

# **Deep Learning Fundus Image Analysis for Early Detection of Diabetic Retinopathy**

## **1. INTRODUCTION**

### **1.1 Project Overview**

Diabetic Retinopathy which causes damage to the neurons in the retina, is considered to be a dangerous disease that causes the cell inflammation in retina. Considering this a serious problem and in a way of overcoming this, early detection of diabetic retinopathy's solution has been formulated using prediction. This prediction system that is deployed as a web portal will be very much useful for the doctors that is for the retinopathy doctors who can know the early stages of the disease. Basically, diabetic retinopathy is classified into NPDR (Non Proliferative Diabetic Retinopathy) and PDR (Proliferative Diabetic Retinopathy) disease in which NPDR has classifications such as Mild NPDR, Moderate NPDR, Severe NPDR. Classifying this disease under specific categories will be very much helpful for the doctors for future prescriptions and the current conditional stages of the retina in the eye whether damaged or not. Providing particular doctor's user id which means the doctor must have to register their mail id and phone number so that each and every doctor can view their patient's history. Each prediction shown are accurate such that the necessary precautionary measures by the doctor can easily be given. The reason providing login and register purposes are for security issues.

### **1.2 Purpose**

Patients safety and curability of the disease provided by the doctor's prescription is very important. Knowing the seriousness of the Diabetic Retinopathy doctors recommend ideas and solutions, but analyzing them in early stage would be best for precautionary measures since medicating the disease so that the threat from the disease can be resolved. Hence this concerned in using deep learning and machine learning techniques to find the necessary solution. 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. In order to reduce the time for the doctors this method proposes the solution to analyze DR which uses various datasets' images and learn them to provide accurate results.

## **2. LITERATURE SURVEY**

### **2.1 Existing Problem**

Diabetic retinopathy (DR) is classically defined by its vascular lesions and damage in the neurons of the retina. The cellular and clinical elements of DR have many features of chronic inflammation. Understanding the individual cell-specific inflammatory changes in the retina may lead to novel therapeutic approaches to prevent vision loss. The systematic use of available pharmacotherapy has been reported as a useful adjunct tool to laser photocoagulation, a gold standard therapy for DR. Direct injections or intravitreal anti-inflammatory and antiangiogenesis 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 (particularly hypoglycemic, hypolipidemic, and antihypertensive 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.

## 2.2 References

1. Predicting the Stages of Diabetic Retinopathy using Deep Learning by *Chava Harshitha, Alla Asha, Jangala Lakshmi Sai Pushkala, Rayapudi Naga Swetha Anogini*.  
[10.1109/ICICT50816.2021.9358801](https://doi.org/10.1109/ICICT50816.2021.9358801)
2. Diabetic Retinopathy Prediction using Deep learning by *K V Spoorthi, B S Rekha*  
[10.1109/CSITSS54238.2021.9683553](https://doi.org/10.1109/CSITSS54238.2021.9683553)
3. Diabetic retinopathy classification using a novel DAG network based on multi-feature of fundus images by *LinglingFang, HuanQiao* <https://doi.org/10.1016/j.bspc.2022.103810>
4. A Deep Learning Ensemble Approach for Diabetic Retinopathy Detection by *Sehrish Qummar, Fiaz Gul Khan, Sajid Shah* [10.1109/ACCESS.2019.2947484](https://doi.org/10.1109/ACCESS.2019.2947484)

## 2.3 Problem Statement Definition

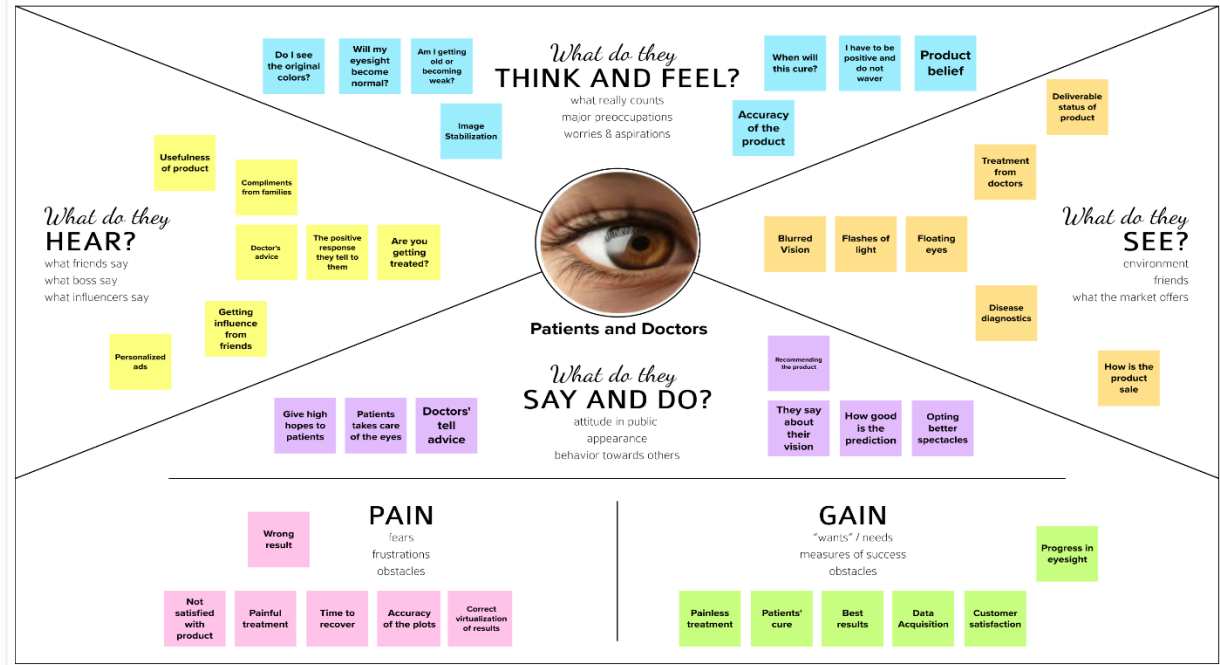
Diabetes mellitus that refers to the abnormal sugar level in the blood. Glucose which is the main source of maintaining blood sugar level in return it is the root cause for several diseases which among them is Diabetic Retinopathy. Diabetic Retinopathy (DR) is a common complication of diabetes mellitus, 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.

## 3. IDEATION & PROPOSED SOLUTION

### 3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

The diabetic retinopathy is a serious disorder that affects the human eye sight. This empathy map gives the insight of the end user of the product. Giving out the pain, hearing and seeing activities, our end users are doctors who use the prediction part suggests the pain and gain of the product. It must be reliable both to the end users and the customers who are making use of the desired product solution. After this, doctors give the correct advice for the four types : Mild NPDR, Moderate NPDR, Severe NPDR, PDR. Knowing this doctors can give right results and the medicative measures for the disease.

