PROJECT DOCUMENTATION

Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy

Team Id:-PNT2022TMID20861

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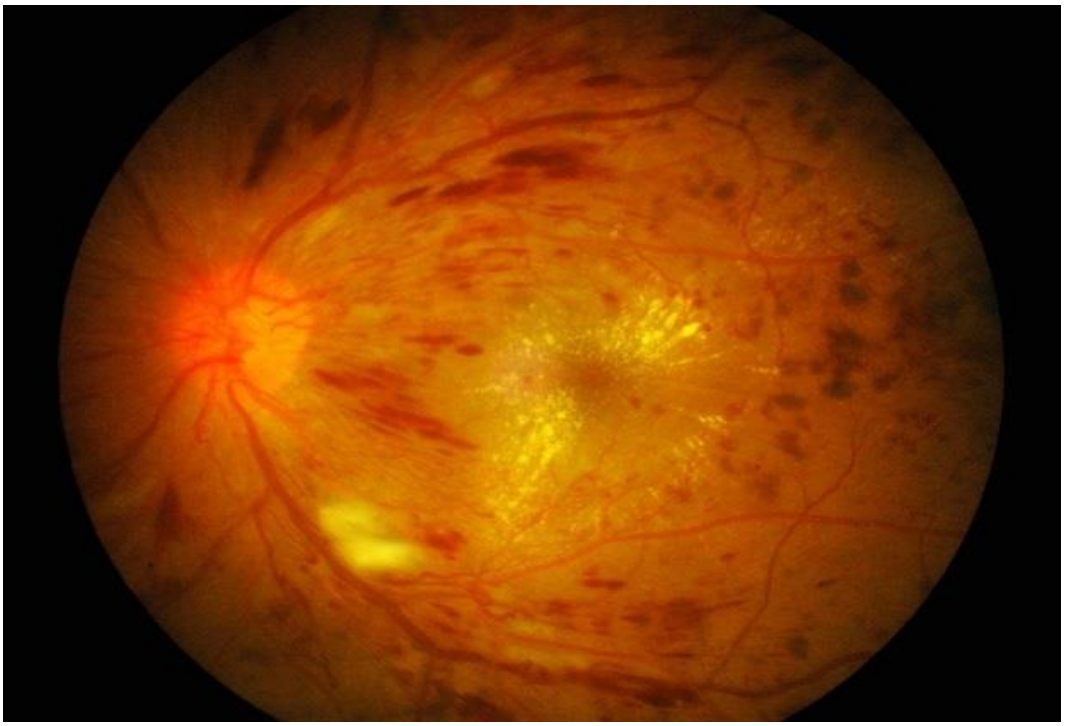
1. INTRODUCTION :-

The main causing of visual loss in the world is diabetic retinopathy. In the initial stages of this disease, the retinal microvasculature is affected by several abnormalities in the eye fundus such as the microaneurysms and/or dot hemorrhages, vascular hyper permeability signs, exudates, and capillary closures . Micro-aneurysm dynamics primarily increase the risk that the laser photo coagulation requires progression to the level Diabetic retinopathy is a diabetes complication that affects eyes.It's caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina).At first, diabetic retinopathy may cause no symptoms or only mild vision problems. Approximately four hundred and twenty million people worldwide have been diagnosed with diabetes mellitus. The prevalence of this disease has doubled in the past 30 years and is only expected to increase, particularly in Asia. Of those with diabetes approximately one-third are expected to be diagnosed with diabetic retinopathy (DR), a chronic eye disease that can progress to irreversible vision loss. Early detection which is critical for good prognosis, release on skilled readers and is both labour and time-intensive. Automated techniques for diabetic retinopathy diagnoses are essential to solving these problems.



1.1 Project Overview :-

Diabetic Retinopathy (DR) is a common complication of diabetes mellitus, which causes lesions on the retina that affect vision. If it is not detected early, it can lead to blindness. Unfortunately, DR is not a reversible process, and treatment only sustains vision. DR early detection and treatment can significantly reduce the risk of vision loss. The manual diagnosis process of DR retina fundus images by ophthalmologists is time, effort and cost-consuming and prone to misdiagnosis unlike computer-aided diagnosis systems.

Transfer learning has become one of the most common techniques that has achieved better performance in many areas, especially in medical image analysis and classification. We used Transfer Learning techniques like Inception V3,Resnet50,Xception V3 that are more widely used as a transfer learning method in medical image analysis and they are highly effective.

1.2 PURPOSE

Diabetic eye screening is important as it helps to prevent sight loss. As someone with diabetes, your eyes are at risk of damage from diabetic retinopathy. Screening can detect the condition early before you notice any changes to your vision. Managing your diabetes is the best way to lower your risk of diabetic retinopathy. That means keeping your blood sugar levels in a healthy range. You can do this by getting regular physical activity, eating healthy, and carefully following your doctor's instructions for your insulin or other diabetes medicines.

To make sure your diabetes treatment plan is working, you'll need a special lab test called an A1C test. This test shows your average blood sugar level over the past 3 months. You can work with your doctor to set a personal A1C goal. Meeting your A1C goal can help prevent or manage diabetic retinopathy.

2. LITERATURE SURVEY :-

ABSTRACT

Diabetic Retinopathy:

Diabetic retinopathy is a diabetes complication that affects eyes.It's caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina).At first, diabetic retinopathy may cause no symptoms or only mild vision problems. Approximately four hundred and twenty million people worldwide have been diagnosed with diabetes mellitus. The prevalence of this disease has doubled in the past 30 years and is only expected to increase, particularly in Asia. Of those with diabetes approximately one-third are expected to be diagnosed with diabetic retinopathy (DR), a chronic eye disease that can progress to irreversible vision loss. Early detection which is critical for good prognosis, release on skilled readers and is both labour and time-intensive. Automated techniques for diabetic retinopathy
diagnoses are essential to solving these problems.

1.Diabetic Retinopathy Detection and Retinal Image Generation (2021)

• To visualize the symptom encoded in the descriptor, they propose PathoGAN, a new network to synthesize medically plausible retinal images.

• By manipulating this descriptors, they could even arbitrarily control the position, quantity, and categories of generated lesions. They also show that their synthesized images carry the symptoms directly related to diabetic retinopathy diagnosis. Their generated images are both qualitatively and quantitatively superior to the ones by previous methods.

• Besides, compared to existing methods that take hours to generate an image,their second level speed endows the potential to be an effective solution for data augmentation.

2.Transfer Learning based Detection of Diabetic Retinopathy from small Dataset (2019)

• Transfer learning from an already trained deep convolutional network can be used to reduce the cost of training from scratch and to train with small training data for deep learning.

• In this work, they used a pretrained Inception-V3 model to take advantage of its Inception modules for Diabetic Retinopathy detection.

• In order to tackle the labelled data insufficiency problem, they subsampled a smaller version of the Kaggle Diabetic Retinopathy classification challenge dataset for model training, and tested the model’s accuracy on a previously unseen data subset. Their technique could be used in other deep learning based medical image classification problems facing the labelled training data insufficiency.

3.AUTOMATIC SEGMENTATION OF RENTINAL VASCULATURE:

• Author developed an unsupervised method for segmenting the retinal vessel.the entire algorithm consist of 4 stages:contrast enhancement,edge enhancement,optic disk removal and vessel segmentation and the post processing.

4.Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs (2018)

• The original study used non-public fundus images from EyePACS and three hospitals in India for training. This Study used a different Eyepatch data set from Kaggle.
• The original study used the bench mark data set Messidor-2 to evaluate the algorithm's performance.

REFERENCES:-

Survey 1 :

1. Taylor, R. & Batey, D. Handbook of Retinal Screening in Diabetes: Diagnosis and Management. Wiley (2012).
2. Wang, F., Casalino, L. P. & Khullar, D. Deep Learning in Medicine-Promise, Progress, and Challenges. JAMA Intern Med. (2018).
3. Guan, M. Y., Gulshan, V., Dai, A. M. & Hinton, G. E. Who Said What: Modeling Individual Labelers Improves Classification. arXiv e-prints., https://ui.adsabs.harvard.edu/\#abs/2017arXiv170308774G. (Accessed March 01, 2017).

Survey 2 :

AUTHORS: Mohamad Hazim Johari , Hasliza Abu Hassan , Ahmad Ihsan Mohd Yassin (July 2018).
TITLE: 'Early Detection of Diabetic Retinopathy by Using Deep Learning Neural Network.'
METHODS: This project presents a method to detect diabetic retinopathy on the fundus images by using deep learning neural network. Convolution Neural Network (CNN) has been used in the project to ease the process of neural learning. The data set used were retrieved from MESSIDOR database and it contains 1200 pieces of fundus images. The images were filtered based on the project needed. There were 580 pieces of images types has been used after filtered and those pictures were divided into 2, which is Exudates images and Normal images. On the training and testing session, the 580 mixed of exudates and normal fundus images were divided into 2 sets which is training set and testing set. The result of the training and testing set were merged into a confusion matrix. The result for this project shows that the accuracy of the CNN for training and testing set was 99.3% and 88.3% respectively.

Survey 3 :

AUTHORS: Lei Lu , Ying Jiang , Ravindran Jaganathan , and Yanli Hao. (Jan 2019). **TITLE:** 'Current Advances in Pharmacotherapy and Technology for Diabetic Retinopathy: A Systematic Review.'
METHODS: Direct injections or intra virtual antiinflammatory and anti angiogenesis agents are widely used pharmacotherapy to effectively treat DR and diabetic macular edema (DME). However, their effectiveness is short term, and the delivery system is often associated with adverse effects, such as cataract and increased intraocular pressure. Further, systemic agents and plants-based drugs have also provided promising treatment in the progression of DR. Recently, advancements in pluripotent stem cells technology enable restoration of retinal functionalities after transplantation of these cells into animals with retinal degeneration. This review paper summarizes the developments in the current and potential pharmacotherapy and therapeutic technology of DR. Literature search was done on online databases, PubMed, Google Scholar, clinitrials.gov, and browsing through individual ophthalmology journals and leading pharmaceutical company websites.

2.3.PROBLEM STATEMENT DEFINITION:-

Given a image of left and right eye of the patient, the main aim of the project is to classify the eye status among one of the following classes 0 - No DR, 1 - Mild, 2 - Moderate, 3 - Severe, 4 - Proliferative DR. So my task is to create an automated analysis system capable of assigning a score based on the above scale.

The detection of this DR in early stages manually is a difficult task. Since a Deep learning techniques are used for early detection of diabetic retinopathy.

