REPORT

Team ID	PNT2022TMID51065
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.

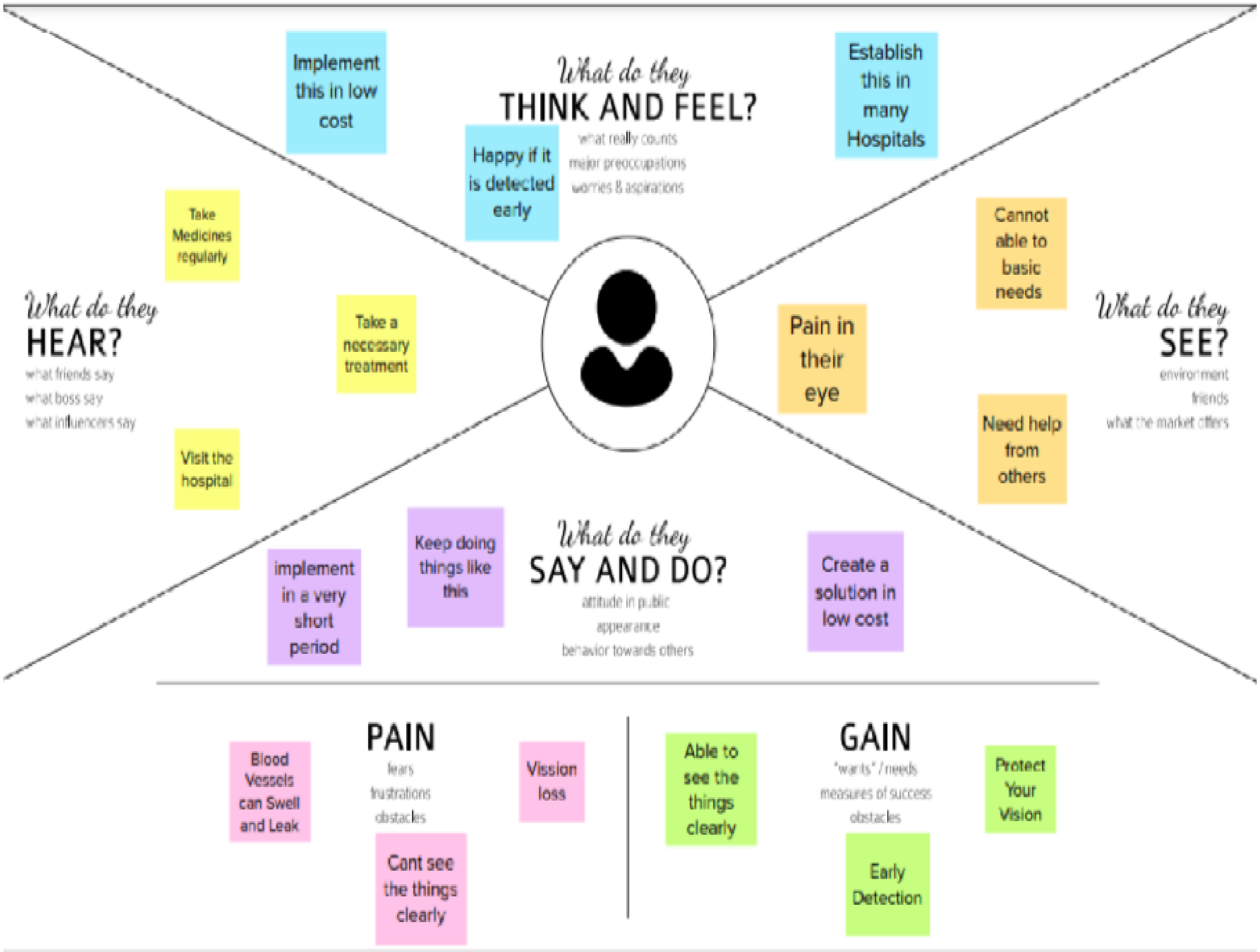
LITERATURE SURVEY:

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.