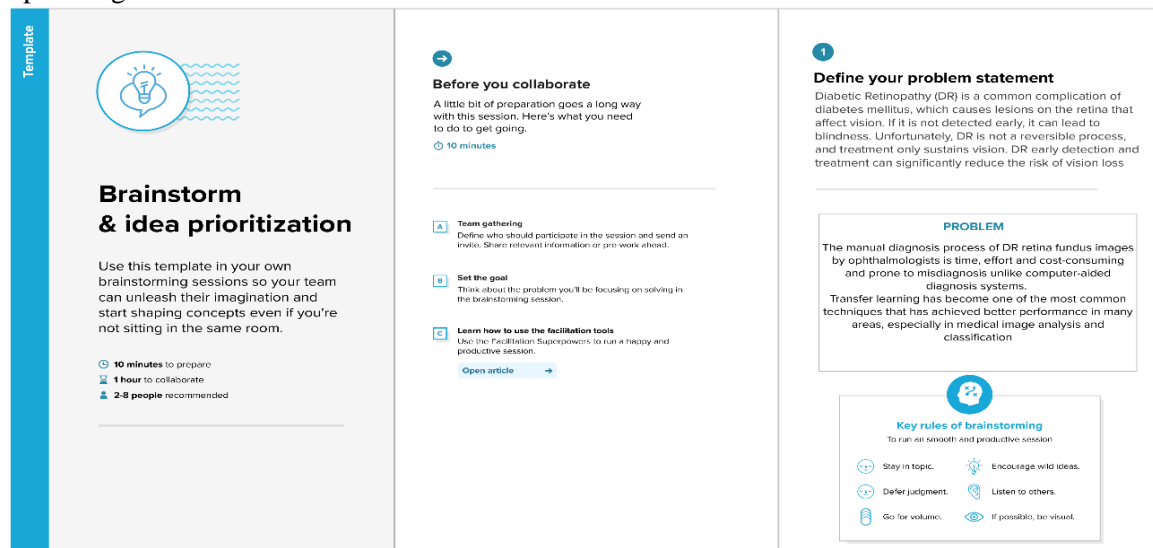


### 3.2 Ideation and Brainstorming

Brainstorm & Idea Prioritization Template: Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

#### Step-1: Team Gathering, Collaboration and Select the Problem Statement

In this initial step all the team mates are gathered in the working platform of mural brainstorming. So the problem statement is understood previously in empathy map. Now brainstorming gives the feasible and ideal solutions that can be provided to avoid the disease. After gathering the members, each members are asked to propose a solution that they come across and give it's brief description at the upcoming slides.



## Step-2: Brainstorm, Idea Listing and Grouping

### 2 Brainstorm

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

10 minutes

**TIP**  
 You can select a sticky note and hit the pencil icon to sketch (can't start drawing)

**Santhosh**

Quit alcohol intake	Lowering blood sugar	Intake of omega 3 fatty acids
Reduce over usage of painkillers	Intake of VEGF drugs	Drink enough water
Explore if any existing medicines	Metastatic tumor treatment	Treatment of glycemia

**Pugalenthi**

Lubricate the eyes	Stop taking eye drops	Avoid cigarette
Use low sodium and potassium foods	Manage diabetes and heart disease	Avoid prolonged use of insulin
Eat healthy non-vegetables and fruits	Proper intake of low acids	Drinking water

**Sathish**

Monitor eye vision	Blood glucose control	Stop smoking
Wear contact eye wear	Use glucose regulator	Keep acid premium or to get regular
Monitor your cholesterol level	Take omega 3 fatty acids	Teamwork with experienced doctor

**Raj Kumar**

Reduce eating processed foods	Get good sleep	Avoid mental stress
UKSK eye surgery	Exercise regularly daily	See an ophthalmologist regularly to check
Use medicine to reduce blood sugar levels	Monitor eye progression	Stop using the high dose

### 3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

**Foods**

Intake of vitamins	Omega-3 fatty acids	Consume fishes
Leafy vegetables	Less meat intake	Citrus foods
Drinking water	Processed foods	

**Health**

Exercise	Periodic checkup	Stop treatments and surgery
Periodic checkup	Take care of eyes	Maintain glucose and sugar
Manage stress and diabetes		

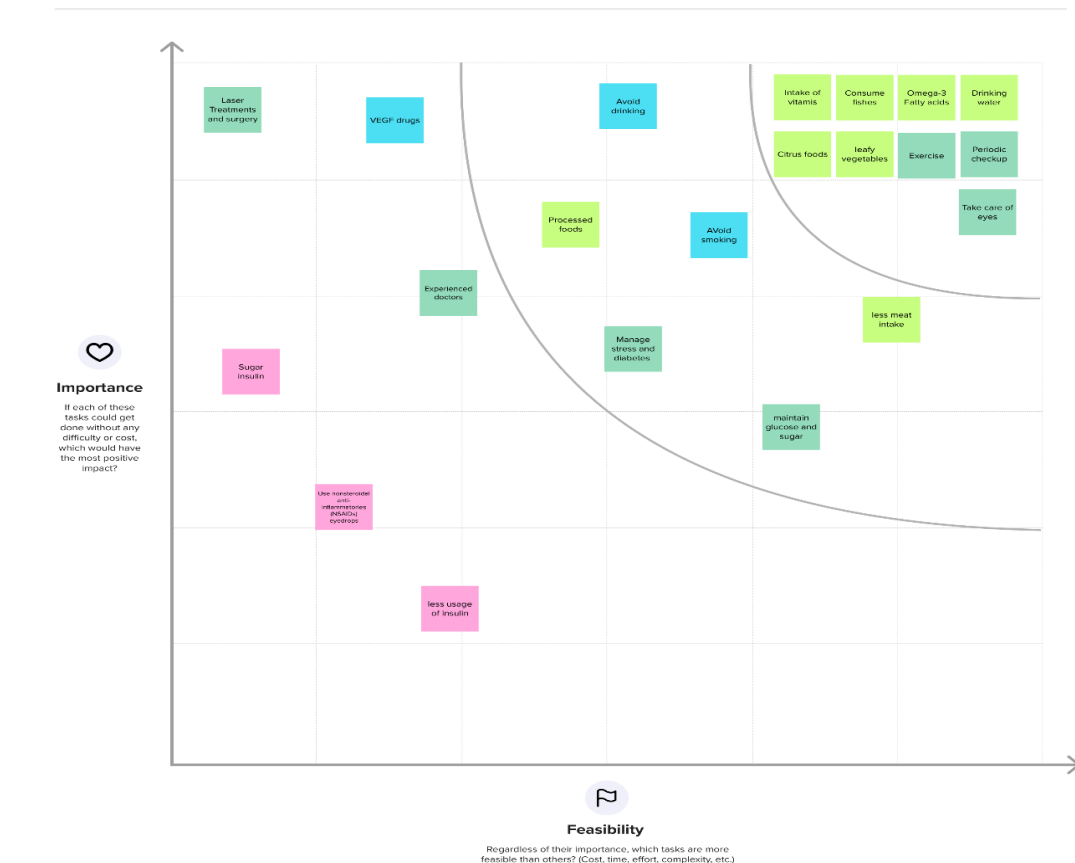
**Drugs**

Stop smoking	Stop drinking	Painkillers
VEGF drugs	Proper dose intake	

**Insulin**

Proper use of insulin	Stop insulin
Less usage of insulin	

## Step-3: Idea Prioritization



### 3.3 Proposed Solution

#### **Problem Statement (Problem to be solved)**

Diabetic Retinopathy (DR) is a common complication of diabetes mellitus (Type 1 diabetes) 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.

#### **Idea / Solution description**

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. Laser treatment that treats the new blood vessels at the back of the eyes

#### **Novelty / Uniqueness**

The levels of diabetic retinopathy are analyzed to provide dosage of anti-VEGF drugs namely ranibizumab (RBZ) or bevacizumab (BVZ) with laser treatment

#### **Social Impact / Customer Satisfaction**

The accuracy of the levels of DR prediction is high so that mispredictions are avoided. Since the level is known, the safe prescription to the ophthalmologist is given.

