

# PROJECT REPORT

## DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RECTINOPATHY

SUBMITTED BY

Team ID: PNT2022TMID52149

A.Thanga Abiya (962719106036)  
T.Thanusha (962719106037)  
A.Subitha (962719106035)  
K.Yoka Muthu Nivethitha (962719106040)

Team ID	PNT2022TMID52149
Project Name	Deep Learning Fundus Image Analysis For Early Detection Of Diabetic Retinopathy

### INTRODUCTION:

Diabetic retinopathy is an eye condition that can cause vision loss and blindness in people who have diabetes. It affects blood vessels in the retina (the light sensitive layer of tissue in the back of your eye). If you have diabetes, it's important to get a comprehensive dilated eye exam at least once a year. Diabetic retinopathy may not have any symptoms at first — but finding it early can help you take steps to protect your vision. We also provide novel results for five different screening and clinical grading systems for diabetic retinopathy including state-of-the-art results for accurately classifying images according to clinical five-grade diabetic retinopathy. These results suggest, that a deep learning system could increase the cost-effectiveness of screening and diagnosis, while attaining higher than recommended performance, and that the system could be applied in clinical examinations requiring finer grading.

The purpose of our study is to investigate the effectiveness of UWF fundus image in DR detection.

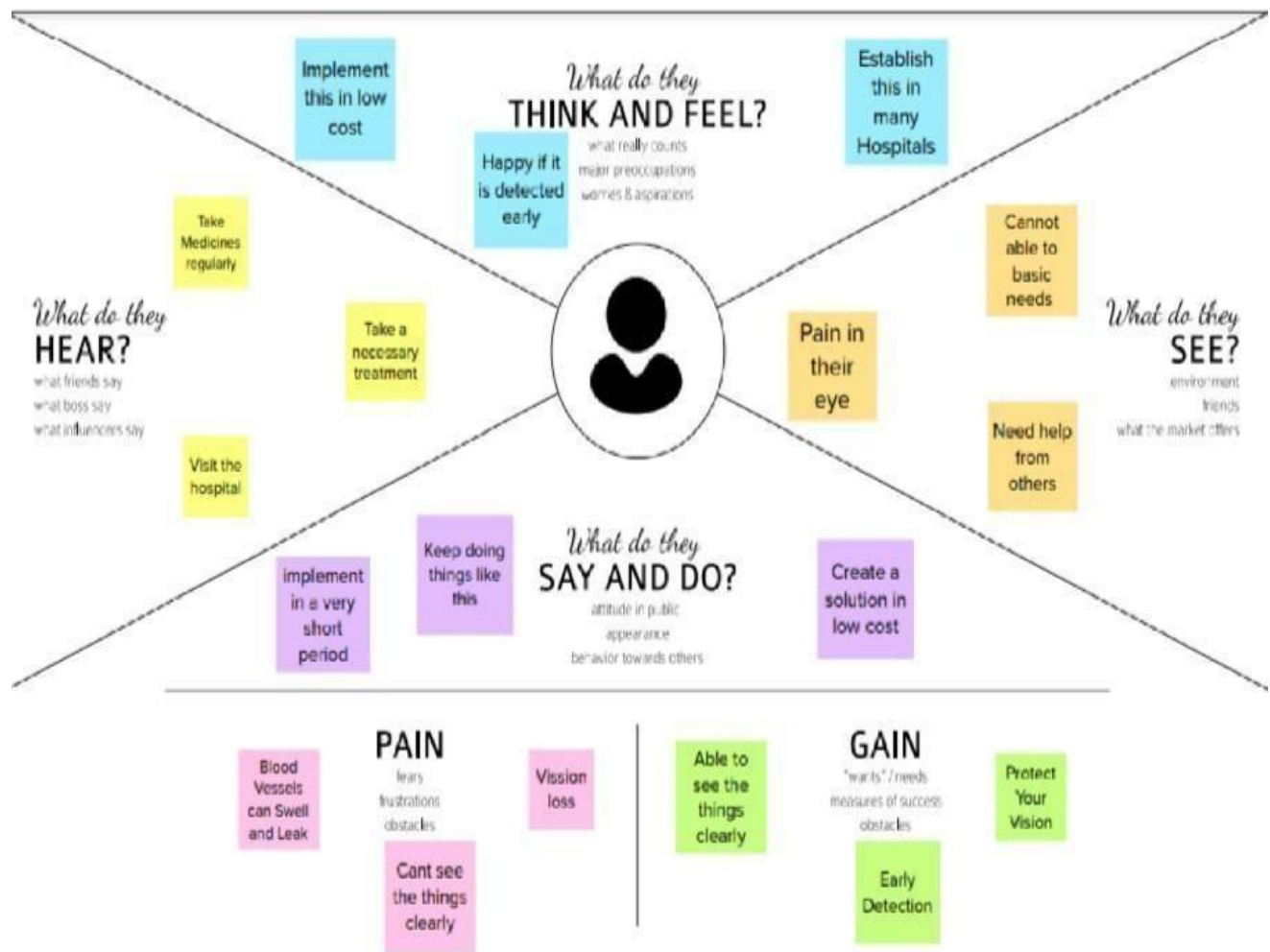
#### **LITERATURE SURVEY:**

People with diabetes can have an eye disease called diabetic retinopathy. This is when high blood sugar levels cause damage to blood vessels in the retina. These blood vessels can swell and leak. Or they can close, stopping blood from passing through. Sometimes abnormal new blood vessels grow on the retina. All of these changes can steal your vision.

The evaluation of the severity and degree of retinopathy associated with a person having diabetes, is currently performed by medical experts based on the fundus or retinal image of the patient's eyes.

## IDEATION & PROPOSED SOLUTION:

### EMPATHY MAP CANVAS:



# IDEATION & BRAINSTROMING:

## Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not coding in the same room.

- 1. Welcome to your
- 2. Welcome to your
- 3. Welcome to your

### Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do in prep work.

- 1. Define
- 2. Define