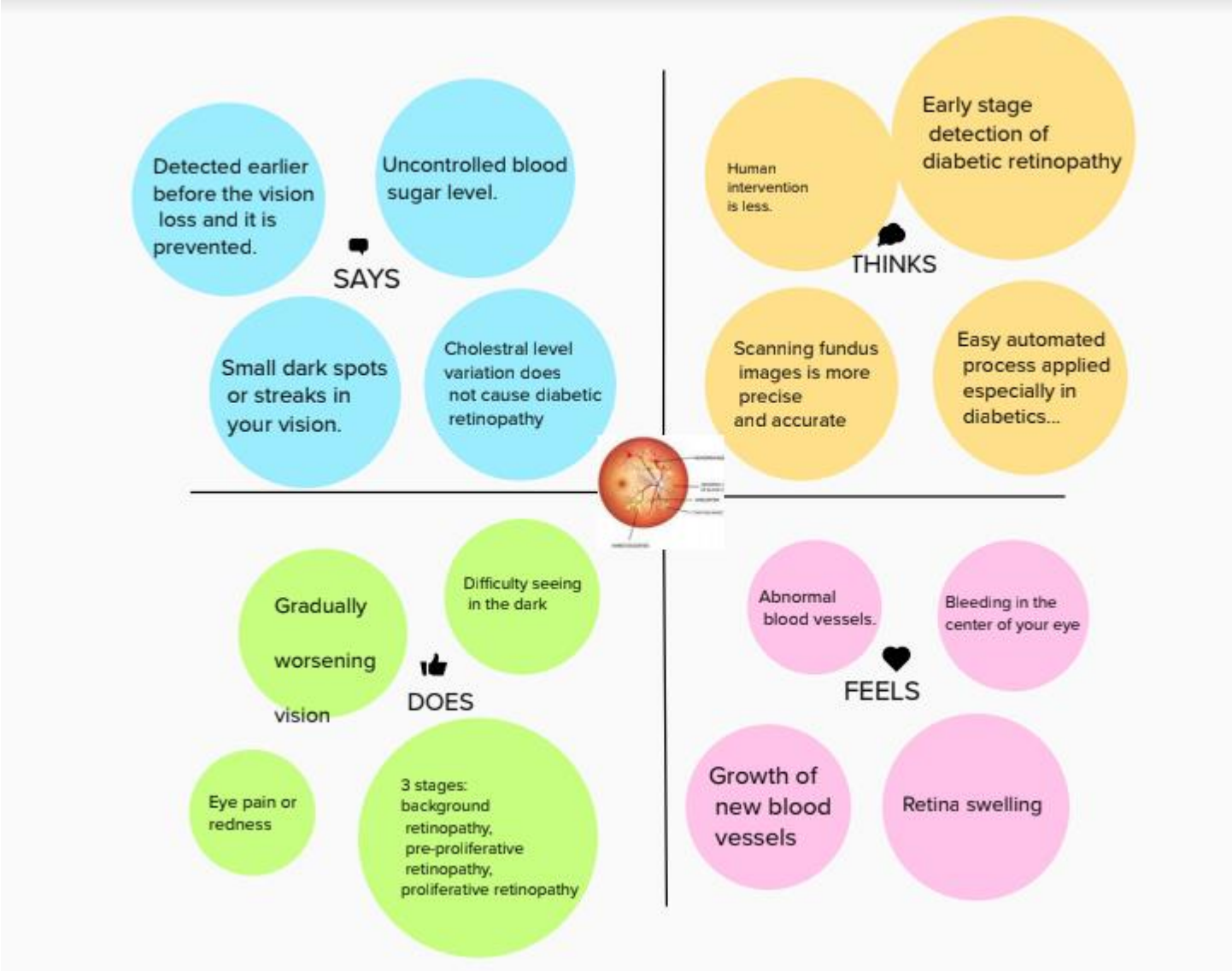
Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Physician	Detect and diagnose condition of an eye	Analysing, prediction , detection is manually difficult	Difficulty in predicting accuracy and contains many stages	complex
PS-2	Opthamologist	Identify and suggest a treatment for diabetic retinopathy	Analyse the level of diabetic retinopathy	Treatment based on different levels of Diabetic Retinopathy	Serious about the treatment

OBJECTIVES :

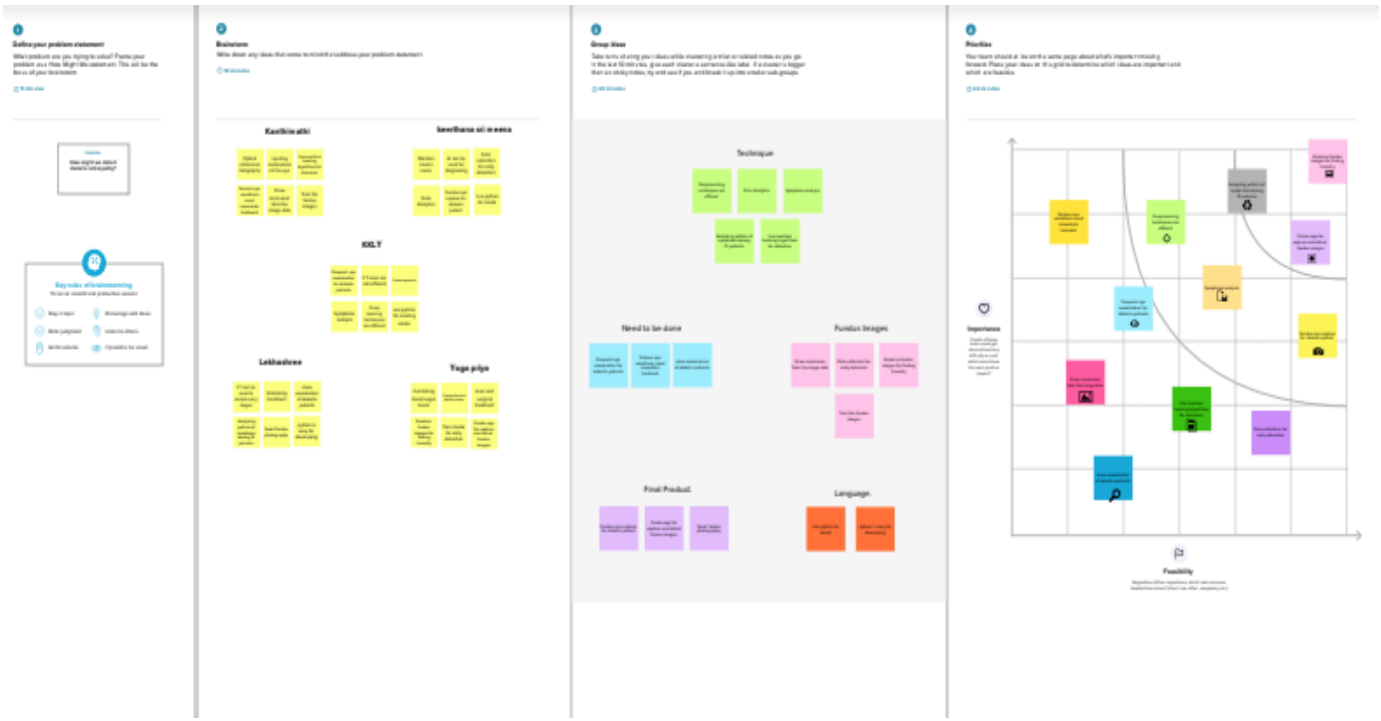
The primary goal is to identify diabetic retinopathy by processing retinal images. Transfer learning has arose as one of the most popular techniques that has enhanced performance in many areas, notably in the analysis and classification of medical images. We used transfer learning techniques that are more frequently used in medical image analysis and have been extremely effective, including such Inception V3, Resnet50, and Xception V3.

3.IDEATION PHASE & PROPOSED SOLUTION :

3.1 Empathy Map Canvas :



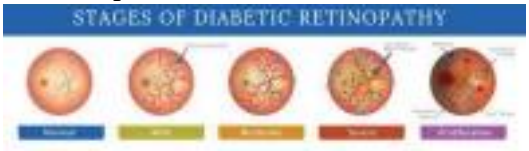
3.2 IDEATION AND BRAINSTORMING:-



3.3 PROPOSED SOLUTION:-

The main aim of this project is to create an appropriate machine learning model to detect Diabetic Retinopathy as soon as early .

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Diabetic retinopathy is a diabetes complication that affects eyes. Considering the fact that Retina is the sensitive part it can result in blurry, less intense eye sight and it can also result in disappearing of eye sight. At first, diabetic retinopathy might cause no symptoms or only mild vision problems. As time goes on, the state of this issue can worsen and lead to partial and then complete blindness to the individual which must be taken care of beforehand to get better at early stages. The condition can develop in anyone who has type 1 or type 2 diabetes. Analysis of fundus image for early detection of Diabetic Retinopathy firstly Analyse the level of DR and To detect whether DR is present or not.
2.	Idea / Solution description	The idea or the solution is to detect the Diabetic Retinopathy from the fundus image dataset as early as possible so that peoples/patients can proceed to their required treatments and prevent vision impairment or permanent vision loss. So, deep learning techniques can be used for early detection of diabetic retinopathy that can prevent blindness and other eye related diseases. The deep learning models like
		Resnet-50, Alexnet, VGG16, Google-Net, U-Net are under study as of now. After completion of data pre-processing, the model will be trained and tested using the dataset Images. In this system we will integrate it with a user interface using flask.

3.	Novelty / Uniqueness	This model provides the patient with the result whether they have serious condition or normal condition. The prediction comes with different levels of illness helps to diagnose properly.
4.	Social Impact / Customer Satisfaction	This model can detect the level of diabetic retinopathy from early-to-late stages with all clinical grades of the customer.Reduction of Diabetic Retinopathy risk.Provides Digital Assistance.Very helpful in making decisions faster.Can be used 24x7.
5.	Business Model (Revenue Model)	We can collaborate with the health care centres and diabetic diagnosis centres for regular screening of diabetic retinopathy whenever the diabetic patient comes to check their diabetic level. 
6.	Scalability of the Solution	The solution with the transfer learning model offers a better solution for diabetic retinopathy and can be detected at an early stage. The model developed using deep learning technology can be implemented on many clinical examinations. There are more and more ways for the scalability of the solution in which the model can be easily integrated & adapted with future technologies.

Proposed solution:

Team ID-PNT2022TMID20861

Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy

1.Customer segment

The detection of DR earlier is irreversible. The image stored in the database and it is detected.A 55 year old woman as been diabetic for 10 years and thought her diabetic under control but found changes in her vision. Easy to examine then manual.

6.Customer constraints

Includes restricted diet, activities does not show up any specific symptoms.
1.Medical expenses
2.The range of vision is gradually decreases
3.Continuos intake of prescribed medicine

5.Available solution

Taking eye test regularly, control of blood sugar and pressure. Incase of proliferative DR, laser treatment provides better results. Early detection of problem in eye sight can be prevented from vision loss.

2.JOBS-TO-BE-DONE/ PROBLEMS

Final stages of DR cannot be cured easily,leads to vision loss,eye illness.
complications may lead to
1.glaucoma
2.blindness
3.Vitreous hemorrahage
4.Detachment in retina

9.Problem root cause

DR caused by high blood sugar due to diabetes. Over time, having too much sugar in your blood can damage your retina the part of your eye that detects light and sends signals to your brain through a nerve in the back of your eye (optic nerve). Diabetes damages blood vessels all over the body.

7.Behaviour

This model consumes less time than manual examination, provides better accuracy. Precautions taken can control DR.

3.Triggers

Improvement in technology provides better result in medical fields. The trigger in DR patients are fluctuating vision, blurred vision, dark or empty areas in vision, floaters.

4.Emotions:Before/ After

Before:
The responses includes fear, anxiety loss of confidence, guilt.
1.Minor internal [pain 2.permanent blindness fear
3.poor vision, insecurity

After:
Early treatment helps vision corrected and regained.
1.Increases hope among the patient.
2.The possibility of getting blind is low.

10.Your solution

Our solution involues using a Deep learning model of Fungus image which detect severity of DR. Reduce of risk by doing

1. Taking regular checkup of eye once in a month.
2. Eating healthy foods that provides nutrients to body
3. Try to intake minimum 150 minutes of moderate aerobic activity
4. Avoid taking of alcohol, smoke.
5. Maintain your blood sugar and blood pressure constantly.
6. Take oral diabetics medications or insulin as directed.
7. Don't seek to heavy light source..