#### **Business Model (Revenue Model)**

There are lot of diabetic retinopathy patients in India, thus would widen the customer range. Ophthalmologists are also target customers they are also benefited hence this adds to the revenue.

#### **Scalability of the Solution**

##### **Online access**

As deployed from the web portal, it can be accessed even from a simple desktop with limited **computing resources**.

##### **Offline Access**

The above solution is also deployed offline in the clinics.

### 3.4 Problem Solution fit

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

#### **Purpose:**

☐ Solve complex problems in a way that fits the state of your customers.

- ❑ Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.
- ❑ Sharpen your communication and marketing strategy with the right triggers and messaging.
- ❑ Increase touch-points with your company by finding the right problem-behavior fit and building trust by solving frequent annoyances, or urgent or costly problems.
- ❑ Understand the existing situation in order to improve it for your target group.

## Problem-Solution fit canvas 2.0

Define CS, fit into	<b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span> Who is your customer?  <b>Ophthalmologist</b> - physician who specializes in the diagnosis and treatment of diseases of the eye.	<b>6. CUSTOMER</b> <span>CC</span> What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.  <ul style="list-style-type: none"> <li>Correct prediction of disease</li> <li>The accuracy of the predicted disease</li> <li>End user's health issue</li> </ul>	<b>5. AVAILABLE SOLUTIONS</b> <span>AS</span> Which solutions are available to the customers when they face the problem <table border="1"> <thead> <tr> <th>Treatment</th> <th>Pros</th> <th>Cons</th> </tr> </thead> <tbody> <tr> <td>Laser</td> <td>Treat new blood vessels</td> <td>Aching or discomfort</td> </tr> <tr> <td>Eye Treatment</td> <td>New blood vessel formation</td> <td>Eye irritation or discomfort</td> </tr> <tr> <td>Eye Surgery</td> <td>Remove vitreous humour</td> <td>bleeding</td> </tr> </tbody> </table>	Treatment	Pros	Cons	Laser	Treat new blood vessels	Aching or discomfort	Eye Treatment	New blood vessel formation	Eye irritation or discomfort	Eye Surgery	Remove vitreous humour	bleeding	Explore AS, differentiate
	Treatment	Pros	Cons													
Laser	Treat new blood vessels	Aching or discomfort														
Eye Treatment	New blood vessel formation	Eye irritation or discomfort														
Eye Surgery	Remove vitreous humour	bleeding														
<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span> Which jobs-to-be-done (or problems) do you address for your customers? These could be more than one, explain different sides  <ul style="list-style-type: none"> <li>Diabetic Retinopathy (DR) is a common complication of diabetes mellitus, which causes lesions on the retina that affect vision</li> <li>The manual diagnosis uses much time and cost to predict unlike the computer aided systems</li> </ul>	<b>9. PROBLEM ROOT CAUSE</b> <span>RC</span> What is the real reason that this problem exists? What is the root story behind the need to do this job? i.e. customers have to do it because of the charge, regulations  <ul style="list-style-type: none"> <li>Correct prediction of disease</li> <li>The accuracy of the predicted disease</li> <li>End user's health issue whether the patient doesn't gets affected.</li> </ul>	<b>7. BEHAVIOUR</b> <span>BE</span> What does your customer do to address the problem and get the job done?  <ul style="list-style-type: none"> <li><b>laser treatment</b> – to treat the growth of new blood vessels at the back of the eye (retina) in cases of proliferative diabetic retinopathy, and to stabilise some cases of maculopathy</li> <li><b>eye injections</b> – to treat severe maculopathy that's threatening your sight</li> <li><b>eye surgery</b> – to remove blood or scar tissue from the eye if laser treatment is not possible because retinopathy is too advanced</li> </ul>	Focus on J&P, tap into BE, understand													
<b>3. TRIGGERS</b> <span>TR</span> What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.  <b>Persons with floating eye, blurred and fluctuating vision</b>	<b>10. YOUR SOLUTION</b> <span>SL</span> If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.  <b>As a student, till now the current laser treatment is the best procedure for diabetic reitnopathy and limited usage of VEGF drugs</b>	<b>8. CHANNELS OF BEHAVIOUR</b> <span>CH</span> <b>8.1 ONLINE</b> What kind of actions do customers take online? Extract online channels from #7  <b>An online diabetic retinopathy screening tool for patients with type 2 diabetes</b>  <b>8.2 OFFLINE</b> What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.  <b>Optical coherence tomography, fundus fluorescein angiography, slit lamp biomicroscopy, and fundus imaging</b>		Extract online & offline CH of BE												
<b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span> How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design.  <b>fear, anxiety, vulnerability, guilt, loss of confidence, anger, stress and self-perception</b>	Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 License Created by Daria Nepriakhina / Amaltama.com															

## 4. REQUIREMENT ANALYSIS

### 4.1 Functional Requirement

A Functional Requirement (FR) is a description of the service that the software must offer. Non-Functional Requirements are the constraints or the requirements imposed on the system.

**Functional Requirements:** Following are the functional requirements of the proposed solution

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Register the user with their user name and user mail id

FR-2	User Confirmation	Confirmation via Email is sent to e-mail
FR-3	Phone number registration	User is asked to register their phone number for future purposes and registration confirmation message.
FR-4	Image Uploading	Upload the diagnosed image to the webpage to predict the result
FR-5	Session Management	Users can login and logout from their current session

#### 4.2 Non-Functional Requirement :

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

FR No.	Non-Functional Requirement	Description
NFR-1	<b>Usability</b>	Difference between the normal eye and diabetic retinopathy eye.
NFR-2	<b>Security</b>	Email verification security is maintained.
NFR-3	<b>Reliability</b>	Logged in details will be sent to the phone number
NFR-4	<b>Performance</b>	Fast prediction of the result required
NFR-5	<b>Availability</b>	Accessible webpage from any device
NFR-6	<b>Scalability</b>	Flexible to add new modules to increase productivity

## 5. PROJECT DESIGN

### 5.1 Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Below Fig.5.1 shows the level 0 DFD of the Diabetic Retinopathy Prediction system. The initial 0<sup>th</sup> stage consists of User Login that comprises of Registering and logging in of new user. This is the inputs given at the initial stage to the system. Whereas the hidden technology stack helps in prediction part from the images provided by the user to predict and the prediction results are sent to the web browser for doctor's further analysis of the patient.

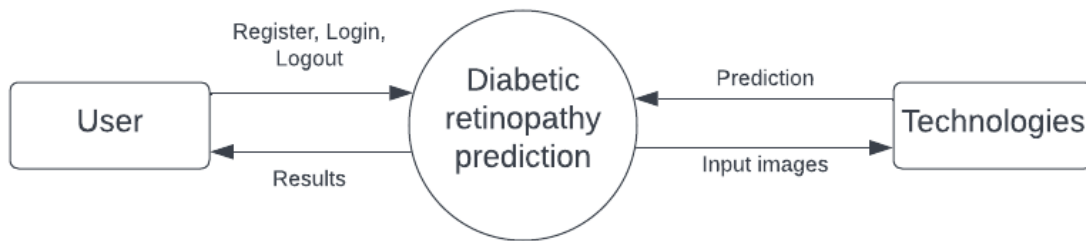


Figure 5.1 Level 0 DFD for Diabetic retinopathy prediction

Fig. 5.2 shows the level 1 DFD that explains about technology stack on the hold by not showing the in-depth architecture.