### Define your problem statement

What problem are you trying to solve? Frame your problem as a clear target for solutions. The aim is to be clear about your problem.

- 1. Define
- 2. Define

### Brainstorm

Brainstorming is a creative process to generate ideas. It's a time when you can think out loud and share your ideas with others.

- 1. Define
- 2. Define

### Group ideas

Now that you have your ideas, it's time to group them. This is where you can start to see patterns and group similar ideas together.

- 1. Define
- 2. Define

### Prioritize

Now that you have your ideas, it's time to prioritize them. This is where you can start to see which ideas are most important and which are less so.

- 1. Define
- 2. Define

### After you collaborate

Now that you have your ideas, it's time to implement them. This is where you can start to see which ideas are most important and which are less so.

- 1. Define
- 2. Define

## PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement	<b>Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy:</b>  The Diabetic Retinopathy is a disease which affects the vision of the patient. The project is the time consuming, cost effective detection the DR with the high accuracy without need of Clinicians.
2.	Idea / Solution description	Collect the datasets for classifying the normal retina and diabetic retina in real time. Develop the machine learning algorithm to classify normal retina and diabetic retina. After developing the algorithm, train the model with datasets collected in real time datasets. <input type="checkbox"/> Validation for test data will be carried. Once the performance accuracy is above 98%, the algorithm will be implemented.
3.	Novelty / Uniqueness	Using the trained model with more than 98% accuracy to detect the diabetic retinopathy will result in the more accurate result.
4.	Social Impact / Customer Satisfaction	This will very helpful for the people to easily detect diabetic retinopathy within the less amount of time and take necessary treatment to prevent the Caustious effects
5.	Business Model (Revenue Model)	This will be developed as a product to detect diabetic retinopathy. This will reduce the number of Clinicians and time required to detect the DR in the hospitals.
6.	Scalability of the Solution	This will be done by collecting the correct information as a constraint and training the model with more datasets till the accuracy becomes greater than the 98%.Once the optimum accuracy is reached, then it will be implemented using embedded device