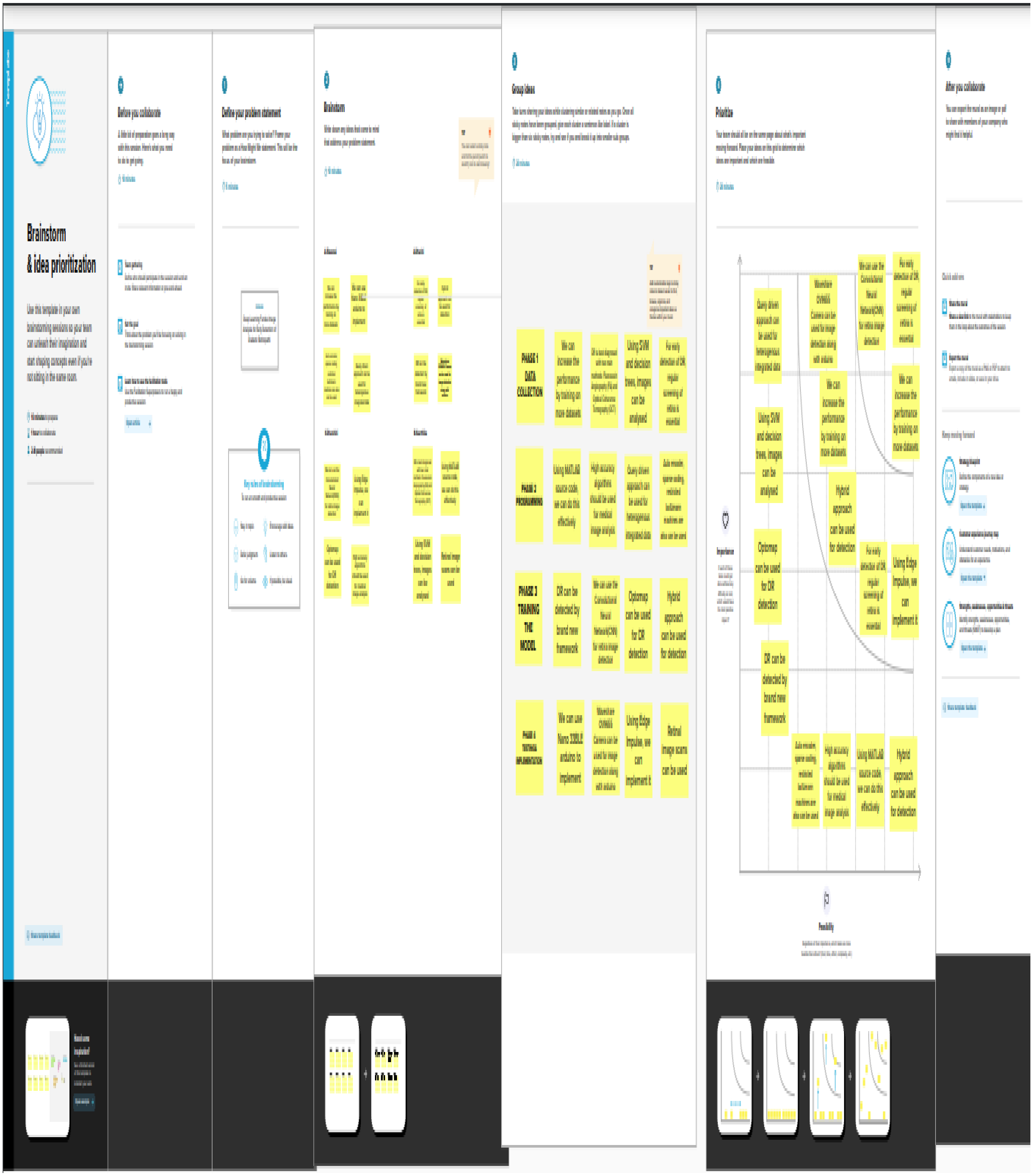
The evaluation of the severity and degree of retinopathy associated with a person having diabetes, is currently performed by medical experts based on the fundus or retinal image of the patient’s eyes.

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 sitting in the same room.

Before you collaborate

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

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

Key rules of brainstorming

Brainstorm

Write down any ideas that come to mind that address your problem statement.

Group ideas

PHASE 1 DATA COLLECTION	We can increase the performance by training on more datasets	DR is best diagnosed with two main methods: Fluorescein Angiography (FA) and Optical Coherence Tomography (OCT)	Using SVM and decision trees, images can be analysed	For early detection of DR, regular screening of retina is essential
PHASE 2 PROGRAMMING	Using MATLAB source code, we can do this effectively	High accuracy algorithms should be used for medical image analysis	Query driven approach can be used for heterogenous integrated data	Auto encoders, sparse coding, restricted boltzmann machines are also can be used
PHASE 3 TRAINING THE MODEL	DR can be detected by brand new framework	We can use the Convolutional Neural Network(CNN) for retinal image detection	Optomap can be used for DR detection	Hybrid approach can be used for detection
PHASE 4 TESTING & IMPLEMENTATION	We can use Nano 33BLE arduino to implement	Waveshare OV7670 Camera can be used for image detection along with arduino	Using Edge Impulse, we can implement it	Retinal image scans can be used

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

Query driven approach can be used for heterogenous integrated data

Waveshare OV7670 Camera can be used for image detection along with arduino

We can use the Convolutional Neural Network(CNN) for retinal image detection

For early detection of DR, regular screening of retina is essential

Using SVM and decision trees, images can be analysed

We can increase the performance by training on more datasets

We can increase the performance by training on more datasets

Hybrid approach can be used for detection

Optomap can be used for DR detection

For early detection of DR, regular screening of retina is essential

Using Edge Impulse, we can implement it

DR can be detected by brand new framework

Auto encoders, sparse coding, restricted boltzmann machines are also can be used

High accuracy algorithms should be used for medical image analysis

Using MATLAB source code, we can do this effectively

Hybrid approach can be used for detection

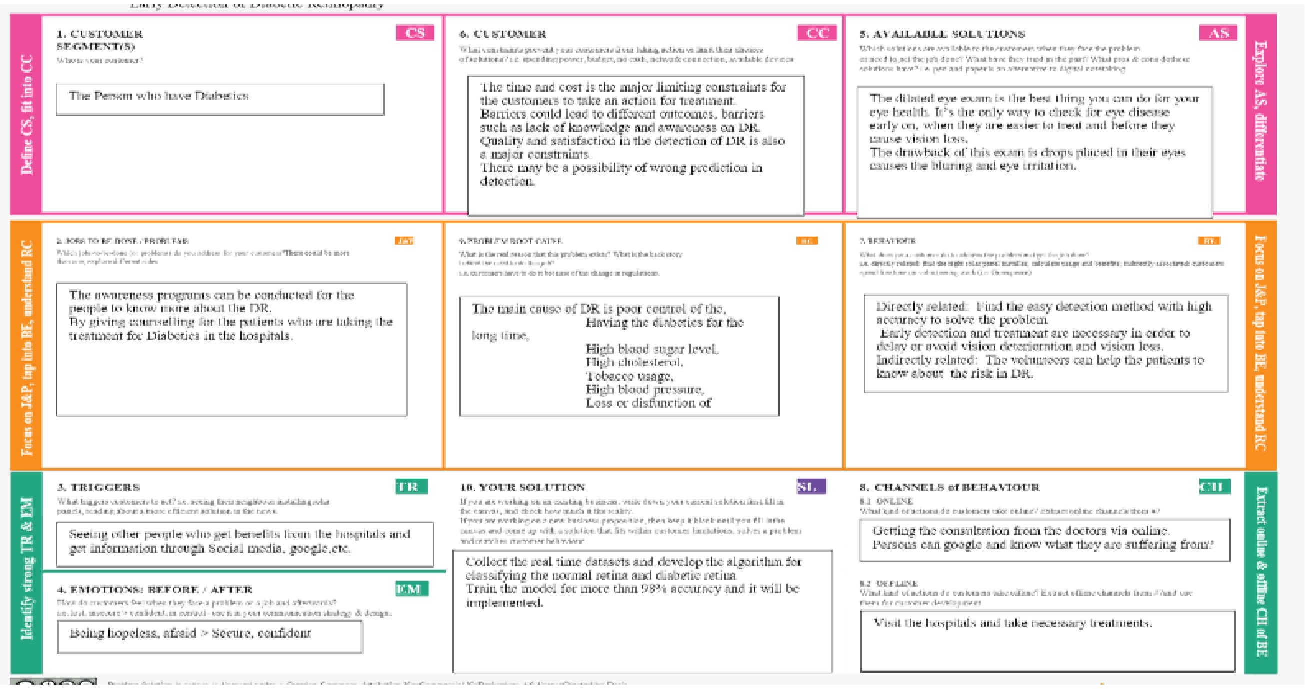
After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement	**Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy:** 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. 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:



Early Detection of Diabetic Retinopathy

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?

The Person who have Diabetics

6. CUSTOMER CC

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.

5. AVAILABLE SOLUTIONS AS

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 bluring and eye irritation.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS TO BE DONE / PROBLEMS J&P

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 Diabetics in the hospitals.

9. PROBLEM ROOT CAUSE RC

The main cause of DR is poor control of the,
Having the diabetics for the long time,
High blood sugar level,
High cholesterol,
Tobacco usage,
High blood pressure,
Loss or disfunction of

7. BEHAVIOUR BE

Directly related: Find 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.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

Seeing other people who get benefits from the hospitals and get information through Social media, google,etc.

4. EMOTIONS: BEFORE / AFTER EM

Being hopeless, afraid > Secure, confident

10. YOUR SOLUTION SL

Collect the real time datasets and develop the algorithm for classifying the normal retina and diabetic retina
Train the model for more than 98% accuracy and it will be implemented.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE

Getting the consultation from the doctors via online.
Persons can google and know what they are suffering from?

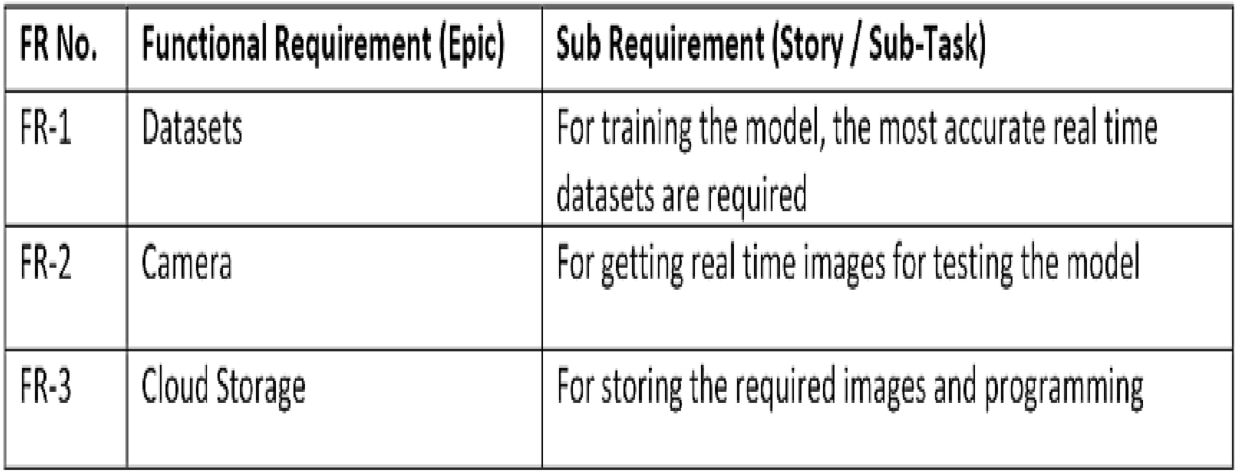
8.2 OFFLINE

Visit the hospitals and take necessary treatments.

Extract online & offline CH of BE

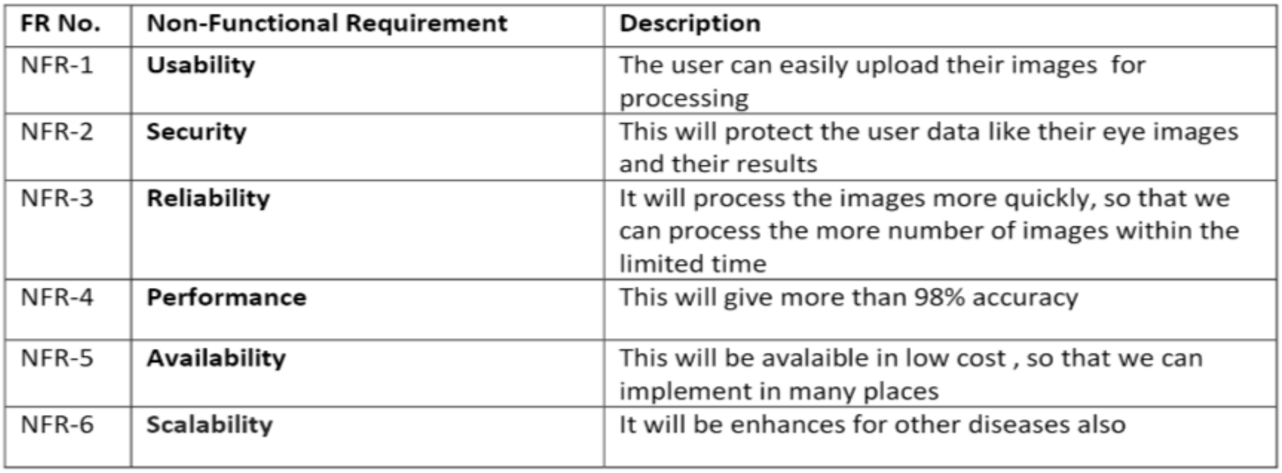
REQUIREMENT ANALYSIS:

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

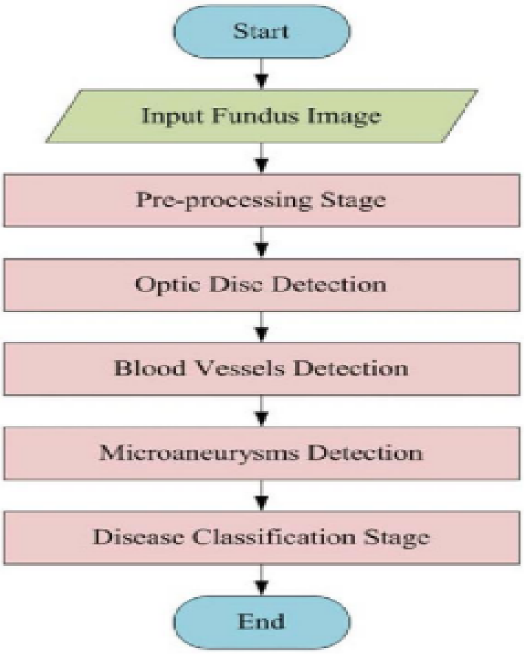
NON FUNCTIONAL REQUIREMENT:



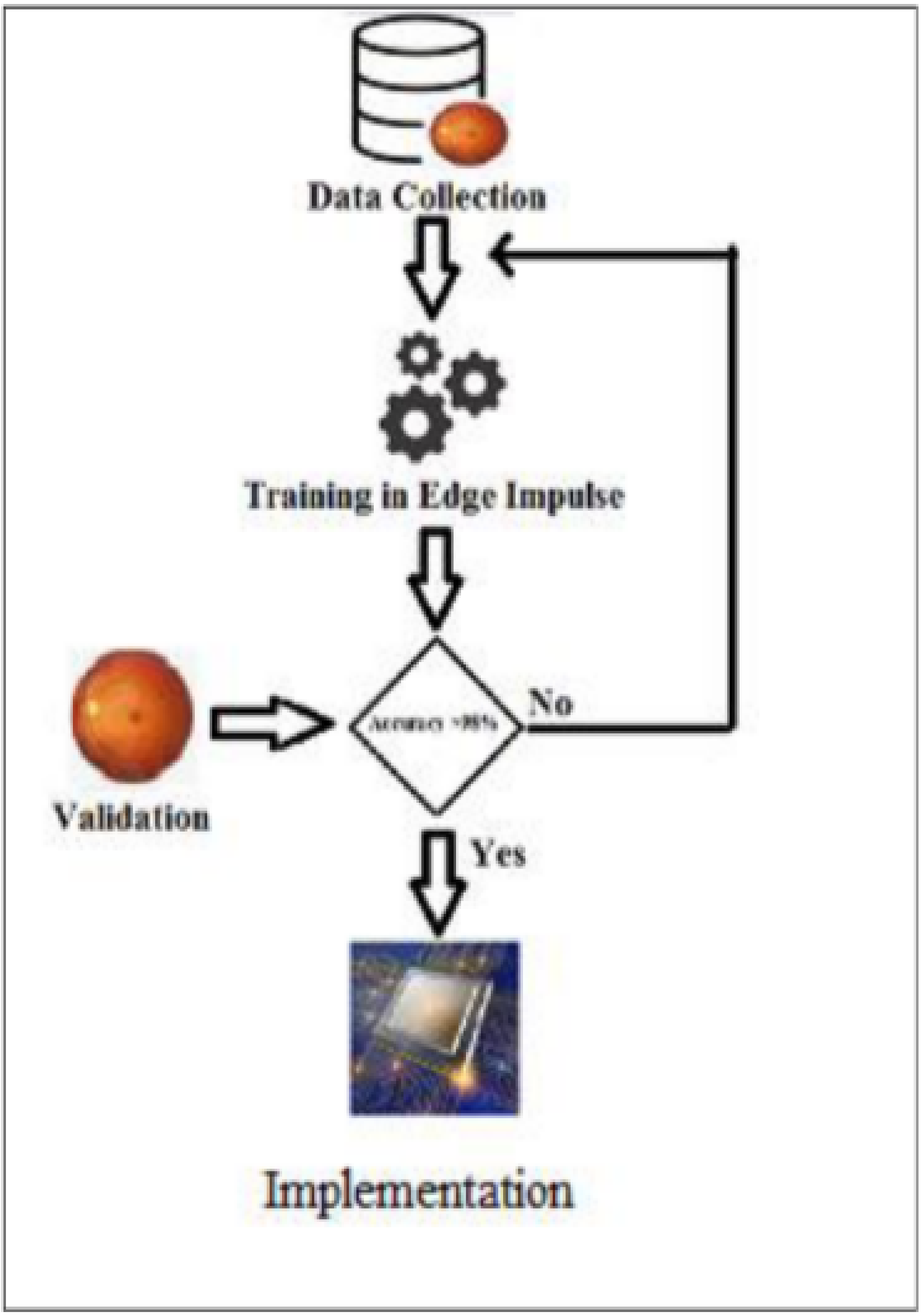
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The user can easily upload their images for processing
NFR-2	**Security**	This will protect the user data like their eye images and their results
NFR-3	**Reliability**	It will process the images more quickly, so that we can process the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

