracy.

PAPER IV: "Classification of Diabetic Retinopathy through Deep Feature Extraction and Classic Machine Learning Approach" [IEEE Access, 2020]
In this research, a CNN architecture is used, named ResNet-50, as feature extraction and classification. The model works by using fundus images from dataset and diagnosis of DR by an ophthalmologist takes a long time. The accuracy and sensitivity obtained for each classifier are evaluated such as SVM with 99%.

PAPER V: "An Improved Approach for Detection of Diabetic Retinopathy Using Feature Importance and Machine Learning Algorithms" [IEEE Access, 2019]
The proposed method applies classification algorithms on several features (e.g., Optical disk diameter, lesion-specific) of an existing DR data-set. Later the features were extracted and used for final decision making to predict DR. The proposed method achieved 88% accurate results than existing approaches by introducing a tree-based feature selection method.

PAPER VI: "Diabetic Retinopathy Detection Using Machine Learning and Texture Features" [IEEE Access, 2018]
In this work, they introduced the use of different texture features of DR. Support Vector Machine (SVM) are used for the classification of extracted histogram. The techniques, Local Ternary Pattern (LTP) and Local Energy-based Shape Histogram (LESH) captured the relationships between neighboring pixels. LESH was the best performing with an accuracy of 0.904 and accuracy of 0.931 using SVM.

III. OVERALL DESCRIPTION

Diabetic Retinopathy (DR) is a frequent visual disease and the circumstances of this is cause of blindness in patients. Regular check-ups and medications is the most essential way to kick out disease. Our project Diabetic Retinopathy Detection and Classification aims at designing and developing an automated system to analyze and classify the retinal images.

IV. SYSTEM DESIGN

SYSTEM ARCHITECTURE

System design represents a plan or drawing that shows the function along with working of a system.

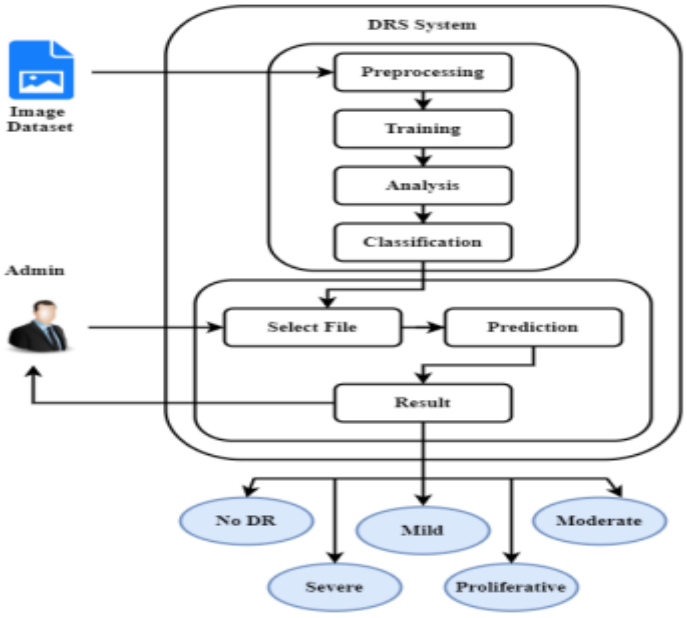

Figure: Architecture Diagram of Diabetic Retinopathy

The above image depicts the architecture diagram of Diabetic Retinopathy. The image dataset is Preprocessed in other

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words data which is gathered from other sources are in row format and not appropriate for analysis. This data is cleansed and sent to training model. For training the model, we have used model transfer learning approach and Mobile-net is used for bootstrapping the pre-trained model. Later, after analysis of data KNN algorithm is used for classification. And then one file is selected by admin to predict the result and the predicton of result is done using tensor-flow Keras library. And then admin selects the file to predict the result, prediction is done by using tensor-flow Keras library. The result consists of five categories they are No DR, Mild, Moderate, Severe, Proliferative.

CLASS MODEL

It is a conceptual model that describes different classes present in a system along with their attributes, operations and their relationships among objects.