## PROBLEM SOLUTION FIT:

PROBLEM SOLUTION FIT: A FRAMEWORK FOR ADDRESSING PROBLEMS		
<b>1. CUSTOMER SEGMENTS</b> <small>Who are your customers?</small> <div>The Person who have Diabetes</div>	<b>6. CUSTOMER</b> <small>What constraints prevent your customers from taking action to solve their current problem? (i.e. spending power, budget, no cash, technical constraints, or subtle forces)</small> <div>The time and cost is the major limiting constraints for the customers to take an action for treatment. Barriers could lead to different outcomes, barriers such as lack of knowledge and awareness on DR. Quality and satisfaction in the detection of DR is also a major constraints. There may be a possibility of wrong prediction in detection.</div>	<b>5. AVAILABLE SOLUTIONS</b> <small>Which solution can resolve the customer's problem? How the problem is solved by the solution? What have they tried in the past? What pros &amp; cons define solution here? (i.e. past and present, as experience or digital recordings)</small> <div>The dilated eye exam is the best thing you can do for your eye health. It's the only way to check for eye disease early on, when they are easier to treat and before they cause vision loss. The drawback of this exam is drops placed in their eyes causes the blurring and eye irritation.</div>
<b>2. JOBS TO BE DONE / FROM PM</b> <small>What do customers or partners do you address for your business? There could be more than one required &amp; desired jobs</small> <div>The awareness programs can be conducted for the people to know more about the DR. By giving counselling for the patients who are taking the treatment for Diabetes in the hospitals.</div>	<b>3. PROBLEM ROOT CAUSE</b> <small>What is the root cause that the problem exists? What is the history? (i.e. what is the root cause of the problem?)  <small>(i.e. what is the root cause of the problem?)</small></small> <div>The main cause of DR is poor control of the long time.            Having the diabetes for too long time.            High blood sugar level.            High cholesterol.            Tobacco usage.            High blood pressure.            Loss or dysfunction of</div>	<b>7. BENEFIT</b> <small>What do customers or partners do you address for your business? (i.e. what is the benefit of the solution?)  <small>(i.e. what is the benefit of the solution?)</small></small> <div>Directly related: I had the easy detection method with high accuracy to solve the problem. Early detection and treatment are necessary in order to delay or avoid vision deterioration and vision loss. Indirectly related: The volunteers can help the patients to know about the risk in DR.</div>
<b>3. TRIGGERS</b> <small>What triggers customers to act? (i.e. seeing facts, seeing an advertisement, seeing a friend, seeing a more efficient solution in the news)</small> <div>Seeing other people who get benefits from the hospitals and got information through Social media, google, etc.</div>	<b>10. YOUR SOLUTION</b> <small>How are you solving the problem? (i.e. what is your current solution doing for the customer, and how have you made it better?)  <small>(i.e. what is your current solution doing for the customer, and how have you made it better?)</small></small> <div>Collect the real time datasets and develop the algorithm for classifying the normal retina and diabetic retina. Train the model for more than 99% accuracy and it will be implemented.</div>	<b>8. CHANNELS OF BEHAVIOUR</b> <small>8.1. OFFLINE  <small>(i.e. what is the offline channel of the solution?)</small></small> <div>Getting the consultation from the doctors via call. Patients can google and know what they are suffering from?</div>
<b>4. EMOTIONS: BEFORE / AFTER</b> <small>How do customers feel when they face a problem or a job and afterwards? (i.e. how do customers feel when they face a problem or a job and afterwards?)</small> <div>Being hopeless, afraid &gt; Secure, confident</div>		<small>8.2. ONLINE  <small>(i.e. what is the online channel of the solution?)</small></small> <div>Visit the hospitals and take necessary treatments.</div>