PROJECT DESIGN:

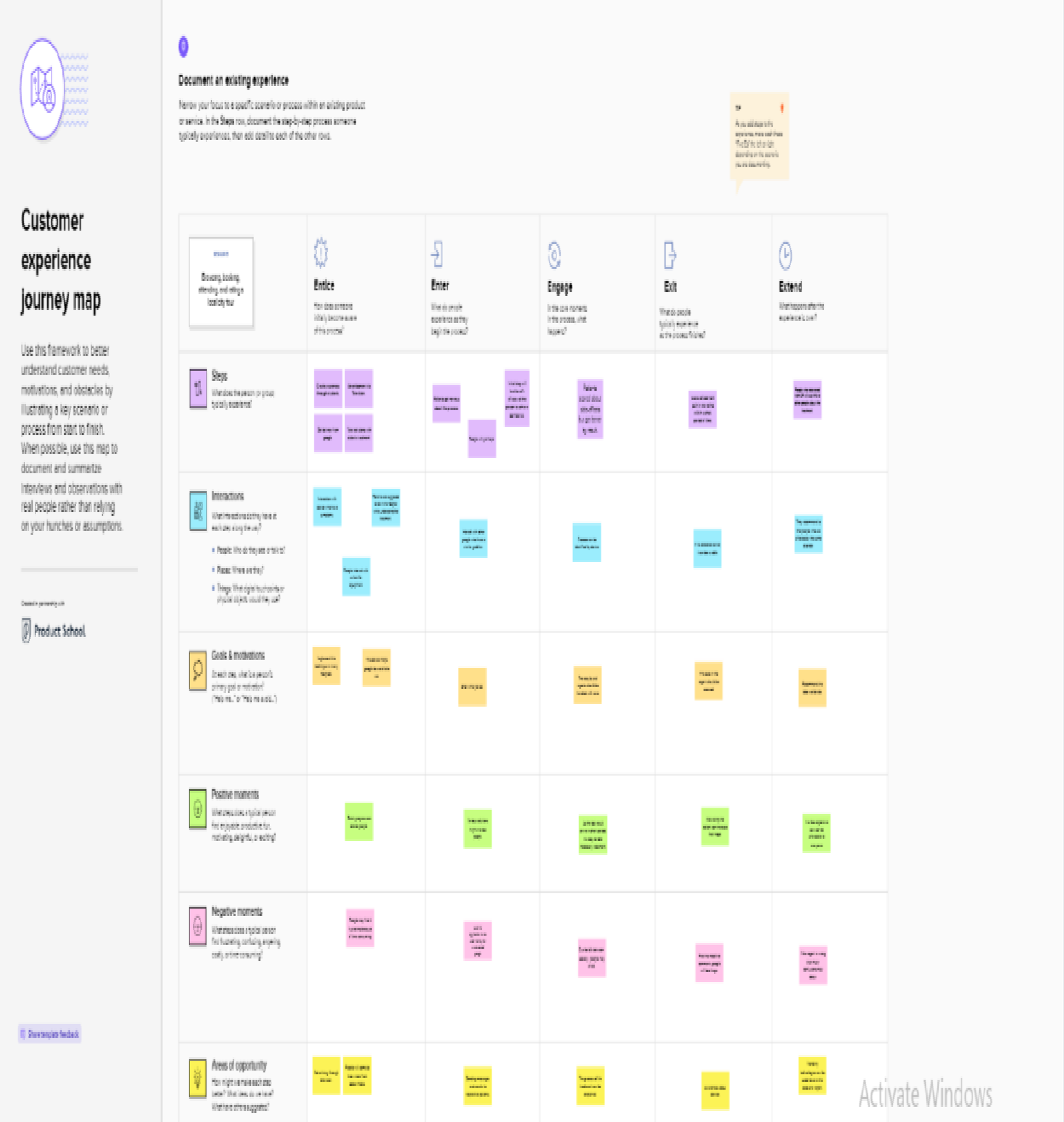
DATA FLOW DIAGRAM:



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.

Created in partnership with

Product School

Share template feedback

Document an existing experience

Narrow your focus to a specific scenario or process within an existing product or service. In the Steps row, document the step-by-step process someone typically experiences, then add detail to each of the other rows.

Browsing, booking, attending, and rating a local city tour

Entice
How does someone initially become aware of this process?

Enter
What do people experience as they begin the process?

Engage
In the core moments in the process, what happens?

Exit
What do people typically experience as the process finishes?

Extend
What happens after the experience is over?

Steps
What does the person (or group) typically experience?

Interactions
What interactions do they have at each step along the way?
- People: Who do they see or talk to?
- Places: Where are they?
- Things: What digital touchpoints or physical objects would they use?

Goals & motivations
At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")

Positive moments
What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?

Negative moments
What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?

Areas of opportunity
How might we make each step better? What ideas do we have? What have others suggested?