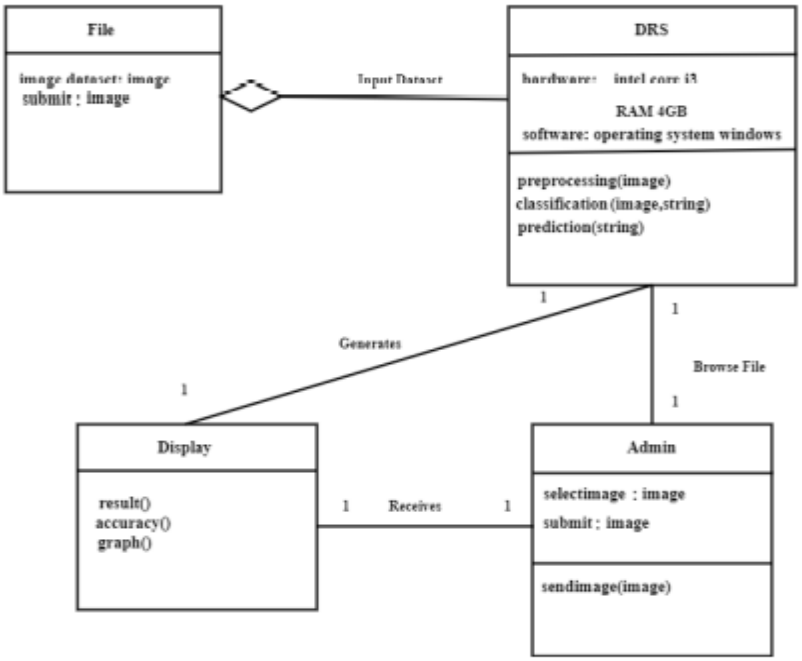
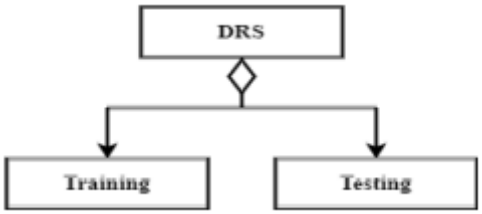


Figure: DRS Class Diagram

The classes included in this model are Admin, DRS, Display and File. The Admin class includes selecting images and submit option. Select image and submit as its attributes. Then the admin model interact with the DRS model. It preprocesses and analyses the data. It fetches image from the File model and it displays the result to the user.

STATE MODEL

The state model contains different states and describes how the control flows from one state to another.



In training phase first the user uploads the image and on uploading the control goes to the Preprocessing state. System is trained using diabetic Retinopathy dataset. At the start, system will be idle, admin collects the data when he browse the specified file. Thus collected data is pre-processed to remove null value. The extracted data is classified into certain classes and the system is trained to generate required output.

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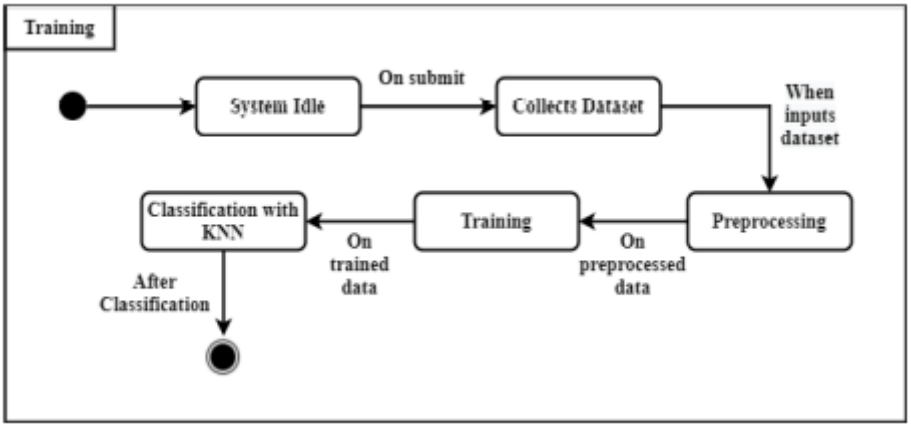