## REQUIREMENT ANALYSIS:

### FUNCTIONAL REQUIREMENT:

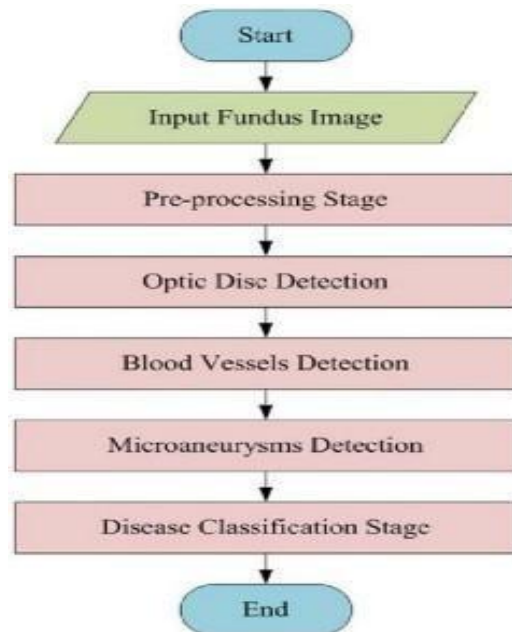
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Datasets	For training the model, the most accurate real time datasets are required
FR-2	Camera	For getting real time images for testing the model
FR-3	Cloud Storage	For storing the required images and programming

## NON FUNCTIONAL REQUIREMENT:

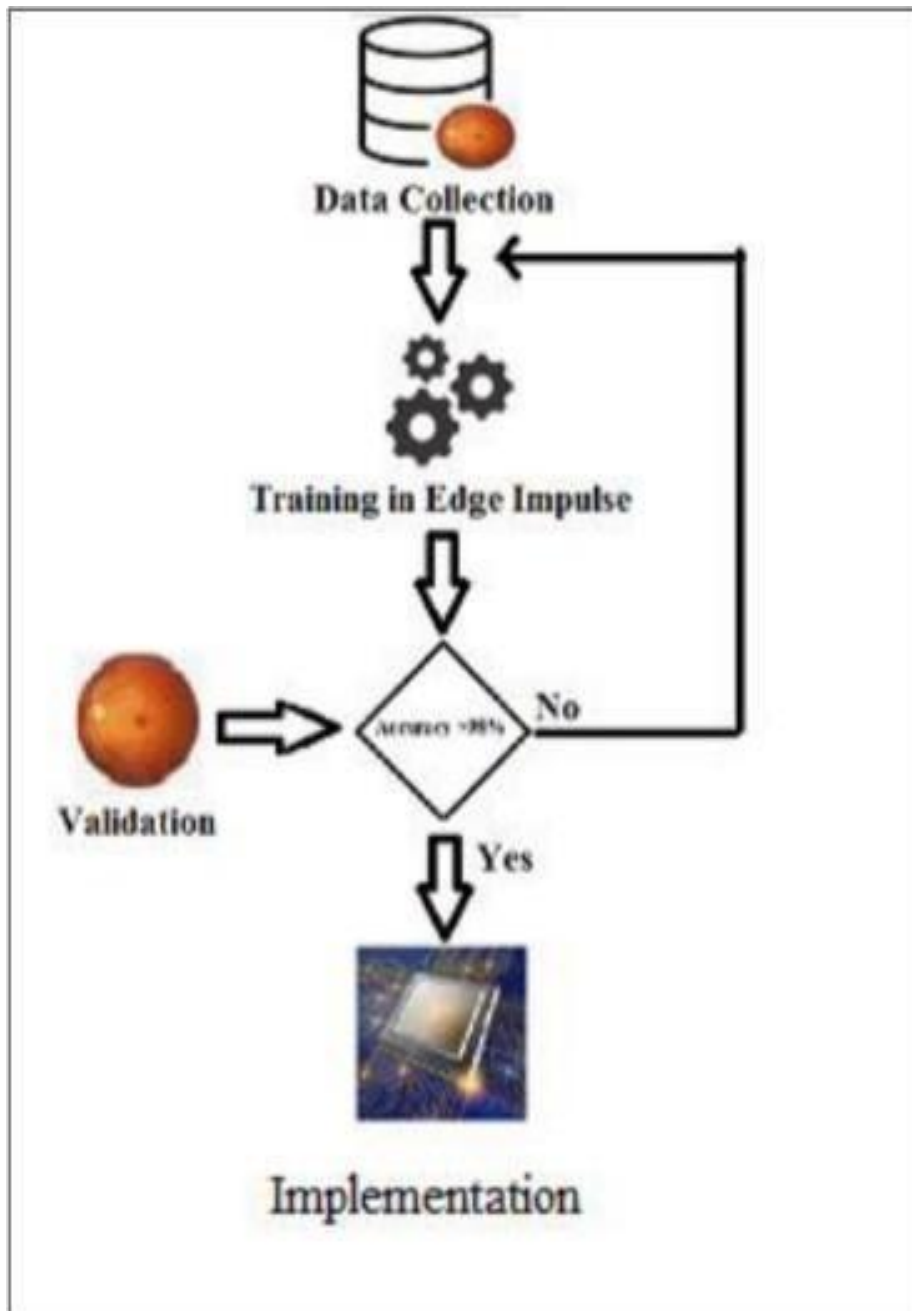
FR No.	Non-Functional Requirement	Description
NFR-1	<b>Usability</b>	The user can easily upload their images for processing
NFR-2	<b>Security</b>	This will protect the user data like their eye images and their results
NFR-3	<b>Reliability</b>	It will process the images more quickly, so that we can process the more number of images within the limited time
NFR-4	<b>Performance</b>	This will give more than 98% accuracy
NFR-5	<b>Availability</b>	This will be available in low cost , so that we can implement in many places
NFR-6	<b>Scalability</b>	It will be enhances for other diseases also