8.Channels & Behaviour

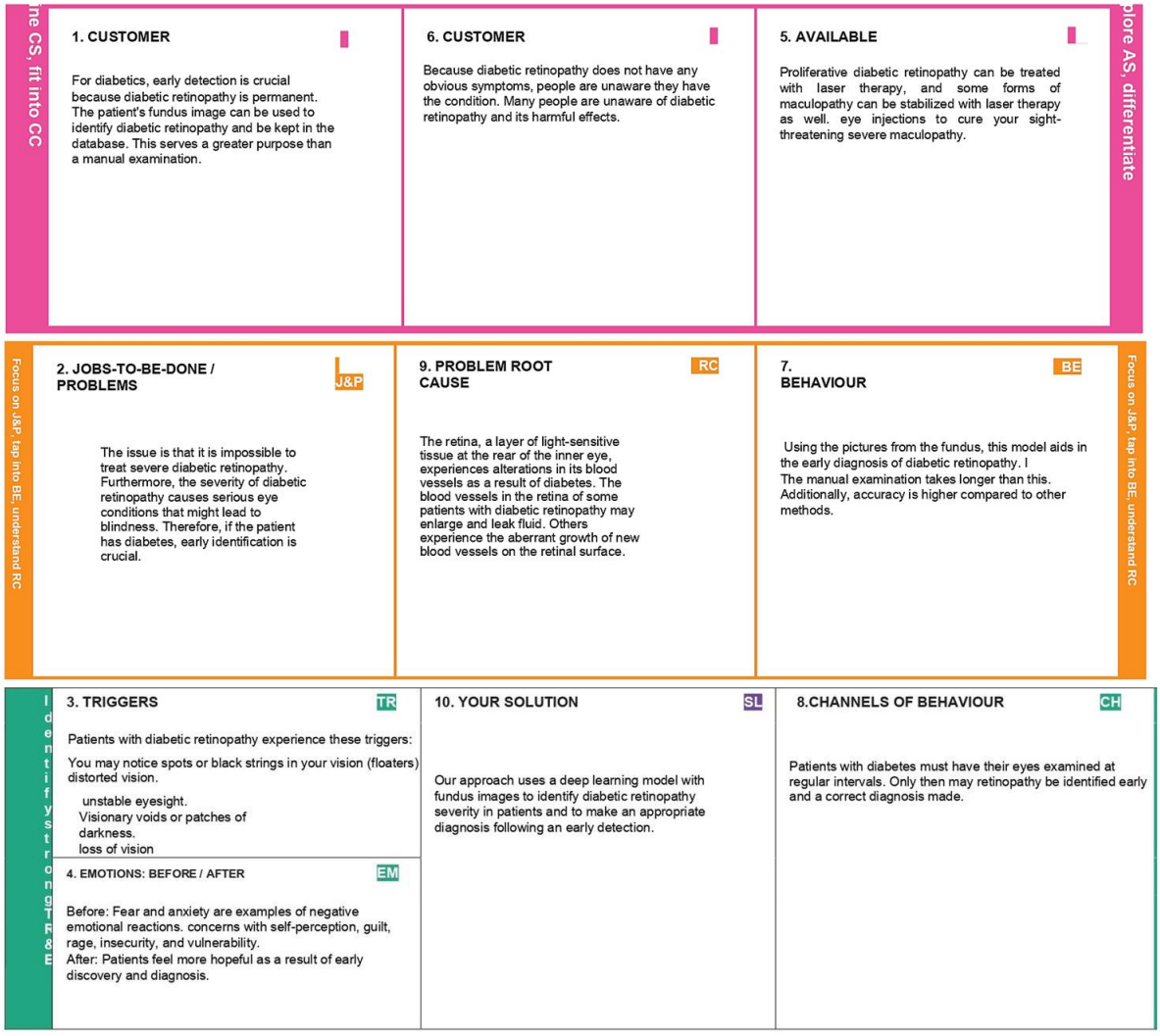
Online:
Earlier detection can prevent from DR, proper diagnosis should be done.

1. Reading reviews of people having blurry vision.
2. Looking for home treatment under difficult situation
3. Analyzing the cause of problem.

Offline:

1. Consulting a doctor.
2. Intaking of medicine as prescribed.
3. Regular checkup of eyes.

4. PROPOSED SOLUTION FIT



5.REQUIREMENT ANALYSIS:-

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Identifying the population eligible for screening and selecting dataset	Determine the group to be screened based on best evidence and use registers to make sure people's details are collected and up to date. It is necessary to select the appropriate dataset to enhance the model's performance.
FR-2	Invitation and information	Invite the full cohort for screening, supplying information tailored appropriately for different groups to enable informed choice to participate
FR-3	Analysis	It should analyze the medical condition [DR] in order to predict/detect the disease accurately.
FR-4	Diagnosis	The training should ensure proper diagnosis and make sure to identify the true and false of the medical condition

FR-5	Training	Collect the dataset related to the DR fromsource and Train the Model from the dataset for prediction.

FR-6	Testing	Test the model for prediction with different data to ensure it has trained well to predict/detect the medical condition
FR-7	Intervention /Treatment	Intervene/treat cases appropriately; in some conditions, surveillance or follow up will also be required. The testing of the model gives us the level of the medical condition so that we can go for the required treatment.
FR-8	Reporting	Collect, analyze and report on outcomes to identify false negatives and improve effectiveness and cost effectiveness of screening programme

Non-functional Requirements:

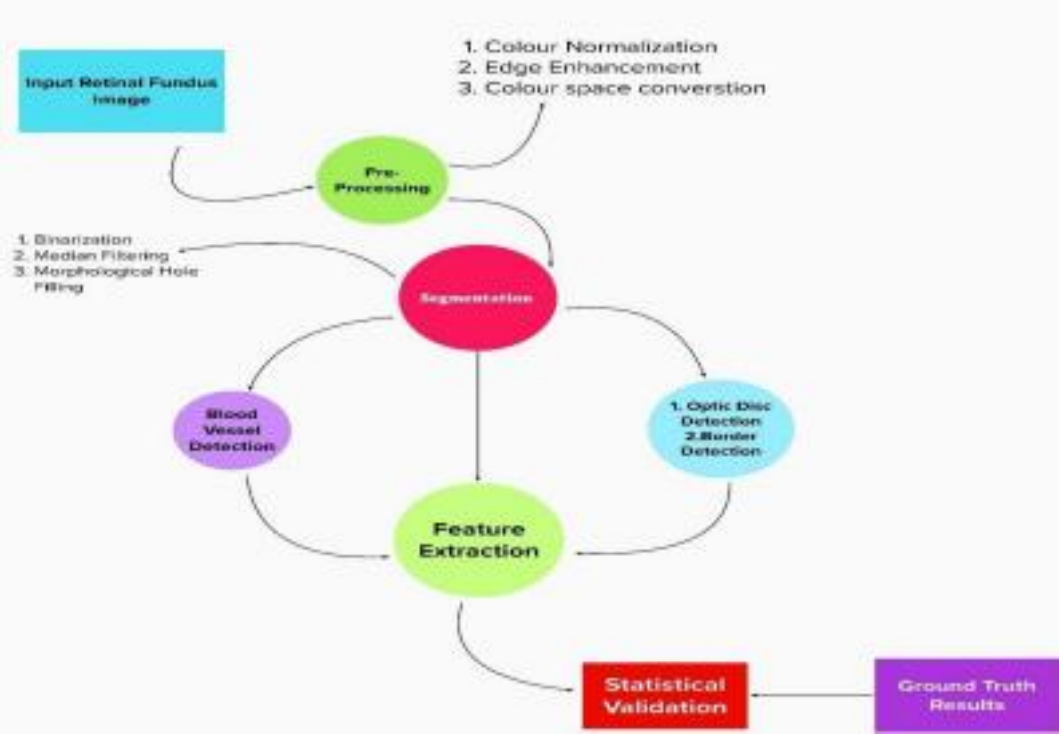
Following are the non-functional requirements of the proposed solution.

NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	The product must be easily usable by any type of users (literate and illiterate), the people how are old and affected by DR can also use this tool for Diagnosis. Assuring that a software can effectively perform one or more defined functions.
NFR-2	Security	Data security is important to store the customer data in the secured manner. The information should not be leaked outside.

NFR-3	Reliability	There is a chance of hardware failure or false positives when the testing data is more of different than the training dataset. It will process the images more quickly, so that we can process the more number of images within the limited time.
NFR-4	Performance	This will give more than 98% accuracy. The performance of the model is meant to give speedy results for the patients.
NFR-5	Availability	It can be made available across the earth using network connection. It can be made affordable for poor. Quality, and accessibility is made easier using this technology.
NFR-6	Scalability	It can be developed further to detect Diabetic macular Edema and glaucoma diseases. The product must hold stable even when multiple users are using it at the same times.

6.PROJECT DESIGN:-
6.1 DATA FLOW DIAGRAM:-

Data Flow Diagram:



The classic visual representation of how information moves through a system is a data flow diagram (DFD). The ideal amount of the system needs can be graphically represented by a tidy and understandable DFD. It demonstrates how information enters and exits the system, whatmodifies the data, and where information is kept.

- Diabetic retinopathy diseaseis frequently detected and examined using retinal fundus Pre-processing of raw retinal fundus images isperformed using extraction of the green channel, histogramequalization, image enhancement,and resizing techniques.

- One of the main tasks in retinalimage processing is thesegmentation of the retinal vasculature from images of the eye fundus.
- By omitting the optic disc (OD) regionof the retina, the computer-assisted automatic recognition and segmentation of blood vessels.
- Mathematicalbinary morphological techniques are used to identify the retinal bloodvessels.
- The term "feature extraction from the fundus images for the diagnosis of Diabetic Retinopathy" refers to a sophisticated eye screeningtechnique that allows for the early detection of eye-related disorders.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Patient (Web user)	Registration	USN-1	As a user, I can register through website either email id or phone number with password.	I can create my account.	High	Sprint-3
	Login	USN-2	As a user, I can login to the site by the given Login credentials.	I can login and access my account.	High	Sprint-3
	Upload image	USN-3	As a user, I can upload my data in the form of pdf, doc etc.	I can upload my data's.	Medium	Sprint-3
Administration (Web developer)	Admin login	USN-4	As an Admin I can login to the site and analyse the user data.	I can login and analyse the user data.	High	Sprint-3
	Data collection	USN-5	As an admin, I can collect the dataset related to the DR from source.	I can collect the dataset.	Low	Sprint-1

	Create model	USN-6	As an admin, I can create the model and train the model from the dataset for prediction.	I can create and train the model.	High	Sprint-1
	Test the model	USN-7	As an admin, I can test the model for predictio n.	I can test the model.	High	Sprint-2
Patient (Web user)	Diagnosis	USN-8	As a user I can get the diagnosis result on the application and follow up with treatments.	He/she can get the results and continue the treatment.	High	Sprint-2