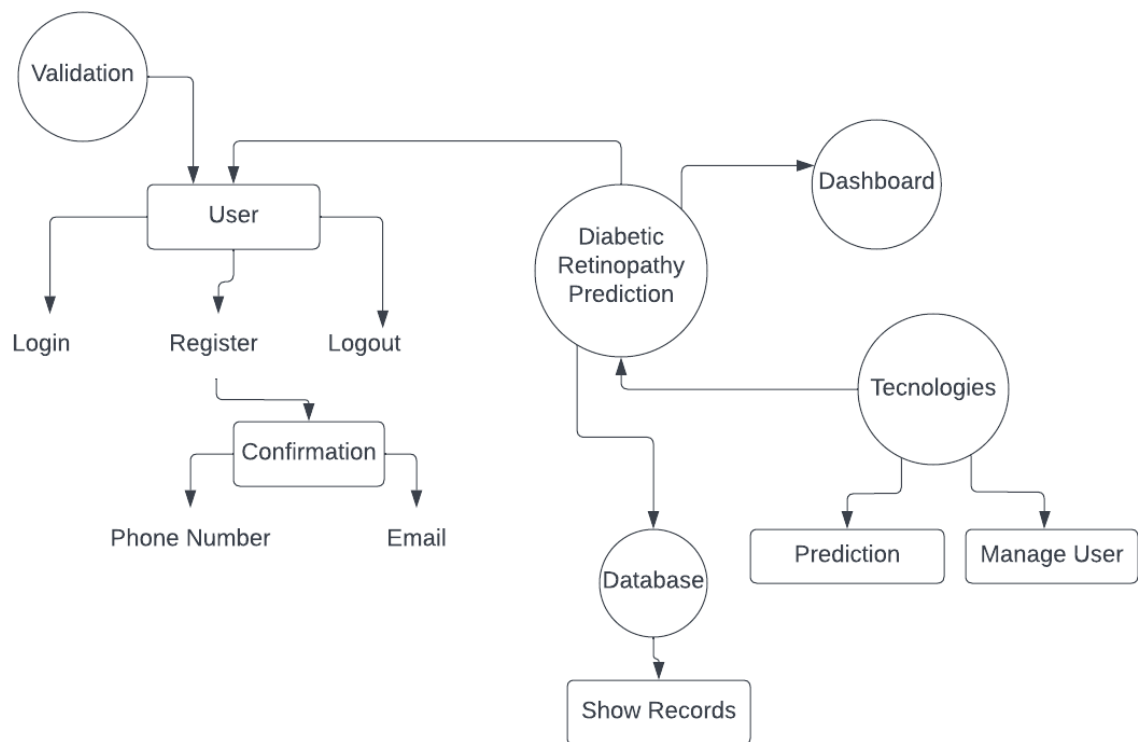


Figure 5.2 Level 1 DFD for Diabetic retinopathy prediction

## 5.2 Solution & Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.



- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

Figure 5.3 shows the solution architecture involved during the development of the web app which explains the various modules and its submodules and the process that is used for the enhancement of the project and the overall flow of the system.

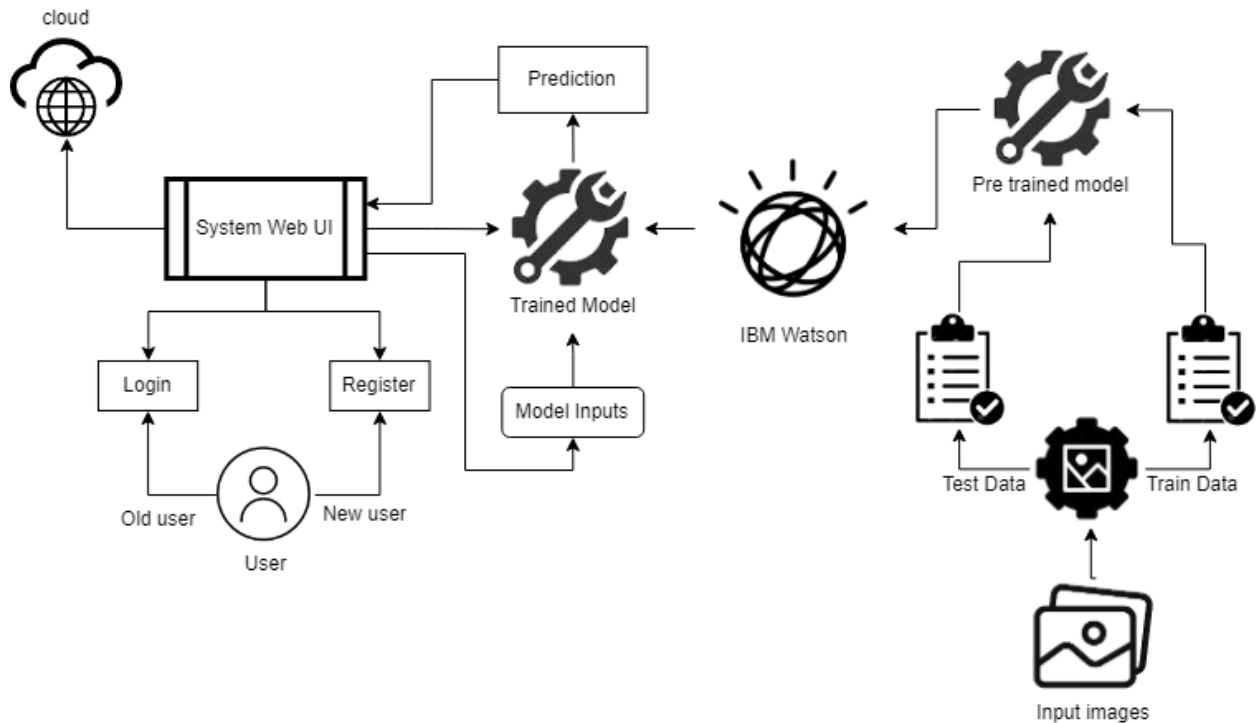


Figure 5.3 Solution Architecture for DR

### 5.3 User Stories

User stories below include sprint progress which means the team's and team member's progress of each assigned task given to them is categorized to four sprints and shown below.

Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1

Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email	High	Sprint-1
	USN-3	The registration is confirmed using phone number	I received a confirmation message	Low	Sprint-2
	USN-4	As a user, I can register for the application through Gmail	I can register via gmail	Medium	Sprint-3
Login	USN-5	As a user, I can log into the application by entering email & password	I can log in to the application after registration	High	Sprint-1
Dashboard	USN-6	User can see their dashboard	Users see their profile activity	Medium	Sprint - 4
Validataion	USN-7	Validates user login id	Checks for the mail	Low	Sprint-2
Patient's name and ID	USN-8	Doctor uses this report for seeing patient's activity	Storing patient's ID	Medium	Sprint-3
Upload Images	USN-9	Prediction part	Show the disease level	High	Sprint-2
Logout	USN-10	Logout from the current user	Logs out	High	Sprint-4

## 6. PROJECT PLANNING AND SCHEDULING

### 6.1 Sprint Planning & Estimation

The tasks to be done during the sprint executions are

- As a user, I can register for the application by entering my email, password, and confirming my password.
- As a user, I will receive confirmation email once I have registered for the application
- The registration is confirmed using phone number
- As a user, I can register for the application through Gmail
- As a user, I can log into the application by entering email & password
- User can see their dashboard
- Validates user login id
- Doctor uses this report for seeing patient's activity
- Prediction part
- Logout from the current user

Each task are given to sprints and they are shown in the next sub [section 6.2](#).