## PROJECT DESIGN:

### DATA FLOW DIAGRAM:




## SOLUTION ARCHITECTURE:






# USER STORIES:



## Customer experience journey map

Use this framework to better understand customer needs, motivations, and obstacles by illustrating a key scenario or process from start to finish. When possible, use this map to document and summarize interviews and observations with real people rather than relying on your hunches or assumptions.

Create a primary role

 Product School

[Download feedback](#)

**Document an existing experience**

Review your focus to a specific scenario or process within an existing product or service. In the Scenario, document the end-to-end process someone typically experiences that also deals to each of the other roles.

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As the individual in the scenario, review and then modify the map to reflect your own experiences.

Scenario	Anticipate	Enter	Engage	Exit	Extend
Scenario: booking, attending, and selling a local day tour	For each scenario, what is the main role of the person?	What is the main scenario or the beginning of the process?	What are the main steps or the process of the process?	What is the main step or the process of the process?	What is the main step or the process of the process?
<b>Steps</b> What does the person or group typically experience?	<div>Step 1: Search for a tour</div> <div>Step 2: Book a tour</div> <div>Step 3: Receive confirmation</div> <div>Step 4: Prepare for the tour</div>	<div>Step 5: Arrive at the tour location</div> <div>Step 6: Meet the guide</div> <div>Step 7: Start the tour</div>	<div>Step 8: Engage with the guide</div> <div>Step 9: Enjoy the tour</div> <div>Step 10: Provide feedback</div>	<div>Step 11: Depart the tour location</div> <div>Step 12: Receive a receipt</div>	<div>Step 13: Review the tour experience</div> <div>Step 14: Recommend the tour to others</div>
<b>Interactions</b> What interactions are there at each step along the way? <ul style="list-style-type: none"> <li>People: Who do they see or interact with?</li> <li>Places: Where are they?</li> <li>Things: What objects or technology are they using?</li> </ul>	<div>Interaction 1: Search for a tour</div> <div>Interaction 2: Book a tour</div> <div>Interaction 3: Receive confirmation</div>	<div>Interaction 4: Arrive at the tour location</div> <div>Interaction 5: Meet the guide</div>	<div>Interaction 6: Engage with the guide</div> <div>Interaction 7: Enjoy the tour</div>	<div>Interaction 8: Depart the tour location</div> <div>Interaction 9: Receive a receipt</div>	<div>Interaction 10: Review the tour experience</div> <div>Interaction 11: Recommend the tour to others</div>
<b>Goals &amp; motivations</b> What does the person or group want to achieve or accomplish? (How do they feel? What do they want?)	<div>Goal 1: Find a tour</div> <div>Goal 2: Book a tour</div>	<div>Goal 3: Arrive at the tour location</div>	<div>Goal 4: Engage with the guide</div>	<div>Goal 5: Depart the tour location</div>	<div>Goal 6: Review the tour experience</div>