6.2 TECHNOLOGY ARCHITECTURE:-

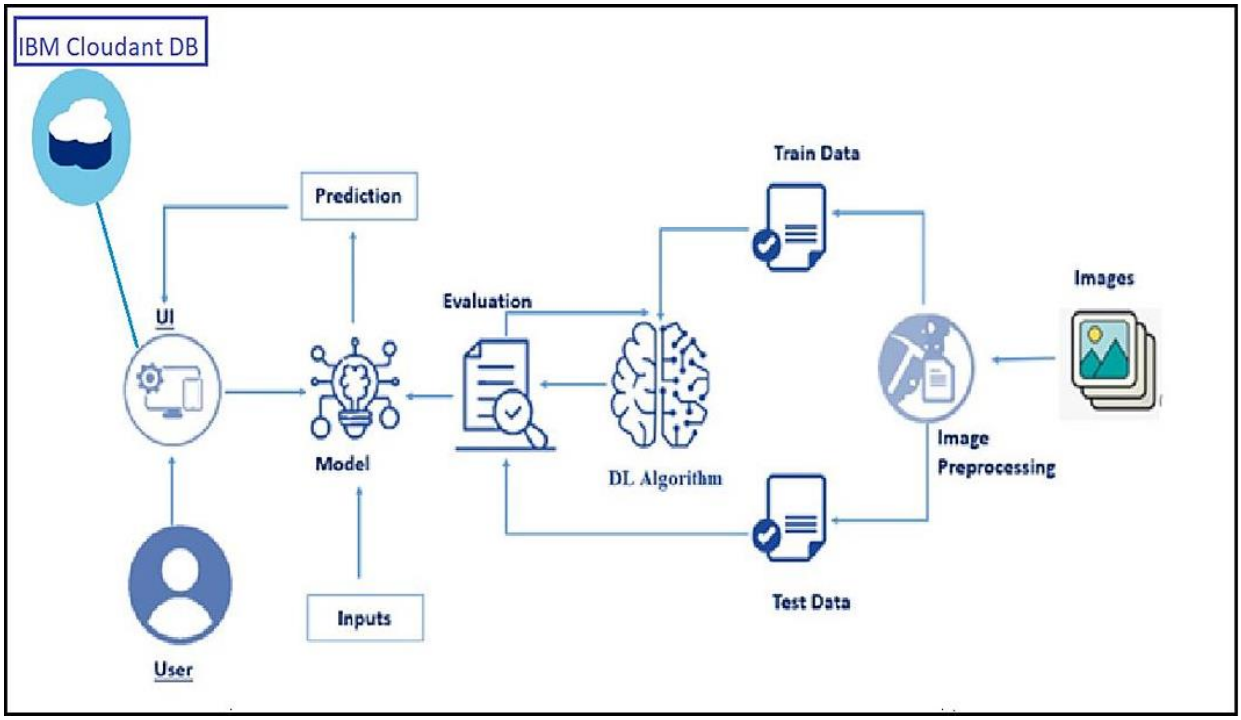


Table-1:Components& Technologies:

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI	HTML, CSS, JavaScript,Python
2	Application Logic-1	Data Preprocessing	
3.	Application Logic-2	CNN Model Creating	
4.	Application Logic-3	Web Application(UI)	
5.	Database	Images(Jpeg,PNG,Jpg,etc..,)	Upload Folder Keras, Tensorflow,Numpy(Importing Essential Libraries)
6.	File Storage	File Storage requirements	IBM Cloud Storage Keras, Tensorflow,Numpy-(Importing Essential Libraries)
7	External API	Keras	Flask Image processing API
8.	Deep Learning Model	Inception v3Architecture	network
9.	Infrastructure (Server / Cloud)	Application Deployment on Webserver	

Pretrained convolutional neural model that is 18 layers deep.
Flask- A python WSGI HTTP server

Table-2:Application characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Flask	Flask Frameworks
2.	Security Implementations	CSRF Protection,Secure Flag For Cookies	Flask-WTF, Session Cookie Secure
3.	Scalable Architecture	Micro-Services	Micro Web Application FrameworkBy Flask

6.3 USER STORIES:-

Project Planning Phase

Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3		USN-8	As a user, I can benefit from the result as it will help me know whether treatment is necessary or not.	8	Medium	Keerthana Srimeena S Kanthimathi V
Sprint-2		USN-9	As a user, I can get the results on the spot immediately after the screening process.	7	Low	Yogapriya D
Sprint-4	Results	USN-10	As a user, I can complete the screening process within minutes for a single patient.	10	Medium	Lekhashree M Yogapriya D
Sprint-3	Cost effectivenes s	USN-11	As a user, I can reach many people suffering from diabetes.	4	Medium	Lekhashree M Keerthana Srimeena S

Sprint-2		USN-12	As a user, I can create awareness among diabetic patients to undergo frequent screening	7	Low	Kanthimathi V Yogapriya D

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7.PROJECT PLANNING AND SCHEDULING:-

7.1 SPRINT PLANNING AND ESTIMATION:-

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Screening method	USN-1	As a user, I can find the method more efficient and accurate	7	High	Kanthimathi V
Sprint-2		USN-2	As a user, I can use it with minimal physical interaction with the device.	6	Medium	Yogapriya D
Sprint-4	Physical Features	USN-3	As a user, I can find it portable and lightweight.	10	Low	Lekhashree M Yogapriya D
Sprint-3	Safety	USN-4	As a user, I can be safe as the detection method is free from radiation.	8	High	Keerthana Srimeena S Kanthimathi V
Sprint-1	Testing	USN-5	As a user, I can undergo testing without any fear of pain as this method is pain-free.	7	Low	Keerthana Srimeena S
Sprint-1		USN-6	As a user, I will be	3	Medium	Lekhashree M

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I should be able to register myself with username, password, mobile number, email-id, location	5	High	Kanthimathi V Yogapriya D
Sprint-2	Login	USN-2	As a user, I should be able to register myself and should have forget password for recovery	5	High	Kanthimathi V Yogapriya D
Sprint-1		USN-3	As a user, I can login into my application using my username and password	5	High	Kanthimathi V Yogapriya D
Sprint-2		USN-4	As a user, I should be able to post my queries in the Application	7	High	Kanthimathi V Yogapriya D
Sprint-4	Dashboard	USN-5	As a user, I should	5	Medium	Keerthana Srimeena S

			be able to modify the credentials given by me like my location to get correct suggestions of hospitals nearby			Lekhashree M
Sprint-4	Database	USN-6	As an administrator I should be able to update the contact details and addresses of hospitals	5	Medium	Keerthana Srimeena S Lekhashree M
Sprint-3		USN-7	As an administrator I should be able to read and respond to all the user queries from comment Section	5	Medium	Keerthana Srimeena S Lekhashree M
Sprint-3	User Interface (Detection)	USN-8	As a user, I should be able to upload the image of my retina and should get accurate results of the diagnosis	9	High	Keerthana Srimeena S Lekhashree M

			be able to modify the credentials given by me like my location to get correct suggestions of hospitals nearby			Lekhashree M

Sprint-4	Database	USN-6	As an administrator I should be able to update the contact details and addresses of hospitals	5	Medium	Keerthana Srimeena S Lekhashree M
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Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story points	Duration	Sprint start date	Sprint end Date	Story points completed	Sprint release date
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022		
Sprint-2	12	6 Days	31 Oct 2022	05 Nov 2022		
Sprint-3	14	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022		

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

AV = Sprint/Duration = 20/10 = 2

AV1=sprint duration/velocity=10/6=1.67
AV2=sprint duration/velocity=12/6=2
AV3=sprint duration/velocity=14/6=2.3
AV4=sprint duration/velocity=10/6=1.67

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

Daily progress:

Sprint-1

Task	Hours	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Total
USN-1	15	3	2	3	2	2	3	15
USN-3	15	4	3	2	2	2	2	15

Sprint-2

	Hours	Day 1	Day-2	Day-3	Day-4	Day-5	Day-6
Actual Effort	30	23	18	13	9	5	0
Remaining Effort	30	25	20	15	10	5	0

Task	Hours	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Total
USN-2	12	2	2	2	2	2	2	12
USN-4	24	4	0	5	5	5	5	24

Sprint-3

Task	Hours	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Total
USN-7	15	2	2	4	3	2	2	15
USN-8	27	5	5	5	4	4	4	27

Sprint-4

Task	Hours	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Total
USN-5	12	2	2	2	2	2	2	12

USN-6	12	2	2	2	2	2	2	12

Actual and remaining efforts:

Sprint-2

	Hours	Day 1	Day-2	Day-3	Day-4	Day-5	Day-6
Actual Effort	30	23	18	13	9	5	0
Remaining Effort	30	25	20	15	10	5	0

Sprint-3

	Hours	Day 1	Day-2	Day-3	Day-4	Day-5	Day-6
Actual Effort	42	35	28	19	12	6	0
Remaining Effort	42	35	28	21	14	7	0

Sprint-4

	Hours	Day 1	Day-2	Day-3	Day-4	Day-5	Day-6
Actual Effort	24	20	16	12	8	4	0
Remaining Effort	24	20	16	12	8	4	0

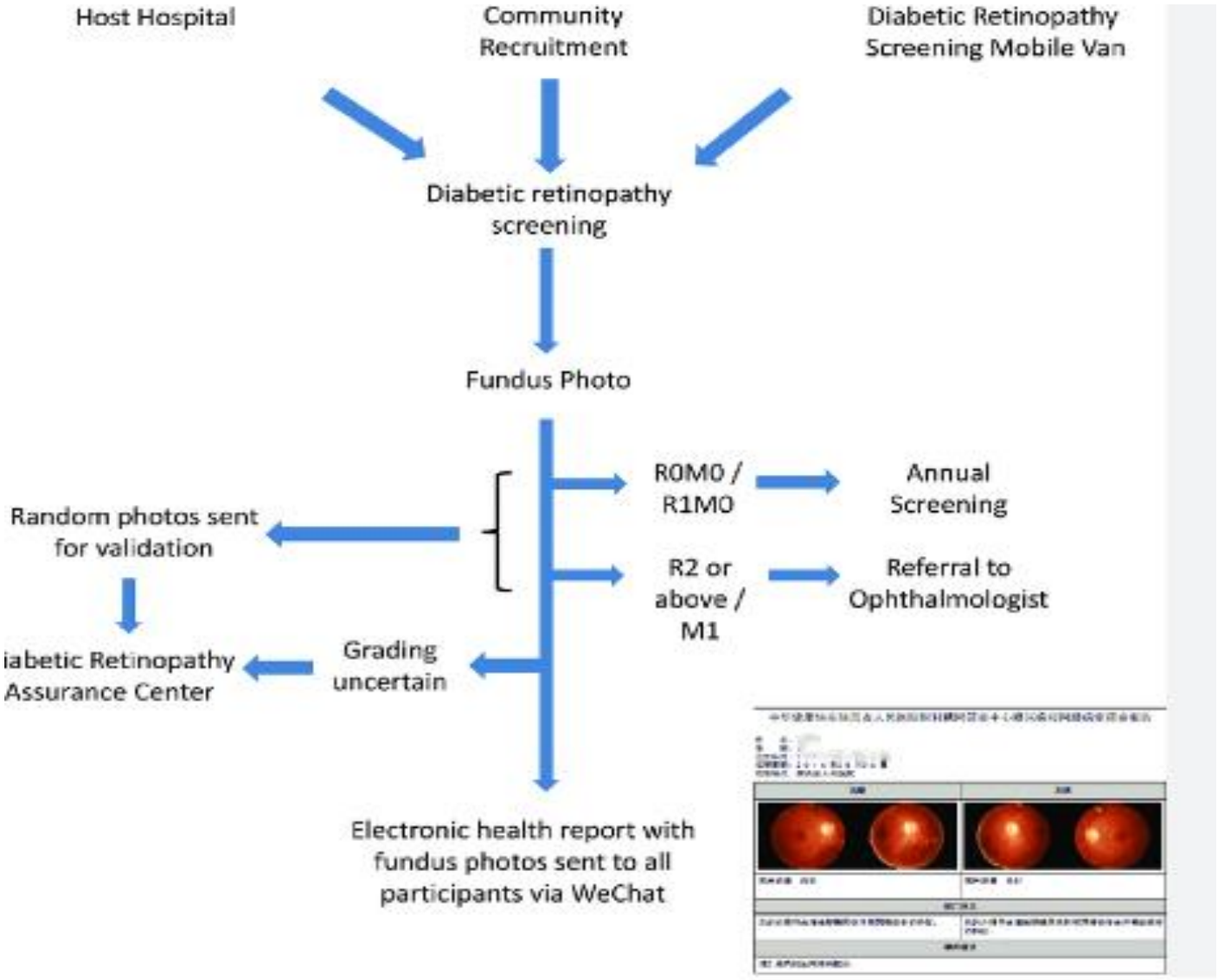
Project Tracker, Velocity & Burndown Chart: (4 Marks) Sprint	Total Story points	Duration	Sprint start date	Sprint end date	Story points completed	Sprint release date
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022		
Sprint-2	12	6 Days	31 Oct 2022	05 Nov 2022		
Sprint-3	14	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022		