Figure: State Diagram of Training DR

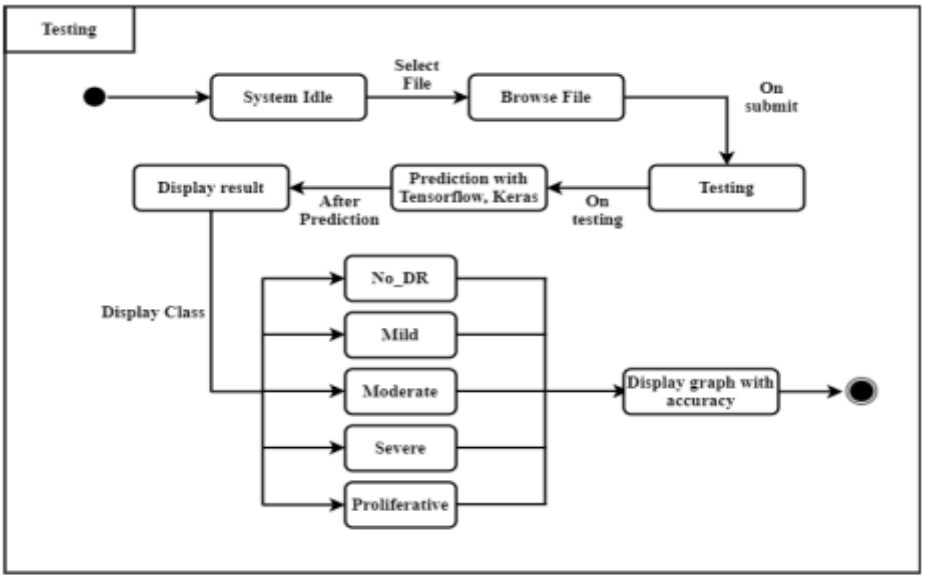

Figure: State Diagram Testing of DRS

The System will be in idle state at the beginning. Then admin collects the data when he browse the specified file. The collected data is tested to remove null value. The extracted data is classified into certain classes which helps for prediction using Tensor-flow, Keras libraries. The system is tested to generate required output based on the user inputs.

Modular Model

Modular Diagram represents each module and sub module of the system.

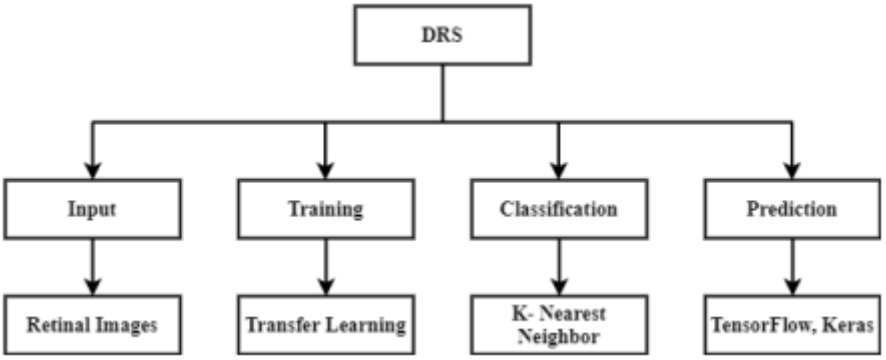

Figure: Modular Diagram

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The above diagram indicates the partitioning of the system architecture. The different modules included in DRS are input, preprocessing, classification and prediction. Input module includes collection of retinal fundus images. The Preprocessing is done by using open-CV and KNN algorithm is used for the classification and prediction uses tensor-flow, Keras library to predict the correct output.

DATA FLOW DIAGRAM

It is the model which describes how the data flows in the system.

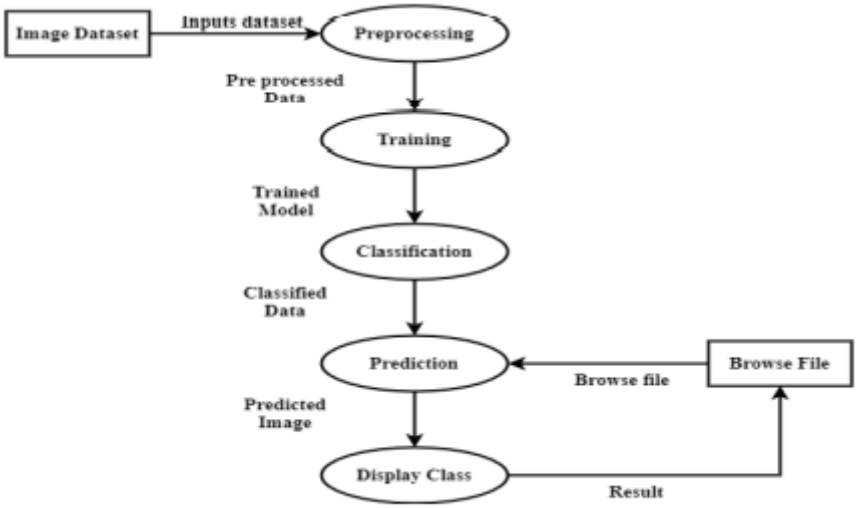

Figure 5.10: Data-Flow Diagram of training DRS

In Dataflow diagram admin inputs the dataset and then processing of data takes place where the impurities are removed from the dataset. Once the classification process is done it is fed in for Prediction to predict diabetes using KNN algorithm. Finally, the outcome is classified as No DR, NPPDR, PDR.

V. IMPLEMENTATION

In the developed system of Diabetic retinopathy detection, the system user can train, test and evaluate the system with different machine learning techniques. When the system user runs the developed program he gets an option to select the image to be tested. The user uploads the input image by browsing from the system. Then the user tests the input image to predict which class of the DR it belongs to. Finally, user is given with output of the class of the DR along with the accuracy graph.