<b>Positive moments</b> What does the person or group experience that is enjoyable, satisfying, or motivating about the experience?	<div>Moment 1: Finding a tour</div>	<div>Moment 2: Meeting the guide</div>	<div>Moment 3: Engaging with the guide</div>	<div>Moment 4: Enjoying the tour</div>	<div>Moment 5: Receiving a receipt</div>
<b>Negative moments</b> What does the person or group experience that is frustrating, confusing, or disappointing about the experience?	<div>Moment 6: Not finding a tour</div>	<div>Moment 7: Not meeting the guide</div>	<div>Moment 8: Not engaging with the guide</div>	<div>Moment 9: Not enjoying the tour</div>	<div>Moment 10: Not receiving a receipt</div>
<b>Areas of opportunity</b> What does the person or group experience that is a challenge or a need? What do others suggest?	<div>Opportunity 1: Finding a tour</div> <div>Opportunity 2: Booking a tour</div>	<div>Opportunity 3: Arriving at the tour location</div>	<div>Opportunity 4: Engaging with the guide</div>	<div>Opportunity 5: Departing the tour location</div>	<div>Opportunity 6: Reviewing the tour experience</div>

## **PROJECT PLANNING AND SCHEDULING :**

### **SPRINT PLANNING AND ESTIMATION:**

<b>S.NO</b>	<b>ACTIVITY TITLE</b>	<b>DESCRIPTION</b>	<b>DURATION</b>
1	Understanding the project and its requirement	Assign the teammembers and createrepository in the GitHub, Assign the task to each team member and teach how to use the GitHub and IBM careereducation .	1 week
2	Start the project	Advice students toattend classes of IBM portal create and develop an rough diagram based on project description and gather informationon AI and IBM project and team leader assign task to each member ofthe project .	1 week

3	Attend class	Team members and team lead must attend the classes and learn from classes provided by IBM and NALAYATHIRAN and must gain access of MIT license for the project.	4 weeks
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4	Budget and scope of project	Reduce cost efficiency and analyse the use of AI in the project	Progress
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## SPRINT DELIVERY SCHEDULE:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Data Collection	Task-1	In Deep Learning Model, It can be split into Testing and Training set.	4	Medium
Sprint-1	Data Pre-processing	Task-2	Import the required data for pre-processing. Application of the image data generator to the train and test set.	7	Low
Sprint-1	Build Homepage	USN-1	Homepage give the brief description to the user.	4	Medium
Sprint-2	Create Registration page	USN-2	In this page, User will able to register for the application.	2	Low
Sprint-2	<u>Train, Save, Test</u>	Task-3	To train the model with the configured neural network and save the model. Test the build model against the testing dataset.	3	High
Sprint-3	Create Service Instance	Task-4	Configure the location of resource such as web server and cloud storage for an application.	7	High
Sprint-3	Creating Database	Task-5	IBM Cloud, offered the required credentials to access the services and the database accessed by the users.	6	High
Sprint-3	Creating Tables in Database	Task-6	Structure the required tables with necessary attributes in cloud DB.	4	Medium