PROJECT PLANNING AND SCHEDULING :

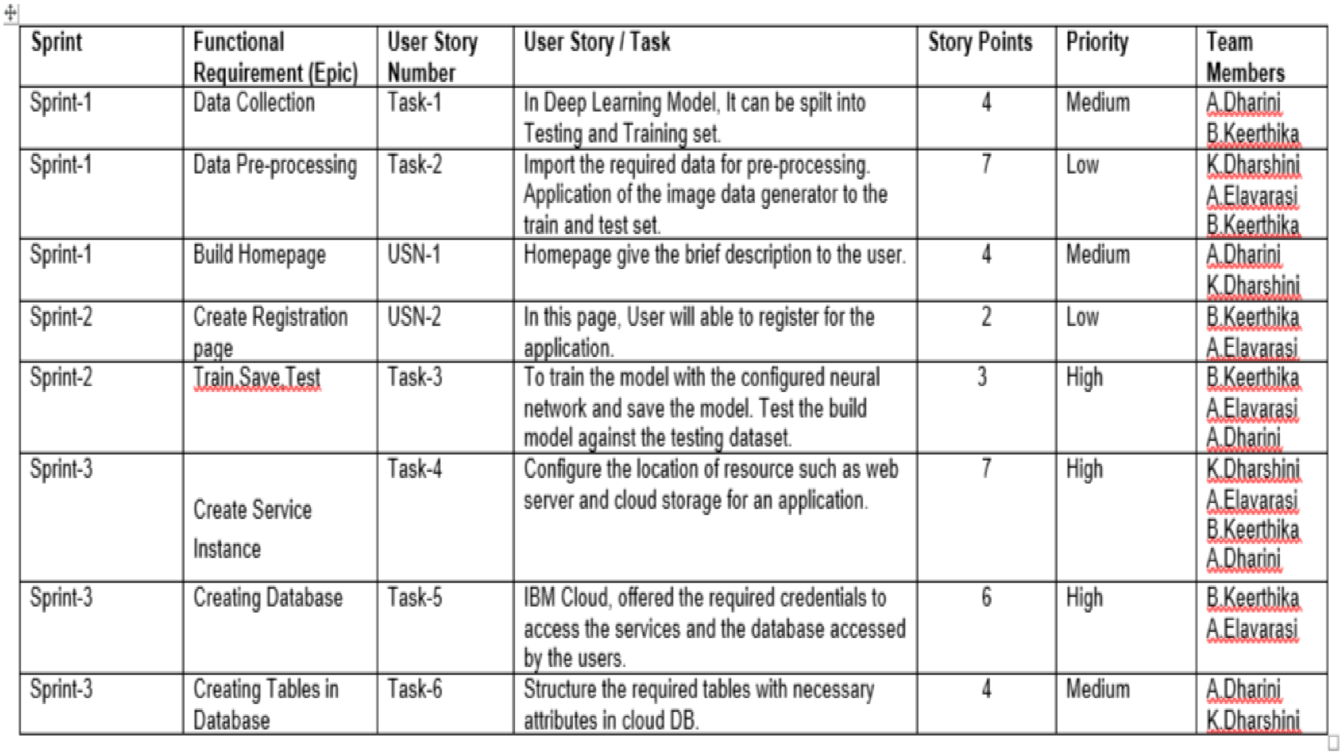
SPRINT PLANNING AND ESTIMATION:

S.NO	ACTIVITY TITLE	DESCRIPTION	DURATION
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

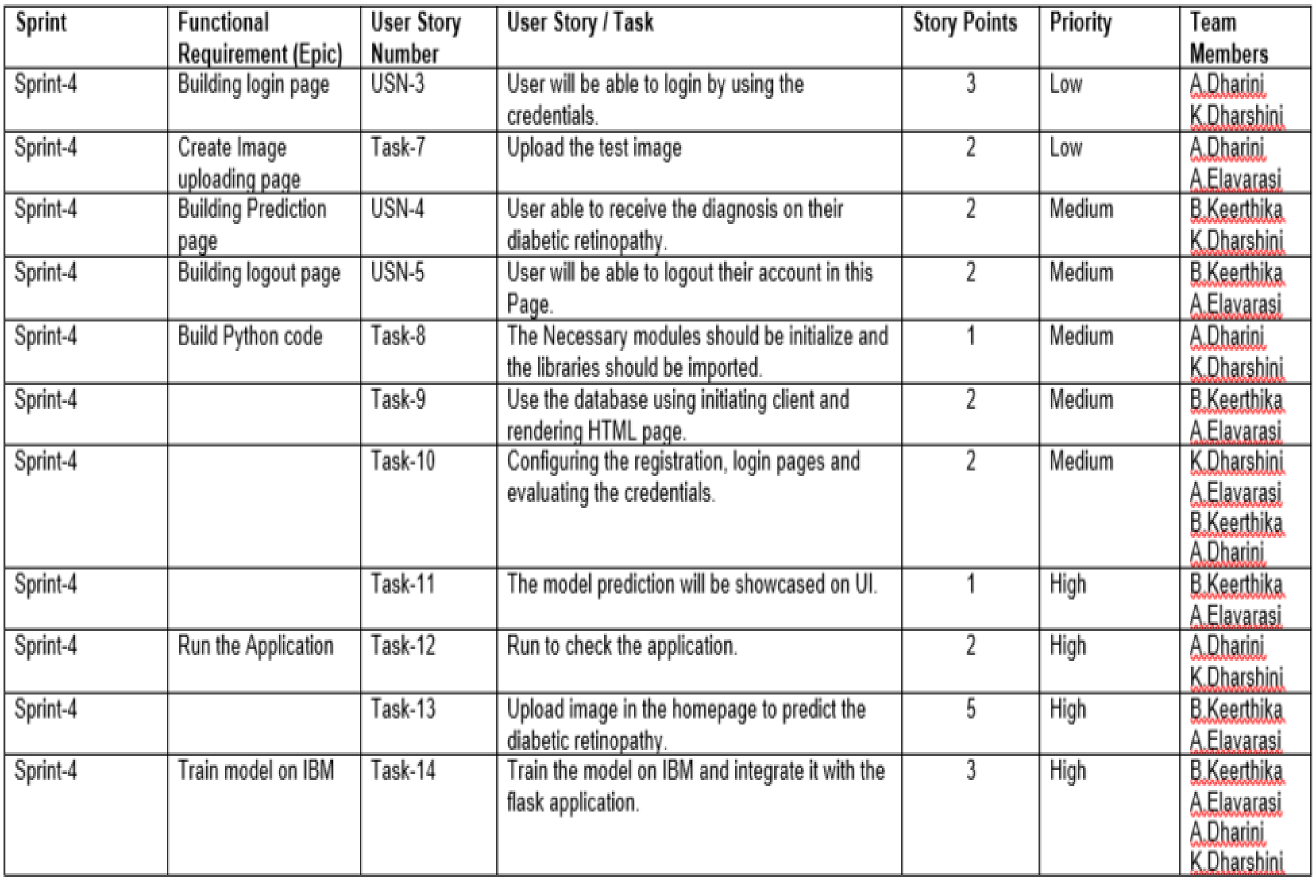
3	Attend class	Team members and team lead mustattend the classes and learnfrom classes provided byIBM and NALAYATHIRAN and must gainaccess of MIT license forthe project.	4 weeks