Velocity:

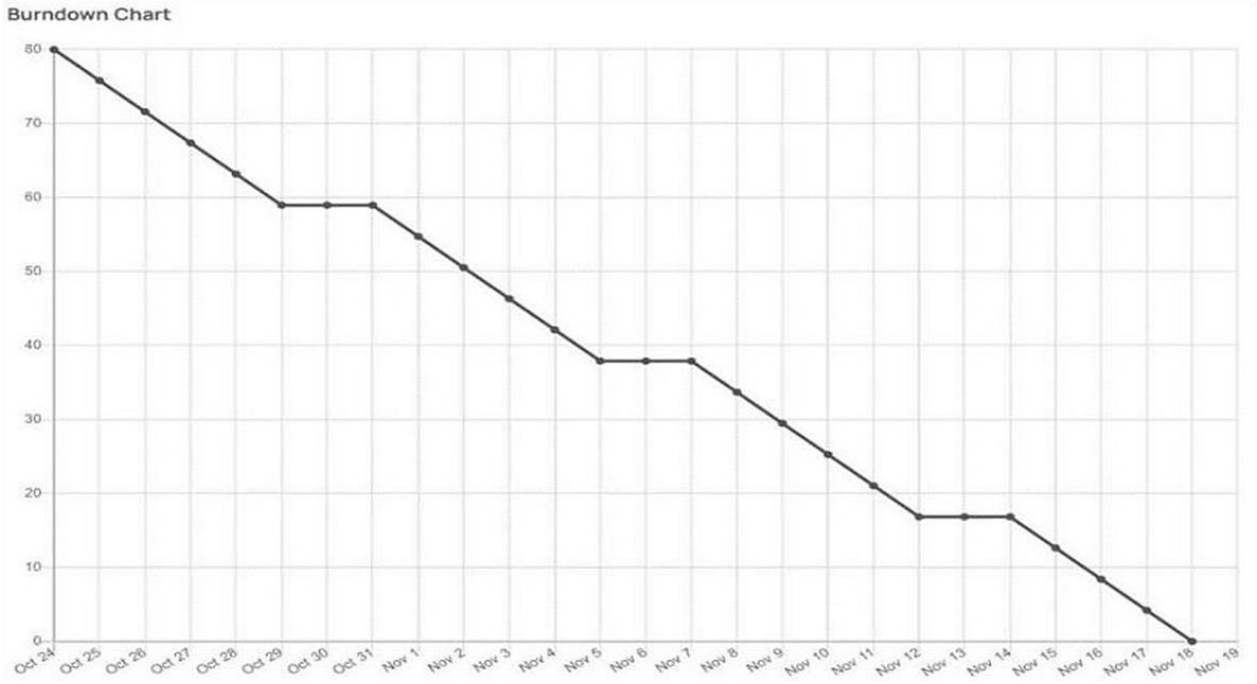
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

AV = Sprint/Duration = 20/10 = 2

AV1=sprint duration/velocity=10/6=1.67
AV2=sprint duration/velocity=12/6=2
AV3=sprint duration/velocity=14/6=2.3
AV4=sprint duration/velocity=10/6=1.6

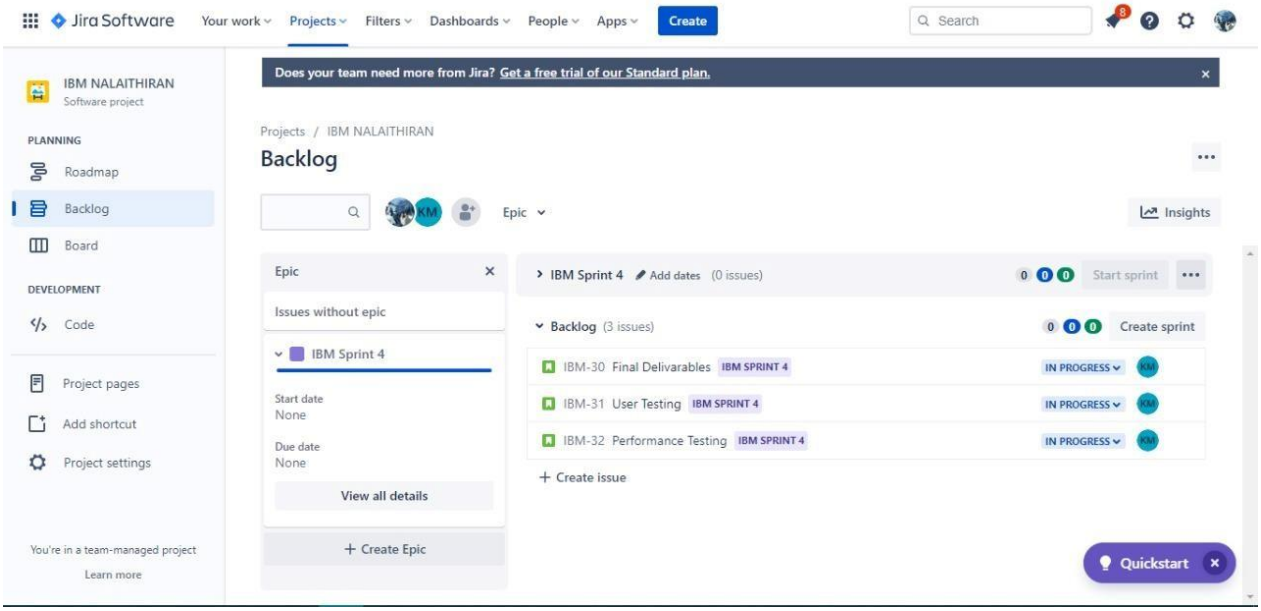

Host Hospital
Community Recruitment
Diabetic Retinopathy Screening Mobile Van
Diabetic retinopathy screening
Fundus Photo
R0M0 / R1M0
Annual Screening
Random photos sent for validation
R2 or above / M1
Referral to Ophthalmologist
iabetic Retinopathy Assurance Center
Grading uncertain
Electronic health report with fundus photos sent to all participants via WeChat

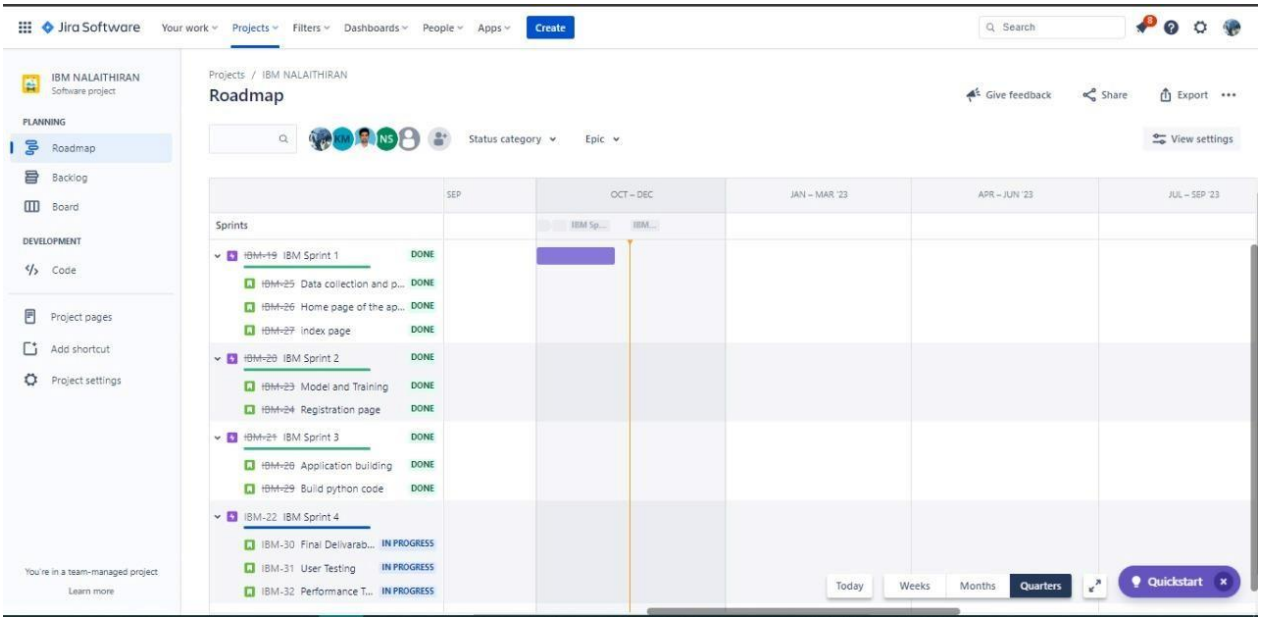
Burn Down Chart & JIRA :



A burn down chart plots the amount of work remaining to perform against the amount of time. In agilesoftware development approaches like Scrum, it is frequently employed. Burn down charts, however,can beused for any project that makes observable progress over time.

JIRA SCREENSHOTS:-





JIRA Folder is created to show the Scrum methodologies and Burn Down chart progress.

8.CODING AND SOLUTIONING:-

Feature 1:-

We have devloped a website which authenticates users and help them upload and check the seriousness of the diabetics.

Feature 2:-

We have devloped a multilayer deep convolutional nueral network that classifies the user image of a eye to which extense has the disease diabetics has been affected.The model will classify the images into 5 categories of diabetics and report them on asking for prediction. We have also devloped a messaging service for recieiving message for the type of diabetics.

9.TESTING:-

9.1 TEST CASES:-

9.2 USER ACCEPTANCE TESTING:-

1. **Purpose of Document:-**

This document serves as a quick reference for the Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy project's test coverage and open issues as of the project's release for user acceptance testing.

2. **Defect Analysis:-**

This shows how many bugs were fixed or closed at each severity level and how they were fixed.