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-4	Building login page	USN-3	User will be able to login by using the credentials.	3	Low
Sprint-4	Create Image uploading page	Task-7	Upload the test image	2	Low
Sprint-4	Building Prediction page	USN-4	User able to receive the diagnosis on their diabetic retinopathy.	2	Medium
Sprint-4	Building logout page	USN-5	User will be able to logout their account in this Page.	2	Medium
Sprint-4	Build Python code	Task-8	The Necessary modules should be initialize and the libraries should be imported.	1	Medium
Sprint-4		Task-9	Use the database using initiating client and rendering HTML page.	2	Medium
Sprint-4		Task-10	Configuring the registration, login pages and evaluating the credentials.	2	Medium
Sprint-4		Task-11	The model prediction will be showcased on UI.	1	High
Sprint-4	Run the Application	Task-12	Run to check the application.	2	High
Sprint-4		Task-13	Upload image in the homepage to predict the diabetic retinopathy.	5	High
Sprint-4	Train model on IBM	Task-14	Train the model on IBM and integrate it with the flask application.	3	High

## CODING:

```

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("inception-diabetic.h5")
app = Flask(__name__)
app.secret_key="abc"
app.config['UPLOAD_FOLDER'] = "User_Images"
# Authenticate using an IAM API key
client=Cloudant.iam('0f5ab837-7e5c-486c-a220-5256e075616c-
bluemix','0UGpqPnFUGkN6XC93fLwLujtajQ7wWmOVf7HGB2z2gq
X',connect=True)
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')
        passwd = request.args.get('pass')
        print(user, passwd)
        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 passwd == 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 i.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=(224, 224))
        x = image.img_to_array(img) # img 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 = 'AC040db3f6fc52556d2a15a7c8814238e2'
        auth_token = '1dedefd14bb721ecb05dd4c68dc1ec82'

        client = Client(account_sid, auth_token)