4	Budget and scope of project	Reduce cost efficiencyand analyse the use ofAI in the project	Progress

SPRINT DELIVERY SCHEDULE:



Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	Task-1	In Deep Learning Model, It can be spilt into Testing and Training set.	4	Medium	A.Dharini B.Keerthika
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	K.Dharshini A.Elavarasi B.Keerthika
Sprint-1	Build Homepage	USN-1	Homepage give the brief description to the user.	4	Medium	A.Dharini K.Dharshini
Sprint-2	Create Registration page	USN-2	In this page, User will able to register for the application.	2	Low	B.Keerthika A.Elavarasi
Sprint-2	Train,Save,Test	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	B.Keerthika A.Elavarasi A.Dharini
Sprint-3	Create Service Instance	Task-4	Configure the location of resource such as web server and cloud storage for an application.	7	High	K.Dharshini A.Elavarasi B.Keerthika A.Dharini
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	B.Keerthika A.Elavarasi
Sprint-3	Creating Tables in Database	Task-6	Structure the required tables with necessary attributes in cloud DB.	4	Medium	A.Dharini K.Dharshini



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

CODING:

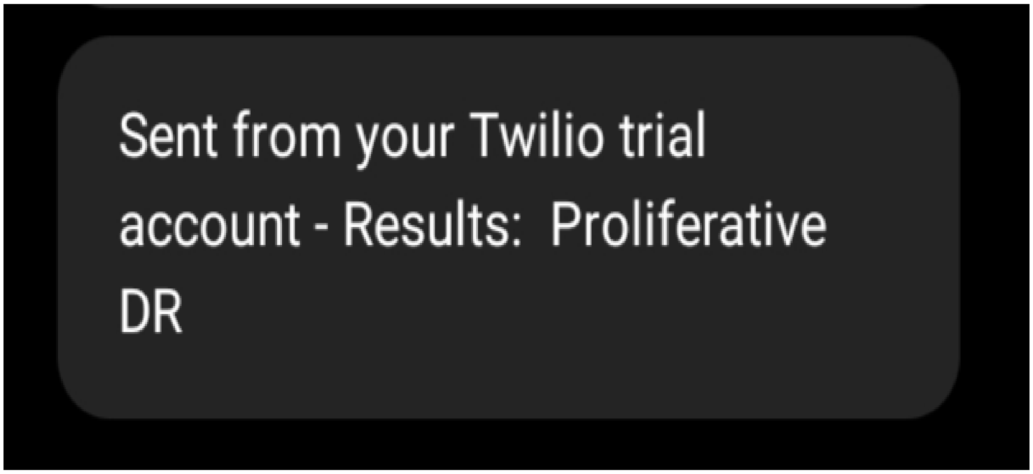
```
import numpy as np
import os
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.applications.inception_v3 import
preprocess_input
from flask import Flask, request,flash, render_template, redirect,url_for
from cloudant.client import 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')
        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')
```