Resolution	Severity 1	Severity 2	Severity 3	Severity4	Subtotal
By Design	5	4	2	3	14
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	9	2	4	15	30

Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won'tFix	0	5	2	1	8
Totals	17	14	13	21	65

3. Test-CaseAnalysis

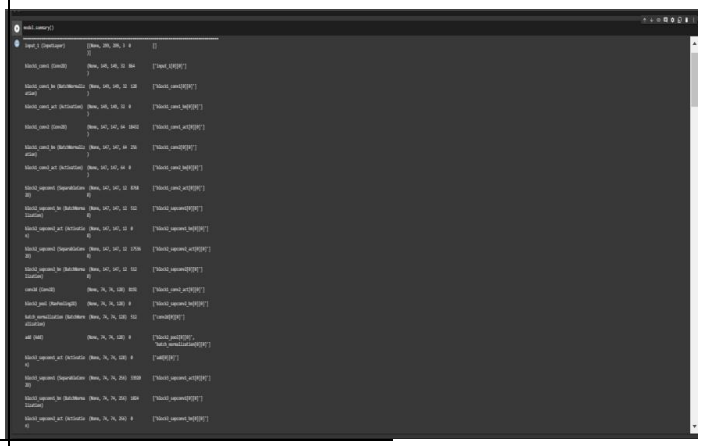
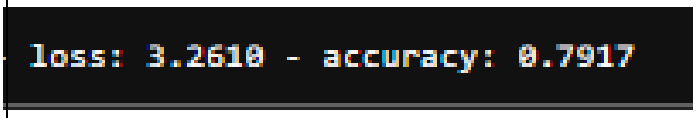
This report shows the number of test cases that have passed, failed,and untested.

Section	TotalCases	Not Tested	Fail	Pass
PrintEngine	9	0	0	9
ClientApplication	45	0	0	45
Security	2	0	0	2
Out-sourceShipping	3	0	0	3
ExceptionReporting	9	0	0	9
FinalReportOutput	4	0	0	4
VersionControl	2	0	0	2

9.RESULTS:-

9.1 Performance Metrics:-

Model Performance Testing:

S. NO	Parameter	Values	Screenshot
1.	Model Summary	**Total params: 21,885,485** **Trainable params: 1,024,005** **Non-trainable params: 20,861,480**	
2.	Accuracy	Training Accuracy – **0.7917** Validation Accuracy – **loss 3.2610**	
3.	Confidence Score(Only Yolo Projects)	Class Detected - Confidence Score -	-- -- -- --

Project team shall fill the following information in model performance testing template.

10.ADVANTAGES AND DISADVANTAGES:-

10.1 ADVANTAGES:-

There are several advantages of using deep learning for fundus image analysis for early detection of diabetic retinopathy.

First, deep learning is well-suited for image analysis tasks. This is because deep learning algorithms can automatically learn features from images, which is essential for accurate image analysis.

Second, deep learning is efficient at handling large amounts of data. This is important for medical image analysis, as medical images are often very large.

Third, deep learning is scalable. This means that it can be used to train models on very large datasets, which is important for medical image analysis tasks where data is often limited.

Fourth, deep learning is able to learn from data with little supervision. This is important for medical image analysis, as often there is limited labeled data available.

Finally, deep learning is robust. This means that it is less likely to overfit to the data, which is important for medical image analysis where data is often limited.

10.2 DISADVANTAGES:-

There are several disadvantages of deep learning for early detection of diabetic retinopathy. One disadvantage is that deep learning requires a large amount of data to train the models. This can be a challenge for researchers who do not have access to a large dataset. Another challenge is that deep learning models can be very complex, which can make them difficult to interpret. Finally, deep learning models can be computationally intensive, which can make them difficult to deploy in resource-limited settings.

11.CONCLUSION:-

Diabetic retinopathy (DR) is a leading cause of blindness in the United States. Early detection and treatment of DR is critical to preventing vision loss. However, DR is often asymptomatic in its early stages, making it difficult to detect.

Deep learning (DL) is a type of artificial intelligence that can be used to automatically detect patterns in data. DL has been shown to be effective for detecting DR in images of the retina.

In this study, a DL algorithm was used to automatically detect DR in fundus images. The algorithm was able to accurately detect DR in early stages, before it is symptomatic. This could potentially lead to earlier diagnosis and treatment of DR, which could help to prevent vision loss.

12.FUTURE SCOPE:-

There is a great potential for deep learning in fundus image analysis for early detection of diabetic retinopathy. However, there are a few challenges that need to be addressed. First, the current data sets are small and lack diversity. Second, the images are often low quality and need to be pre-processed before they can be used for deep learning. Third, the ground truth labels for the images are often not available. Finally, the current deep learning models are not able to generalize well to real-world data.

13.APPENDIX:-

app.py:-

```
import numpy as np
import os
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.applications.inception_v3 import preprocess_input
from flask import Flask, request,flash, render_template, redirect,url_for
from cloudant.client import Cloudant
from twilio.rest import Client
model = load_model(r"Updated-xception-diabetic-retinopathy.h5")
app = Flask(_name_)
app.secret_key="abc"
app.config['UPLOAD_FOLDER'] = "User_Images"
# Authenticate using an IAM API key

client = Cloudant.iam('08bcbaf0-260b-48e0-abdb-08db348afcf2-bluemix',
                      'yhZfUubpS3vS1vEKZSS37teD6IAUi8oLynOCQLIwnQsa', connect=True)
# Create a database using an initialized client
my_database = client.create_database('my_database')
if my_database.exists():
   print("Database '{0}' successfully created.".format('my_db'))
# default home page or route

user = ""

@app.route('/')
def index():
   return render_template('index.html', pred="Login", vis ="visible")

@ app.route('/index')
def home():
   return render_template("index.html", pred="Login", vis ="visible")


# registration page
@ app.route('/register',methods=["GET","POST"])
```

```
def register():
    if request.method == "POST":
        name = request.form.get("name")
        mail = request.form.get("emailid")
        mobile = request.form.get("num")
        pswd = request.form.get("pass")
        data = {
            'name': name,
            'mail': mail,
            'mobile': mobile,
            'psw': pswd
        }
        print(data)
        query = {'mail': {'$eq': data['mail']}}
        docs = my_database.get_query_result(query)
        print(docs)
        print(len(docs.all()))
        if (len(docs.all()) == 0):
            url = my_database.create_document(data)
            return render_template("register.html", pred=" Registration Successful , please login using your details ")
        else:
            return render_template('register.html', pred=" You are already a member , please login using your details ")
    else:
        return render_template('register.html')


@ app.route('/login', methods=['GET','POST'])
def login():
    if request.method  == "GET":
        user = request.args.get('mail')
        passw = request.args.get('pass')
        print(user, passw)
        query = {'mail': {'$eq': user}}
        docs = my_database.get_query_result(query)
        print(docs)
        print(len(docs.all()))
        if (len(docs.all()) == 0):
            return render_template('login.html', pred="")
        else:
            if ((user == docs[0][0]['mail'] and passw == docs[0][0]['psw'])):
                flash("Logged in as " + str(user))
                return render_template('index.html', pred="Logged in as "+str(user), vis ="hidden", vis2="visible")
            else:
                return render_template('login.html', pred="The password is wrong.")
    else:
        return render_template('login.html')
```

```
@ app.route('/logout')
def logout():
    return render_template('logout.html')

@app.route("/predict",methods=["GET",  "POST"])
def predict():
    if request.method == "POST":
        f = request.files['file']
        # getting the current path 1.e where app.py is present
        basepath = os.path.dirname(_file_)
        #print ( " current path " , basepath )
        # from anywhere in the system we can give image but we want that
        filepath = os.path.join(str(basepath), 'User_Images', str(f.filename))
        #print ( " upload folder is " , filepath )
        f.save(filepath)
        img = image.load_img(filepath, target_size=(299, 299))
        x = image.img_to_array(img)  # ing to array
        x = np.expand_dims(x, axis=0)  # used for adding one more dimension
        #print ( x )
        img_data = preprocess_input(x)
        prediction = np.argmax(model.predict(img_data), axis=1)
        index = [' No Diabetic Retinopathy ', ' Mild NPDR ',
                 ' Moderate NPDR ', ' Severe NPDR ', ' Proliferative DR ']
        result = str(index[prediction[0]])
        print(result)
        account_sid = 'AC8e0f2f5263d71c8f630a6486779cf08b'
        auth_token = '30b489873afb3c47340070eabd6bfb15'

        client = Client(account_sid, auth_token)

        ''' Change the value of 'from' with the number
        received from Twilio and the value of 'to'
        with the number in which you want to send message.'''
        message = client.messages.create(
                                  from_='+16075363206',
                                  body ='Results: '+ result,
                                  to ='+919445979800'
                              )
        return render_template('prediction.html', prediction=result, fname = filepath)
    else:
        return render_template("prediction.html")

if__name__== "_main_":
    app.debug = True
    app.run()
```

cloud.ipynb:-

```
from cloudant.client import Cloudant
client=Cloudant.iam('655489f8-18d0-4a44-a701-5de60570a973-
bluemix','Jc4eF6CXk72w0wGCsM_KUuXKVjsCcT4a54UKBXckK5Bv',connect=True)
my_database=client.create_database('my-database')
```

index.html:-

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <!-- CSS only -->
    <link
      href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/css/bootstrap.min.css"
      rel="stylesheet"
      integrity="sha384-iYQeCzEYFbKjA/T2uDLTpkwGzCiq6soy8tYaI1GyVh/UjpbCx/TYkiZhlZB6+fzT"
      crossorigin="anonymous"
    />
    <!-- JavaScript Bundle with Popper -->
    <script
      src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/js/bootstrap.bundle.min.js"
      integrity="sha384-u1OknCvxWvY5kfmNBILK2hRnQC3Pr17a+RTT6rIHI7NnikvbZlHgTPOOmMi466C8"
      crossorigin="anonymous"
    ></script>
    <style>
        #navbarRight {
            margin-left: auto;
            padding-right:10px;
        }
        .navbar-brand{
            padding-left:15px;
        }
    </style>
    <title>DR Predcition</title>
  </head>
  <body>
    <nav class="navbar navbar-expand-lg navbar-light bg-dark">
        <div>
        <a class="navbar-brand" href="#" style="color:aliceblue">Diabetic Retinopathy Classification</a>
        </div>
        {{msg}}
        <div class="navbar-collapse collapse w-100 order-3 dual-collapse2" id="navbarNav">
          <ul class="navbar-nav mr-auto text-center" id="navbarRight">
```