```



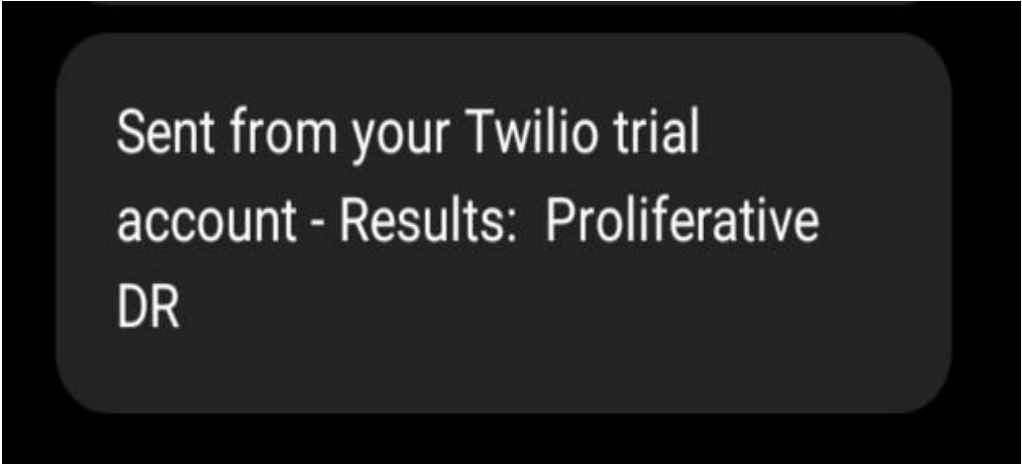
```

''' 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_='+17262274397',
    body='Results: '+ result,
    to ='+918925176648'
)
return render_template('prediction.html', prediction=result, fname =
filepath)
else:
    return render_template("prediction.html")

if __name__ == "__main__":
    app.debug = True
    app.run()

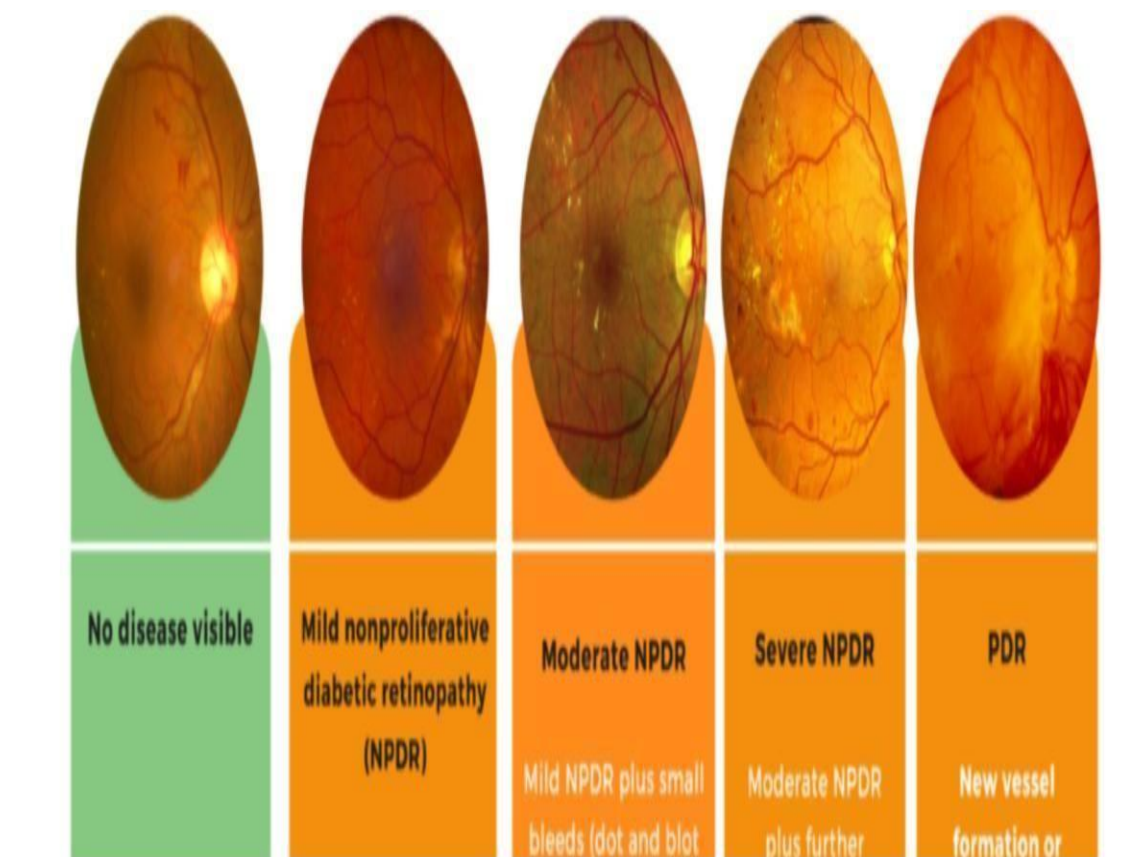
```

**SOLUTION :**



Sent from your Twilio trial  
account - Results: Proliferative  
DR

## TESTING:



## RESULTS:

Diabetic Retinopathy Classification

[Home](#) [Logout](#)

Upload Image

Choose File No file chosen

Predict

No Diabetic Retinopathy

**ADVANTAGES:**

Earlier detection reduce the risk of Vision loss.

The amount of time for detecting the DR is less.

Cost of detecting is less.

**DISADVANTAGES:**

If the images is not uploaded correctly then detection may be difficult.