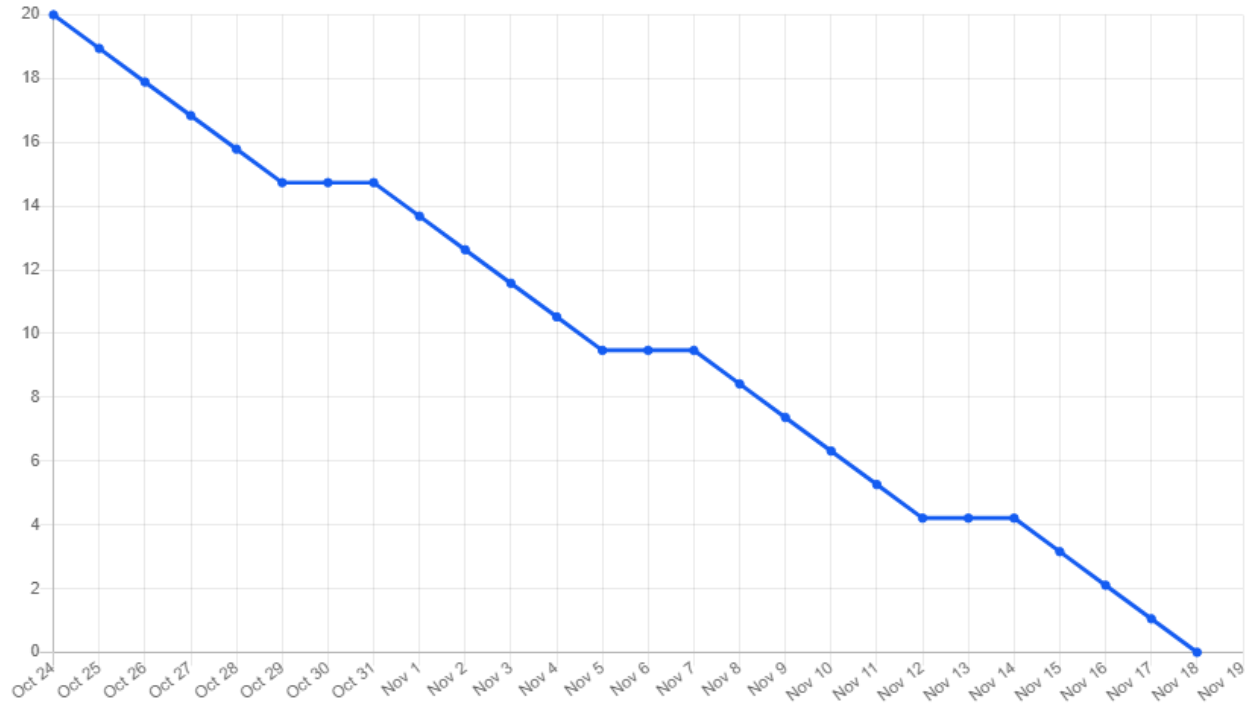
<b>Sprint</b>	<b>Functional Requirement (Epic)</b>	<b>User Story Number</b>	<b>User Story / Task</b>	<b>Story Points</b>	<b>Priority</b>	<b>Team Members</b>
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	2
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	2
Sprint-2		USN-3	As a user, I can register for the application through mail	2	Low	2
Sprint-3		USN-4	Connecting to database	2	High	2
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	1
Sprint-4	Dashboard	USN-6	User can see their dashboard	2	Medium	3
Sprint-2	Validation	USN-7	Validates user login id	2	Low	4
Sprint-3	Patient's name and ID	USN-8	Doctor uses this report for seeing patient's activity	1	Medium	3
Sprint-2	Upload Images	USN-9	Prediction part	2	High	2
Sprint-4	Logout	USN-10	Logout from the current user	2	High	1

## 6.2 Sprint Delivery Schedule

Sprint delivery schedule aims in completing the sprint from the starting to the ending date

<b>Sprint</b>	<b>Total Story Points</b>	<b>Duration</b>	<b>Sprint Start Date</b>	<b>Sprint End Date (Planned)</b>	<b>Story Points Completed (as on Planned End Date)</b>	<b>Sprint Release Date (Actual)</b>
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	16	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	18	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	15	19 Nov 2022

Velocity for Sprint-1 =  $20/8 = 2.5$   
 Velocity for Sprint-2 =  $20/10 = 2$   
 Velocity for Sprint-3 =  $20/8 = 2.5$   
 Velocity for Sprint-4 =  $20/10 = 2$



### 6.3 Reports from JIRA

Jira reports include the starting and ending project date with the completion status

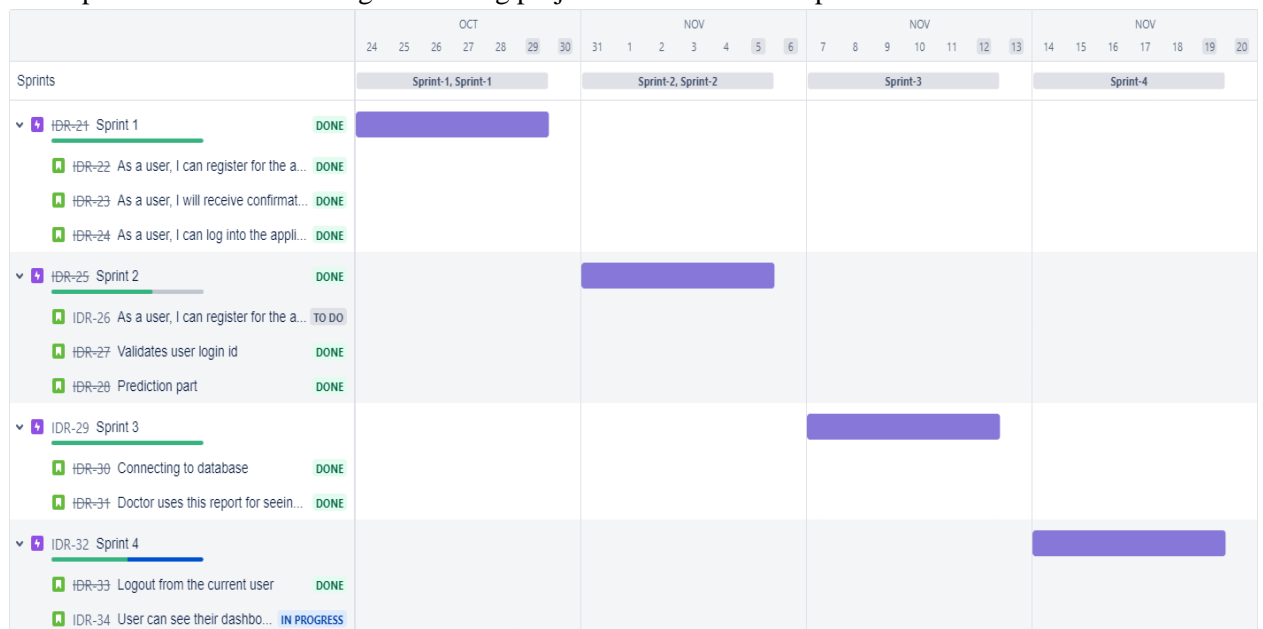


Figure 6.1 Timeline for each sprint

Sprint 1 shows the activities to be done and the progress status and similarly for all the sprints