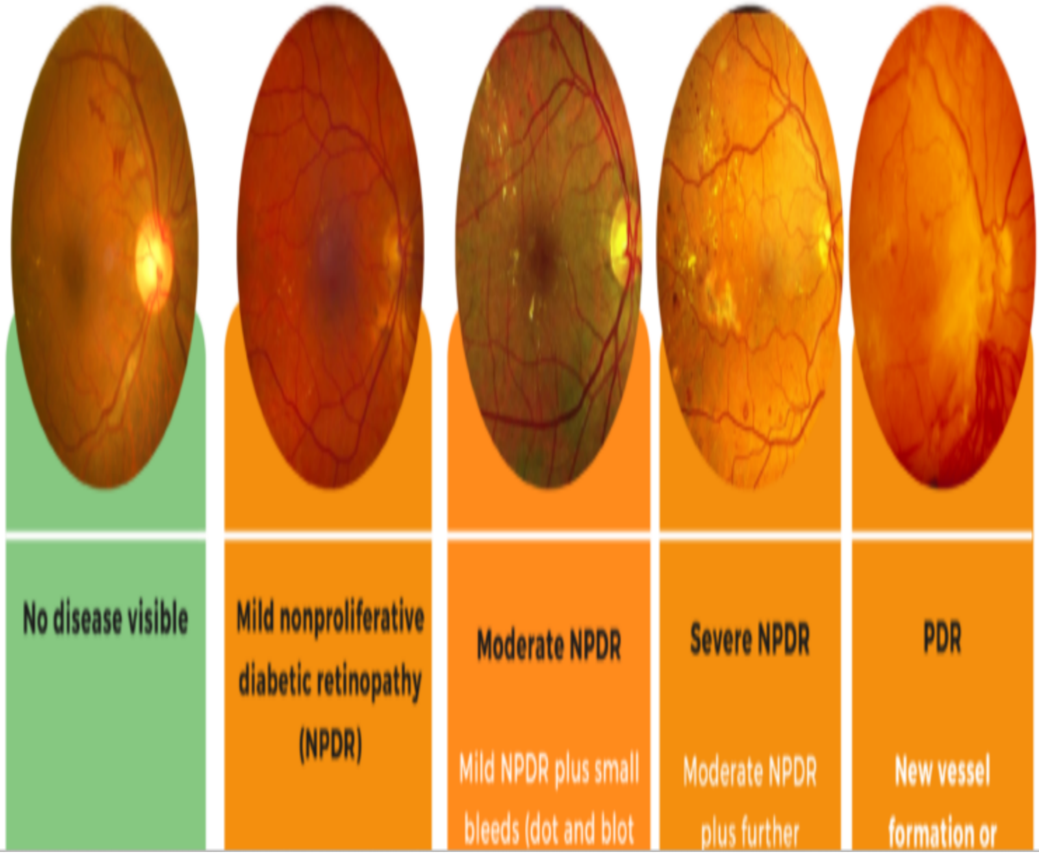
```
@app.route("/predict",methods=["GET", "POST"])
def predict():
    if request.method == "POST":
        f = request.files['file']
        # getting the current path 1.e where app.py is present
        basepath = os.path.dirname(__file__)
        #print ( " current path " , basepath )
        # from 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=(224, 224))
        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 = '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 :

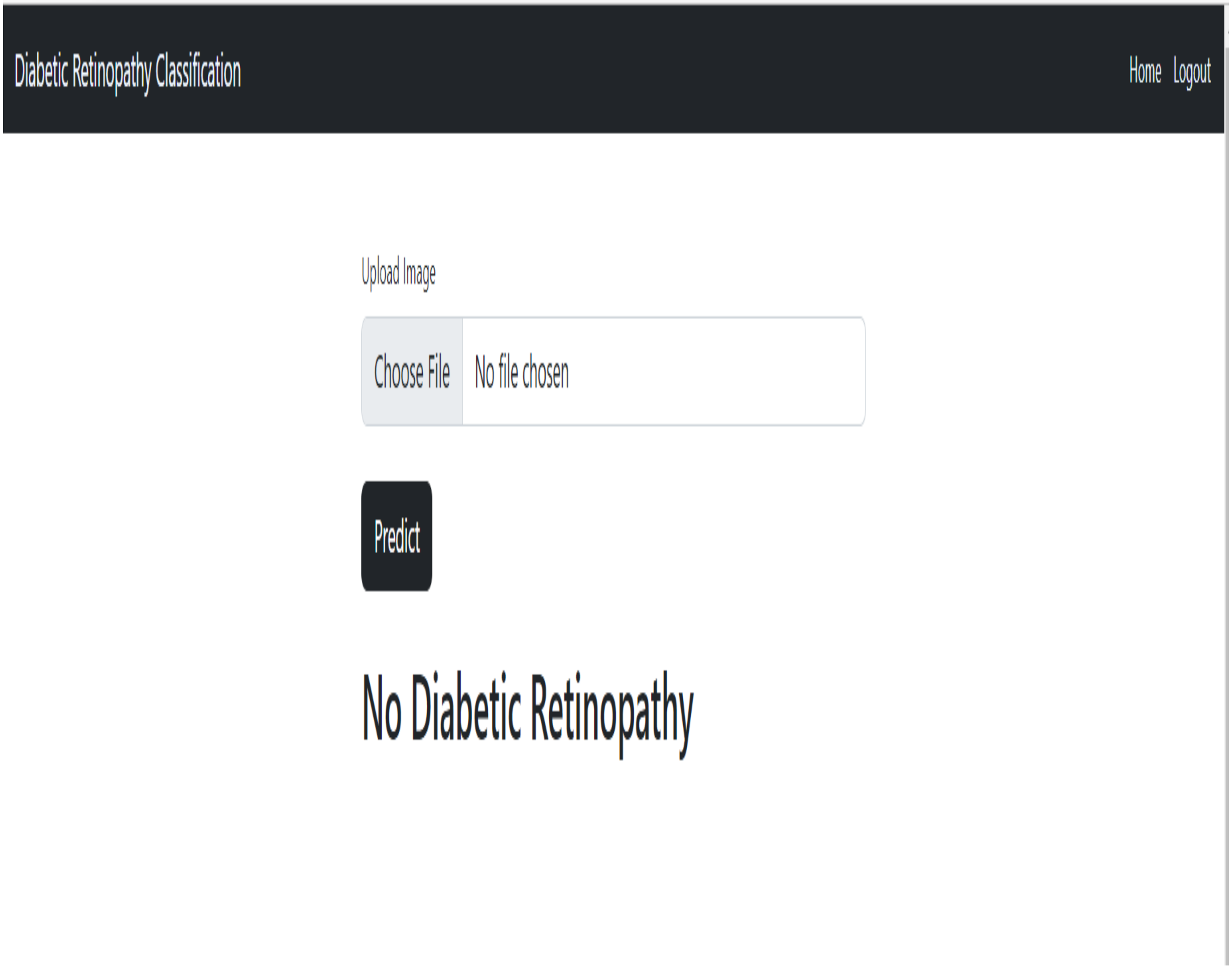


Sent from your Twilio trial account - Results: Proliferative DR

TESTING:


No disease visible
Mild nonproliferative diabetic retinopathy (NPDR)
Moderate NPDR
Mild NPDR plus small bleeds (dot and blot
Severe NPDR
Moderate NPDR plus further
PDR
New vessel formation or

RESULTS:



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.