```
          <li class="nav-item active">
            <a class="nav-link" href="index" style="color: aliceblue;">Home </a>
          </li>
          <li class="nav-item" style="visibility:{{ vis2 }}">
            <a class="nav-link" href="predict" style="color: aliceblue;">Prediction</a>
          </li>
          <li class="nav-item">
            <a class="nav-link" href="login" style="color: aliceblue;">{{pred}}</a>
          </li>
          <li class="nav-item" style="visibility:{{ vis }}">
            <a class="nav-link" href="register" style="color: aliceblue;">Register</a>
          </li>
        </ul>
      </div>
    </nav>
    <br><br>
      <div class="jumbotron container">
        <h1 class="display-4">Diabetic Retinopathy</h1>
        <p class="lead">Diabetic retinopathy is a diabetes complication that affects eyes. It's caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina).
          At first, diabetic retinopathy might cause no symptoms or only mild vision problems. But it can lead to blindness.
          The condition can develop in anyone who has type 1 or type 2 diabetes. The longer you have diabetes and the less controlled your blood sugar is, the more likely you are to develop this eye complication.</p>
        <hr class="my-4">
        <div class="d-flex justify-content-center">
          <img style="width:70vw;" src="static/diabetic-retinopathy-home.jpg">
          </div>
      </div>
  </body>
</html>
```

login.html:-

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <!-- CSS only -->
    <link
      href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/css/bootstrap.min.css"
      rel="stylesheet"
      integrity="sha384-iYQeCzEYFbKjA/T2uDLTpkwGzCiq6soy8tYaI1GyVh/UjpbCx/TYkiZhlZB6+fzT"
      crossorigin="anonymous"
    />
    <!-- JavaScript Bundle with Popper -->
```

```
  <script
    src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/js/bootstrap.bundle.min.js"
    integrity="sha384-u1OknCvxWvY5kfmNBILK2hRnQC3Pr17a+RTT6rIHI7NnikvbZlHgTPOOmMi466C8"
    crossorigin="anonymous"
  ></script>
  <style>
     #navbarRight {
        margin-left: auto;
        padding-right:10px;

     }
     .navbar-brand{
        padding-left:15px;
     }
  </style>
  <title>DR Predcition</title>
</head>
<form action="",method='POST'>
  <nav class="navbar navbar-expand-lg navbar-light bg-dark">
     <div>
     <a class="navbar-brand" href="#" style="color:aliceblue">User Login</a>
     </div>
     <div class="navbar-collapse collapse w-100 order-3 dual-collapse2" id="navbarNav">
       <ul class="navbar-nav mr-auto text-center" id="navbarRight">
         <li class="nav-item active">
           <a class="nav-link" href="index" style="color: aliceblue;">Home </a>
         </li>
         <li class="nav-item">
           <a class="nav-link" href="login" style="color: aliceblue;">Login</a>
         </li>
         <li class="nav-item">
           <a class="nav-link" href="register"style="color: aliceblue;">Register</a>
         </li>
       </ul>
     </div>
   </nav>
   <br><br>
   <form class="form-inline" action="/login" method="GET">
   <div class="container" style="width: 600px; height: 600px;">
     <div class="mb-3 d-flex justify-content-center"><script src="https://cdn.lordicon.com/xdjxvujz.js"></script>
        <lord-icon
           src="https://cdn.lordicon.com/elkhjhci.json"
           trigger="hover"
           style="width:200px;height:200px">
        </lord-icon></div>
        <div class="mb-3">
```

```
            <input type="email" class="form-control" id="exampleInputEmail1" name="mail" aria-describedby="emailHelp"
placeholder="Enter Registered Mail ID">
          </div>
          <div class="mb-3">
            <input type="password" class="form-control" id="exampleInputPassword1" name="pass" placeholder="Enter
Password">
          </div>
          <div class="mb-3">
          <button type="submit form-control" class="btn btn-dark btn-primary" style="width:100%;"
type="submit">Login</button>
        </div>
        {{pred}}
    </div>
  </form>
 </body>
</html>
```

logout.html

```
<!DOCTYPE html>
<html lang="en">
 <head>
  <meta charset="UTF-8" />
  <meta http-equiv="X-UA-Compatible" content="IE=edge" />
  <meta name="viewport" content="width=device-width, initial-scale=1.0" />
  <!-- CSS only -->
  <link
   href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/css/bootstrap.min.css"
   rel="stylesheet"
   integrity="sha384-iYQeCzEYFbKjA/T2uDLTpkwGzCiq6soy8tYaI1GyVh/UjpbCx/TYkiZhlZB6+fzT"
   crossorigin="anonymous"
  />
  <!-- JavaScript Bundle with Popper -->
  <script
   src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/js/bootstrap.bundle.min.js"
   integrity="sha384-u1OknCvxWvY5kfmNBILK2hRnQC3Pr17a+RTT6rIHI7NnikvbZlHgTPOOmMi466C8"
   crossorigin="anonymous"
  ></script>
  <style>
     #navbarRight {
        margin-left: auto;
        padding-right:10px;
     }
     .navbar-brand{
        padding-left:15px;
     }
  </style>
  <title>DR Predcition</title>
```

```
  </head>
  <body>
    <nav class="navbar navbar-expand-lg navbar-light bg-dark">
      <div>
      <a class="navbar-brand" href="#" style="color:aliceblue">Diabetic Retinopathy</a>
      </div>
      <div class="navbar-collapse collapse w-100 order-3 dual-collapse2" id="navbarNav">
        <ul class="navbar-nav mr-auto text-center" id="navbarRight">
          <li class="nav-item active">
            <a class="nav-link" href="index" style="color: aliceblue;">Home </a>
          </li>
          <li class="nav-item">
            <a class="nav-link" href="login" style="color: aliceblue;">Login</a>
          </li>
          <li class="nav-item">
            <a class="nav-link" href="register"style="color: aliceblue;">Register</a>
          </li>
        </ul>
      </div>
    </nav>
    <br><br>
    <div class="d-flex justify-content-center">
      <div class="row d-flex display-3 justify-content-center">
        Successfully Logged Out!
        <br><br>
        <a href="login" class="btn btn-lg btn-dark">Login for more Information</a>
          </div>
      </div>
  </body>
</html>
```

prediction.html:-

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8" />
  <meta http-equiv="X-UA-Compatible" content="IE=edge" />
  <meta name="viewport" content="width=device-width, initial-scale=1.0" />
  <!-- CSS only -->
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/css/bootstrap.min.css" rel="stylesheet"
    integrity="sha384-iYQeCzEYFbKjA/T2uDLTpkwGzCiq6soy8tYaI1GyVh/UjpbCx/TYkiZhlZB6+fzT"
crossorigin="anonymous" />
  <!-- JavaScript Bundle with Popper -->
  <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/js/bootstrap.bundle.min.js"
    integrity="sha384-u1OknCvxWvY5kfmNBILK2hRnQC3Pr17a+RTT6rIHI7NnikvbZlHgTPOOmMi466C8"
    crossorigin="anonymous"></script>
```

```
  <style>
    #navbarRight {
    margin-left: auto;
      padding-right: 10px;
    }

    .navbar-brand {
      padding-left: 15px;
    }

    .row {
      width: 90%;
    }
  </style>
  <title>DR Predcition</title>
</head>

<body>
  <nav class="navbar navbar-expand-lg navbar-light bg-dark">
    <div>
      <a class="navbar-brand" href="#" style="color:aliceblue">Diabetic Retinopathy Classification</a>
    </div>
    <div class="navbar-collapse collapse w-100 order-3 dual-collapse2" id="navbarNav">
      <ul class="navbar-nav mr-auto text-center" id="navbarRight">
        <li class="nav-item active">
          <a class="nav-link" href="index" style="color: aliceblue;">Home </a>
        </li>
        <li class="nav-item">
          <a class="nav-link" href="logout" style="color: aliceblue;">Logout</a>
        </li>
      </ul>
    </div>
  </nav>
  <br><br>
  <div class="container justify-content-center" style="width:700px">
    <form action = "/predict" method = "POST" enctype="multipart/form-data">
    <label for="formFileLg" class="form-label">Upload Image</label>
    <input class="form-control form-control-lg" name ="file" type="file" />
    <br>
    <button class="btn btn-lg btn-dark" type = "submit">Predict</button>
    </form>
    <br>
    <h1>{{prediction}}</h1>
  </div>
  <br><br><br>
  <div class="d-flex justify-content-center" >
      <img src="static/level.png" style="width: 90%">
```

```
  </div>
</body>
</html>
```

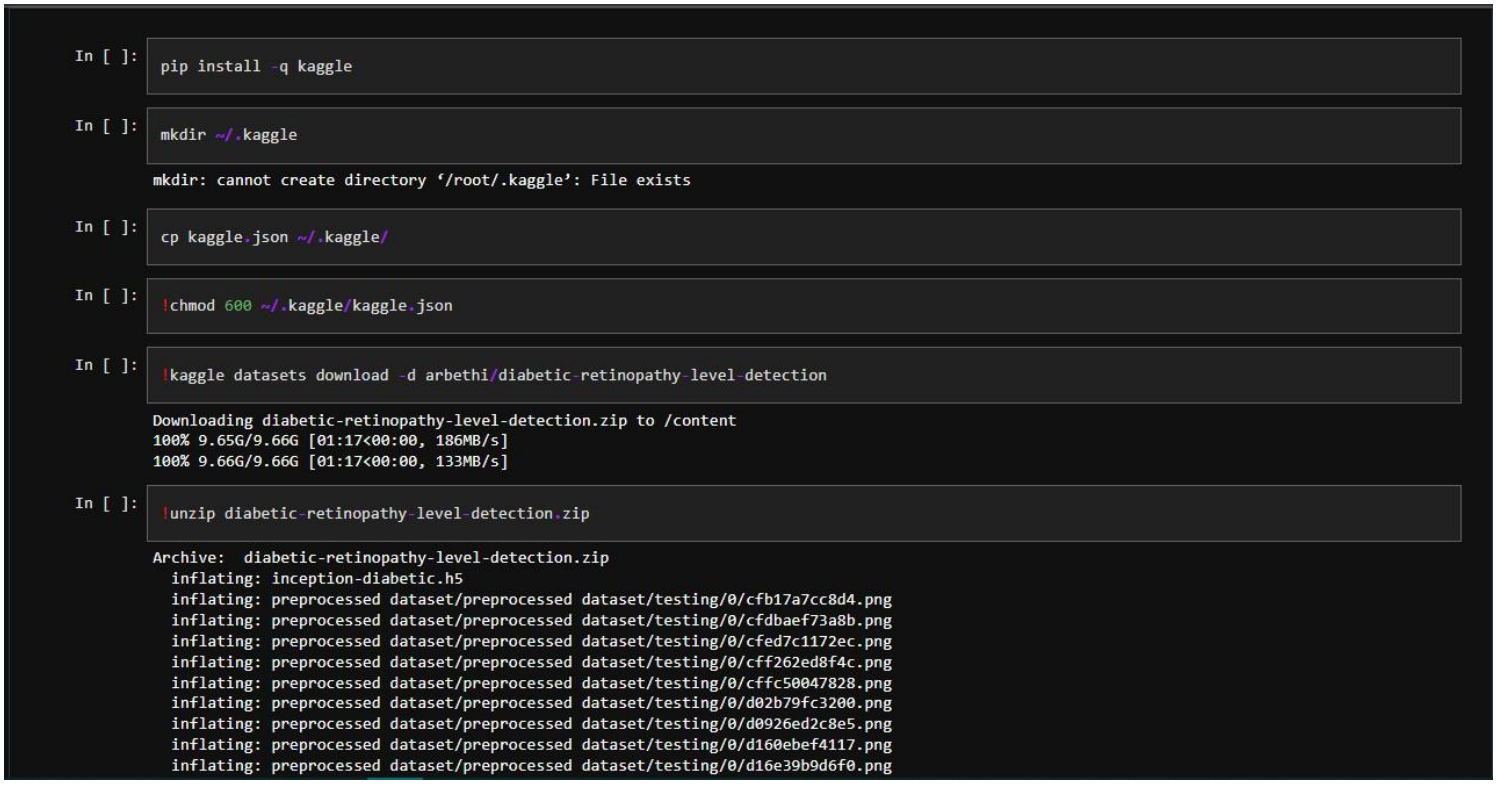
register.html:-

```
<!-- <!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=edge" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <!-- CSS only -->
    <link
      href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/css/bootstrap.min.css"
      rel="stylesheet"
      integrity="sha384-iYQeCzEYFbKjA/T2uDLTpkwGzCiq6soy8tYaI1GyVh/UjpbCx/TYkiZhlZB6+fzT"
      crossorigin="anonymous"
    />
    <!-- JavaScript Bundle with Popper -->
    <script
      src="https://cdn.jsdelivr.net/npm/bootstrap@5.2.1/dist/js/bootstrap.bundle.min.js"
      integrity="sha384-u1OknCvxWvY5kfmNBILK2hRnQC3Pr17a+RTT6rIHI7NnikvbZlHgTPOOmMi466C8"
      crossorigin="anonymous"
    ></script>
    <style>
       #navbarRight {
           margin-left: auto;
           padding-right:10px;