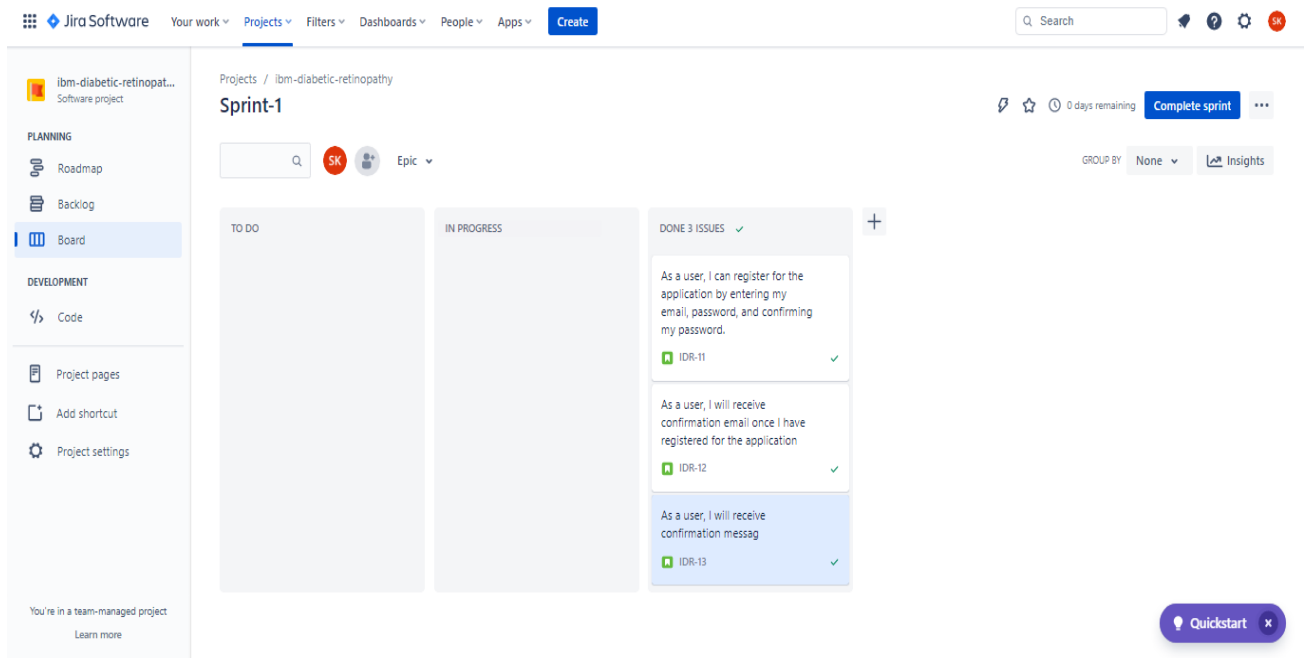


Figure 6.2 Sprint 1

Sprint 2 shows the activities to be done and the progress status

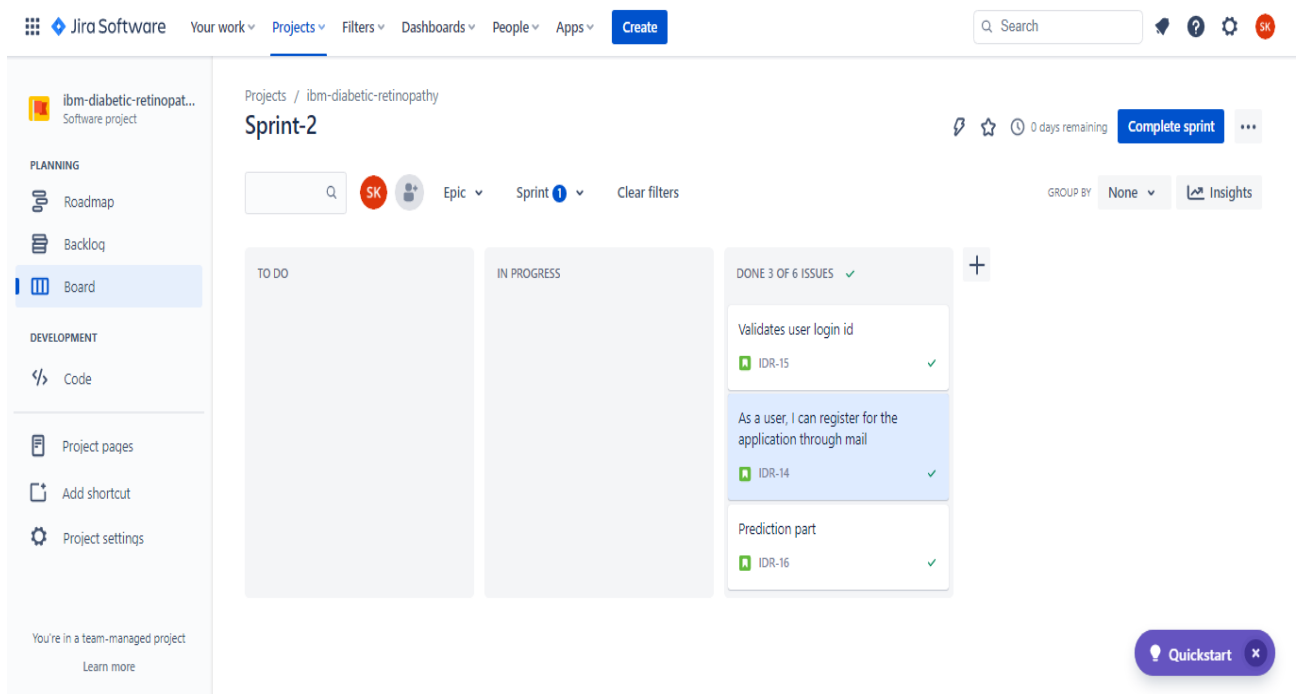


Figure 6.3 Sprint 2

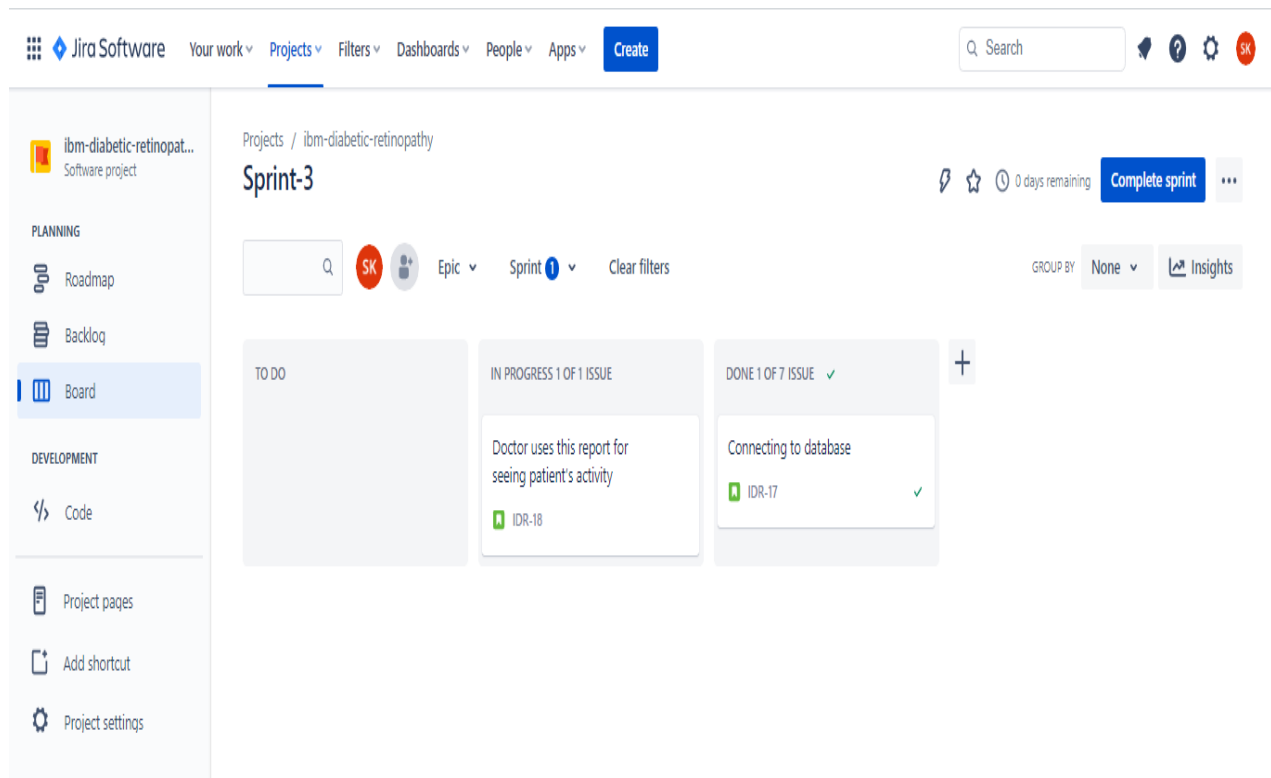


Figure 6.4 Sprint 3

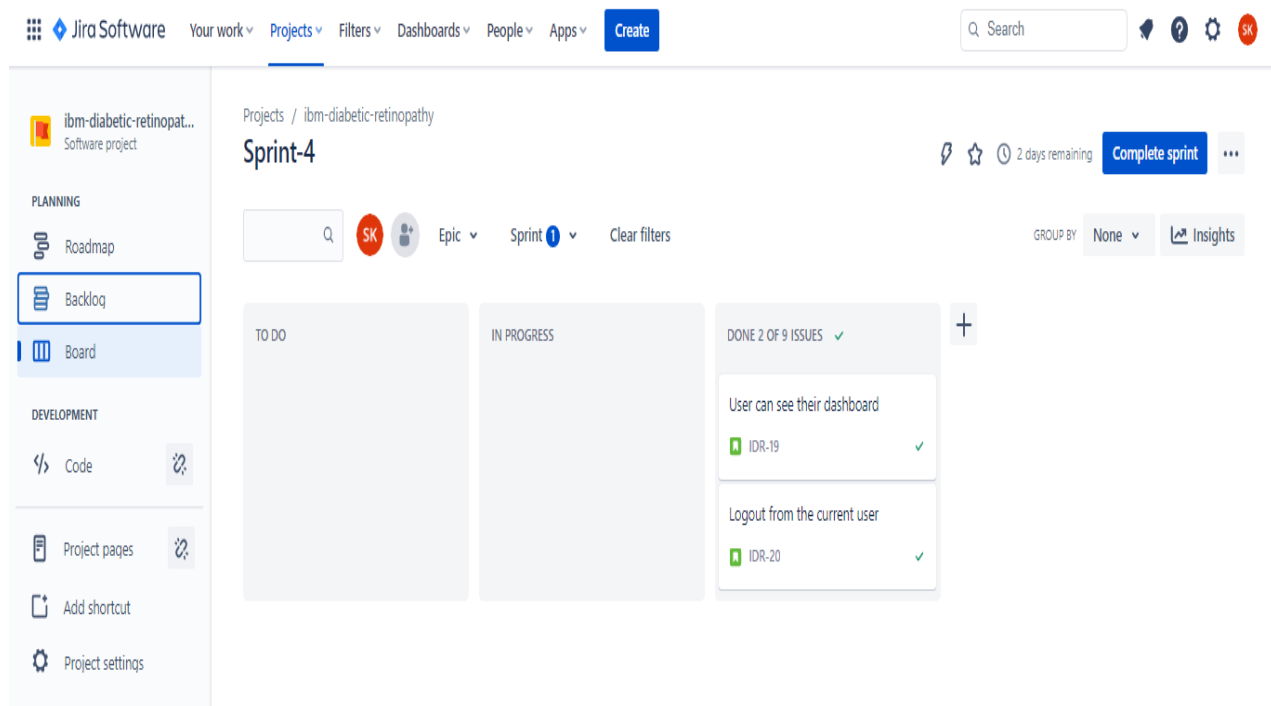


Figure 6.5 Sprint 4

## 7. CODING & SOLUTIONING

### 7.1 Feature 1

- As a user, I can register for the application by entering my email, password, and confirming my password.
- As a user, I will receive confirmation email once I have registered for the application
- As a user, I can log into the application by entering email & password

### Code Snippet

```
@ 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')
```

The registration module since it is essential for new user the registration page is created. While registering the user must provide their user name, mail id, password and their mobile number for other verifications. If successful registration user gets message that “*User registration successful click here to login.*”.



Enter Name

Enter Mail ID

Enter Mobile number

Enter Password

Register

Already Registered: [Login Here](#)

## 7.2 Feature 2

- As a user, I can register for the application through mail
- Validate login
- Prediction part and using twilio portal

## Code Snippet

```
model = load_model(r"Updated-xception-diabetic-retinopathy.h5")
app = Flask(__name__)
app.secret_key="abc"
app.config['UPLOAD_FOLDER'] = "User_Images"
@ 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'])):
                session['user'] = user
```




```

        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')

```

User Login

Home Login Register



The above figure shows the login screen of the web app. Only the registered user has the privileges to access their account and check through the predictions.

### 7.3 Feature 3

Connecting to the database

#### Code Snippet

```

# Authenticate using an IAM API key
client = Cloudant.iam('d3ffc21a-c9d1-4276-a7c3-d7a48a949e1f-bluemix',
                      'oS6rF9Lb8-d8IyJW4VEdHx5kiIN9ehQnNoj8ygKXFjzu',
                      connect=True)

# Create a database using an initialized client
my_database = client.create_database('my_db')
if my_database.exists():
    print("Database '{0}' successfully created.".format('my_db'))

```

Cloudant DB is connected to our web app so that users login details and registration details are stored.