Algorithm for Classification

1. Load the dataset
2. Initialize the arrays to load the images
3. Bootstrap a model from pre-trained model
4. For each data in the model

4.1 Train the model data using transfer learning technique

5. Classify the data using K Nearest Neighbor algorithm

Algorithm for Prediction

1. Select an input image from the testing dataset
2. Load the pre-trained model
3. Predict the class of the image using tensor-flow and Keras library
4. Return the predicted class 5. Display the accuracy graph of the result

Algorithm for K-Nearest Neighbor Classifier

1. Load the data
2. Initialize K to your chosen number of neighbors
3. For each example in the data

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3.1 Calculate the distance between the query example and the current example from the data.
3.2 Add the distance and the index of the example to an ordered collection
4. Sort the ordered collection of distances and indices from smallest to largest (in ascending order) by the distances
5. Pick the first K entries from the sorted collection
6. Get the labels of the selected K entries
7. If regression, return the mean of the K labels
8. If classification, return the mode of the K labels

VI. RESULT AND ANALYSIS

The results and analysis section demonstrate the results that are obtained from the experiments upon the implementation of Diabetic Retinopathy detection system. The dataset is divided into two parts- training and testing. The training dataset is trained using transfer learning technique and the trained model is tested using testing dataset. The outcomes of the test are shown here.

Figure: UI for testing the image

The figure is a User Interface in which the retinal fundus images is given as an input. After uploading the image, it undergoes testing process where the image is predicted for the classification. The classification is of five types based on severity of the Diabetic Retinopathy (DR) i.e. No DR, Mild, Moderate, Severe, Proliferative.

Figure: Uploading the image to be tested

The figure shows the image uploaded which is to be tested for the presence of Diabetic Retinopathy. Here the image is uploaded by browsing the respective image file in the system. On clicking test button the testing process begins.

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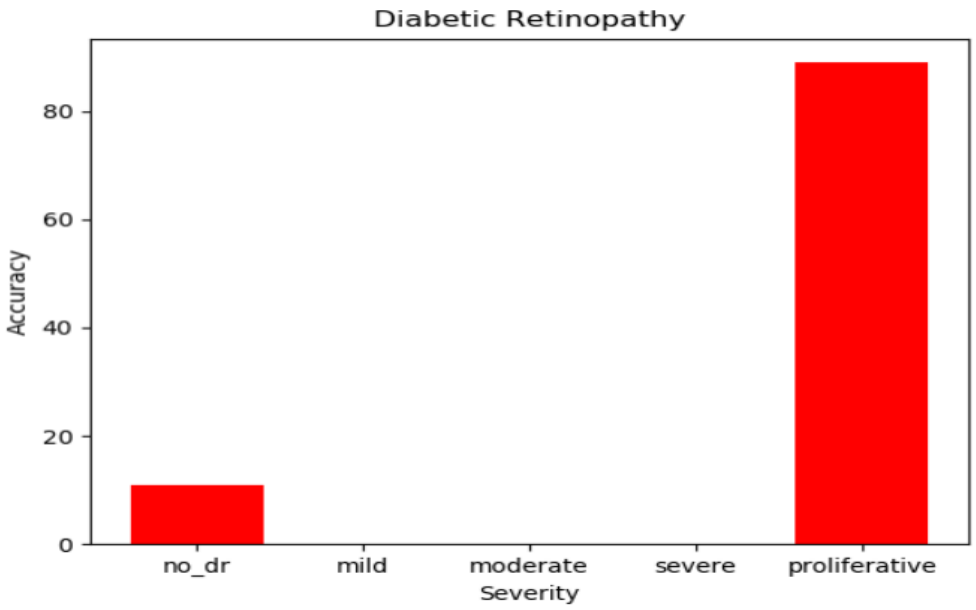

Figure: Displaying the class with accuracy of the tested image

The figure displays the result of the test. It depicts that the chosen fundus image belongs to class 0 which means the patient has No Diabetic retinopathy. It also displays the accuracy of the result i.e. the accuracy of this particular test is 99%. It displays the accuracy graph when clicked on the view graph button.

VII. CONCLUSION AND FUTURE WORK

In the current fast growing world, time is important for each and every person. So, we are trying to reduce wasting time of patients waiting in the queue at the hospital. This prediction model helps the doctors in the efficient Human disease diagnosis process with fewer attributes. As the accuracy resulted in all experiments is not too high, a future work to improve the accuracy is still needed. The final goal of our DR detection system is to classify the fundus images that are free from retinopathy lesions as normal, and to classify the abnormal images according to its severity as non PDR and PDR. Using the data obtained from the images their data are divided into two portions that is training and testing. The Graphic User Interface has been successfully developed. It is capable of inputting a test image to be processed and extract texture features of the image and display these values and the results of the KNN classifiers.

VIII. ACKNOWLEDGEMENT

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