       }
       .navbar-brand{
           padding-left:15px;
       }
    </style>
    <title>DR Predcition</title>
  </head>
  <form action="{{url_for('register')}}" method="post" >
    <nav class="navbar navbar-expand-lg navbar-light bg-dark">
       <div>
       <a class="navbar-brand" href="#" style="color:aliceblue">Registration</a>
       </div>
       <div class="navbar-collapse collapse w-100 order-3 dual-collapse2" id="navbarNav">
         <ul class="navbar-nav mr-auto text-center" id="navbarRight">
           <li class="nav-item active">
             <a class="nav-link" href="index" style="color: aliceblue;">Home </a>
           </li>
```

```
        <li class="nav-item">
          <a class="nav-link" href="login" style="color: aliceblue;">Login</a>
        </li>
        <li class="nav-item">
          <a class="nav-link" href="register"style="color: aliceblue;">Register</a>
        </li>
      </ul>
    </div>
  </nav>
  <br><br>
  <form class="form-inline" method ="POST">
  <div class="container" style="width: 600px; height: 600px;">
    <div class="mb-3 d-flex justify-content-center"><script src="https://cdn.lordicon.com/xdjxvujz.js"></script>
      <lord-icon
        src="https://cdn.lordicon.com/elkhjhci.json"
        trigger="hover"
        style="width:200px;height:200px">
      </lord-icon></div>
                        <div class="mb-3">
        <input type="text" class="form-control" id="exampleInputName" name = "name" aria-describedby="nameHelp"
placeholder="Enter Name">
        </div>
        <div class="mb-3">
          <input type="email" class="form-control" id="exampleInputEmail1" name="emailid" aria-describedby="emailHelp"
placeholder="Enter Mail ID">
        </div>
        <div class="mb-3">
          <input type="number" class="form-control" id="exampleInputNumber1" name="num" aria-
describedby="numberHelp" placeholder="Enter Mobile number">
        </div>
        <div class="mb-3">
          <input type="password" class="form-control" id="exampleInputPassword1" name="pass" placeholder="Enter
Password">
        </div>
        <div class="mb-3">
        <button type="submit form-control" class="btn btn-dark btn-primary" style="width:100%;">Register</button>
      </div>
                        <div class="mb-3 d-flex justify-content-center">
                        <a href="login" class="nav-link"> Already Registered: Login Here</a>
  </div>
  {{pred}}
  </div>
 </form>
</body>
</html> -->
```

Python Notebook screenshots:-



```
In [ ]: pip install -q kaggle

In [ ]: mkdir ~/.kaggle

mkdir: cannot create directory ‘/root/.kaggle’: File exists

In [ ]: cp kaggle.json ~/.kaggle/

In [ ]: !chmod 600 ~/.kaggle/kaggle.json

In [ ]: !kaggle datasets download -d arbethi/diabetic-retinopathy-level-detection

Downloading diabetic-retinopathy-level-detection.zip to /content
100% 9.65G/9.66G [01:17<00:00, 186MB/s]
100% 9.66G/9.66G [01:17<00:00, 133MB/s]

In [ ]: !unzip diabetic-retinopathy-level-detection.zip

Archive:  diabetic-retinopathy-level-detection.zip
  inflating: inception-diabetic.h5
  inflating: preprocessed dataset/preprocessed dataset/testing/0/cfb17a7cc8d4.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/cfdbaef73a8b.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/cfed7c1172ec.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/cff262ed8f4c.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/cffc50047828.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/d02b79fc3200.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/d0926ed2c8e5.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/d160ebef4117.png
  inflating: preprocessed dataset/preprocessed dataset/testing/0/d16e39b9d6f0.png
```

```
inflating: preprocessed dataset/preprocessed dataset/training/4/ebe0175e530c.png
inflating: preprocessed dataset/preprocessed dataset/training/4/ed246ae1ed08.png
inflating: preprocessed dataset/preprocessed dataset/training/4/ed3a0fc5b546.png
inflating: preprocessed dataset/preprocessed dataset/training/4/ee1ec90b980f.png
inflating: preprocessed dataset/preprocessed dataset/training/4/ef26625121b3.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f0098e9d4aee.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f025f33b2c9b.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f03d3c4ce7fb.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f0f89314e860.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f1dc26c4bfa3.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f2d2a0c92034.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f549294e12e1.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f58d37d48e42.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f5e6226bd2e0.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f69835dc7c50.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f6f3ea0d2693.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f72adcac5638.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f850cb51fdba.png
inflating: preprocessed dataset/preprocessed dataset/training/4/f8cf7ed8ef00.png
inflating: preprocessed dataset/preprocessed dataset/training/4/fa59221cf464.png
inflating: preprocessed dataset/preprocessed dataset/training/4/fb696a8e055a.png
inflating: preprocessed dataset/preprocessed dataset/training/4/fce93caa4758.png
inflating: preprocessed dataset/preprocessed dataset/training/4/fdd534271f3d.png
inflating: preprocessed dataset/preprocessed dataset/training/4/ff8a0b45c789.png
```

In [ ]:
```
from tensorflow.keras.layers import Dense,Flatten,Input
```

In [ ]:
```
from tensorflow.keras.models import Model
```

In [ ]:
```
from tensorflow.keras.preprocessing import image
```

In [ ]:
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img
```

In [ ]:
```
from glob import glob
```

In [ ]:
```
import numpy as np
```

In [ ]:
```
import matplotlib.pyplot as plt
```

In [ ]:
```
imageSize=[299,299]
```

In [ ]:
```
trainPath=r"/content/preprocessed dataset/preprocessed dataset/training"
```

In [ ]:
```
testPath=r"/content/preprocessed dataset/preproccessed dataset/testing"
```

In [ ]:
```
train_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_flip=True)
```

In [ ]:
```
test_datagen=ImageDataGenerator(rescale=1./255)
```

In [ ]:
```
training_set=train_datagen.flow_from_directory('/content/preprocessed dataset/preprocessed dataset/training',target_size=(299,299),batch_size=
```

```
Found 3662 images belonging to 5 classes.
```

In [ ]:
```
test_set=test_datagen.flow_from_directory('/content/preprocessed dataset/preprocessed dataset/testing',target_size=(299,299),batch_size=32,cla
```

```
Found 3662 images belonging to 5 classes.
```

In [ ]:
```
test_set=test_datagen.flow_from_directory('/content/preprocessed dataset/preprocessed dataset/testing',target_size=(299,299),batch_size=32,cla
```

```
Found 734 images belonging to 5 classes.
```

In [ ]:
```
xception=Xception(input_shape=imageSize+[3],weights='imagenet',include_top=False)
```

```
Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/xception/xception_weights_tf_dim_ordering_tf_kernels_notop.h
5
83683744/83683744 [==============================] - 0s 0us/step
```

In [ ]:
```
for layer in xception.layers:
  layer.trainable=False
```

In [ ]:
```
x=Flatten()(xception.output)
```

In [ ]:
```
prediction=Dense(5,activation='softmax')(x)
```

In [ ]:
```
model=Model(inputs=xception.input,outputs=prediction)
```

In [ ]:
```
model.summary()
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 299, 299, 3       0
                             )]
```


```
Model: "model"
```


```
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 299, 299, 3       0
                             )]

 block1_conv1 (Conv2D)       (None, 149, 149, 32       864
                             )

 block1_conv1_bn (BatchNormaliz  (None, 149, 149, 32       128
 ation)                      )

 block1_conv1_act (Activation)  (None, 149, 149, 32       0
                             )

 block1_conv2 (Conv2D)       (None, 147, 147, 64       18432
                             )

 block1_conv2_bn (BatchNormaliz  (None, 147, 147, 64       256
 ation)                      )

 block1_conv2_act (Activation)  (None, 147, 147, 64       0
                             )

 block2_sepconv1 (SeparableConv  (None, 147, 147, 12       8768
 2D)                         8)

 block2_sepconv1_bn (BatchNorma  (None, 147, 147, 12       512
 lization)                   8)

 block2_sepconv2_act (Activatio  (None, 147, 147, 12       0
 n)                          8)

 block2_sepconv2 (SeparableConv  (None, 147, 147, 12       17536
 2D)                         8)
```

```
Epoch 21/30
3/3 [==============================] - 43s 13s/step - loss: 3.4297 - accuracy: 0.6771
Epoch 22/30
3/3 [==============================] - 43s 13s/step - loss: 5.0327 - accuracy: 0.6979
Epoch 23/30
3/3 [==============================] - 37s 14s/step - loss: 5.6452 - accuracy: 0.6026
Epoch 24/30
3/3 [==============================] - 44s 14s/step - loss: 5.8190 - accuracy: 0.6562
Epoch 25/30
3/3 [==============================] - 43s 13s/step - loss: 3.5427 - accuracy: 0.6979
Epoch 26/30
3/3 [==============================] - 43s 13s/step - loss: 3.7831 - accuracy: 0.7083
Epoch 27/30
3/3 [==============================] - 50s 16s/step - loss: 3.7079 - accuracy: 0.6250
Epoch 28/30
3/3 [==============================] - 42s 13s/step - loss: 2.3158 - accuracy: 0.7292
Epoch 29/30
3/3 [==============================] - 46s 13s/step - loss: 5.2872 - accuracy: 0.6979
Epoch 30/30
3/3 [==============================] - 43s 13s/step - loss: 3.2610 - accuracy: 0.7917
```

In [ ]:
```
model.save('Updated-Xception-diabetic-retinopathy.h5')
```

```
 alization)                     )

 block14_sepconv2_act (Activati  (None, 10, 10, 2048  0          ['block14_sepconv2_bn[0][0]']
 on)                            )

 flatten (Flatten)              (None, 204800)       0           ['block14_sepconv2_act[0][0]']

 dense (Dense)                  (None, 5)            1024005     ['flatten[0][0]']

==================================================================================================
Total params: 21,885,485
Trainable params: 1,024,005
Non-trainable params: 20,861,480
__________________________________________________________________________________________________
```

In [ ]:
```
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
```

In [ ]:
```
r=model.fit_generator(training_set,validation_data=test_set,epochs=30,steps_per_epoch=len(training_set)//32,validation_steps=len(test_set)//32)
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: UserWarning: `Model.fit_generator` is deprecated and will be removed in a futur
e version. Please use `Model.fit`, which supports generators.
  """Entry point for launching an IPython kernel.
Epoch 1/30
3/3 [==============================] - 52s 15s/step - loss: 10.3196 - accuracy: 0.2396
Epoch 2/30
3/3 [==============================] - 44s 13s/step - loss: 16.3913 - accuracy: 0.4896
Epoch 3/30
3/3 [==============================] - 43s 13s/step - loss: 5.7194 - accuracy: 0.5521
Epoch 4/30
3/3 [==============================] - 45s 13s/step - loss: 6.0489 - accuracy: 0.5104
Epoch 5/30
3/3 [==============================] - 35s 9s/step - loss: 2.6817 - accuracy: 0.5897
Epoch 6/30
3/3 [==============================] - 45s 14s/step - loss: 5.3608 - accuracy: 0.5833
Epoch 7/30
```

GITHUB LINK:- **https://github.com/IBM-EPBL/IBM-Project-5992-1658821742**

DEMO LINK:- **https://youtu.be/0QhLXPX8xWo**