< my_db	:	Document ID	Options	{ } JSON		
All Documents	+	Table	Metadata	{ } JSON		Create Document
Query						
Permissions						
Changes						
Design Documents	+					

id	key	value
<input type="checkbox"/> 61e8a2875afa1b0373d3a1f3b15f76fa	61e8a2875afa1b0373d3a1f3b15f76fa	{ "rev": "1-6ef158a447651babbc111..." }
<input type="checkbox"/> 8194c65200bb42817e3d8cb271eda...	8194c65200bb42817e3d8cb271eda...	{ "rev": "1-b602b4bd18d44e39159eb..." }
<input type="checkbox"/> fe170c1434273d0c45b0d31af9050b...	fe170c1434273d0c45b0d31af9050b...	{ "rev": "1-52f30e1fb98a95aef7f9c0c..." }

## 7.4 Feature 4

Logout from current user and user viewing their dashboard

```
@ app.route('/logout')
def logout():
    session.pop('user',None)
    return render_template('logout.html')

<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!
        </div>
    </div>
```

```

        <a href="login" class="btn btn-lg btn-dark">Login for more
Information</a>
    </div>
</div>
</body>

```

User initially logs in to their account then session log out is necessary hence it is shown below

Diabetic Retinopathy Classification

[Home](#)
[Prediction](#)
[Logged in as santhoshsingh\\_cs@mepcoeng.ac.in](#)

## 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 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.

---

### NORMAL EYE

### DIABETIC RETINOPATHY

Diabetic Retinopathy Classification

[Home](#)
[Prediction](#)
[Login](#)
[Register](#)

## 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 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.

---

### NORMAL EYE

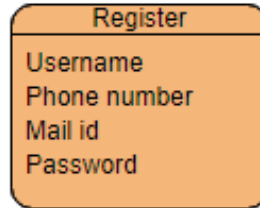
### DIABETIC RETINOPATHY

Finally, the user is able to login to their account.

## 7.5 Database Schema

This system only consists of register table with attributes

- username <string>
- phone number <int,10>
- mail id <string>
- password <string>



## 8. TESTING

### 8.1 Test Cases

#### TC - 1

Test cases	Result
Improper mail id given	Not registered
Phone number not given	Details not stored
Password not provided	Details not stored
Confirmation mail message	Sent successfully
Log in to the application	Successful
Log in to the application with wrong password	Showing error message successfully
Log in to the application showing other user	Improper user
Log in to the application using unregistered mail	Mail not found

#### TC – 2

Test cases	Result
Improper mail id given	Not registered
Password not provided	Not logged in
Log in to the application	Successful
Showing logged in mail id	Successful (logged in as abc@gmail.com)
Upload and correct prediction	Successful

#### TC – 3

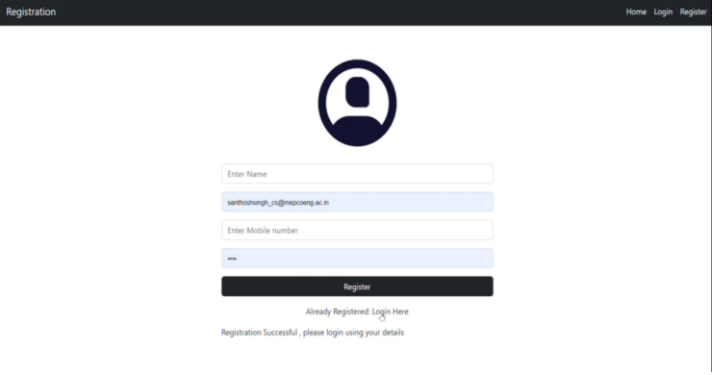
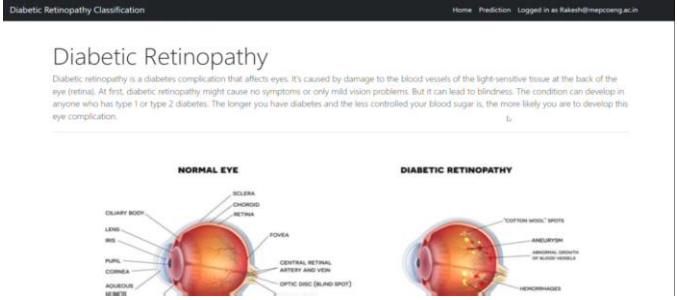
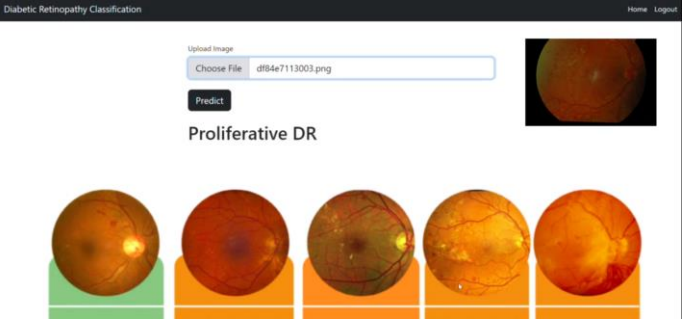
Test cases	Result
Upload and correct prediction	Successful (logged in as <a href="mailto:abc@gmail.com">abc@gmail.com</a> )
Viewing prediction	Successful
Database Creation	Successful
Store data in as a json query	Success

#### TC – 4

Test cases	Result
Logs out of current account	Success
Logs out but session not terminated	False
Dashboard not viewed	Failed
Show current user login	Success

## 8.2 User Acceptance testing

UAT is when we conduct a test to see whether a software product meets the business requirements. It is the final stage of software development before moving on to production. The end-user does it to verify a software system before moving the software product to a live environment. It confirms whether the solution works well for the user or not.

UAT	Testing name	Test Results
UAT 1	Registration of the user	
UAT 2	Login of the registered user	 <p>Top right corner Logged in as <a href="mailto:Rakesh@mepcoeng.ac.in">Rakesh@mepcoeng.ac.in</a></p>
UAT 3	Prediction results	

UAT 4	Logout from user	
-------	------------------	--

Hence from the above test results all the carried Unit testing and integration testing from the sprints are carried out well and the end user application works well.

## 9. RESULTS

### 9.1 Performance Metrics

#### a) Reliability

The new user that is the doctor with new registration is given with login details in which he/she gets their own private dashboard.

#### b) Accuracy

Predicted results proved to be accurately correct, hence it is best suited for prediction

#### c) User friendly

The user-friendly environment and a simple UI made progress better.

## 10. ADVANTAGES AND DISADVANTAGES

### ADVANTAGES

- Better prediction results.
- Good and reliable application.
- Prediction results made easier and its results are sent to registered phone number.

### DISADVANTAGES

- Dashboard results doesn't show properly.
- Each and every patient's name with prediction details is not provided yet.

## 11. CONCLUSION

In the current scenario, the focus of the pharmacotherapy in combating the development and progression of DR is still mainly focused on corticosteroid therapy and anti-VEGF agents. What is the efficacy of compounds derived from plants? In this regard, the early prediction of DR helps one to analyze the DR of a patient. Addition to this, the application can also be modified so that the suggestion of RBZ (Rabeprazole) and BVZ (Bevacizumab) drug suggestion can be provided in future. For, the long-term success of DR therapeutics, research options should consider considering the developing of drug delivery systems to have an extended period of effect for drugs/proteins, or further investigations on the possibility of using pluripotent stem cell technology for transplantation into DR host to restore retinal functions is needed.

## 12. FUTURE SCOPE

The need in DR prediction system may or may not increase. This is only applicable when person maintains the sugar level and the diabetes in their body. This painless photo-based prediction system helps many persons with DR disease. If the current application is not enough only for prediction it can be modified as seen in the conclusion section. Hence the DR prediction creates good impact between the users who try them because of their advantage.

## 13. APPENDIX

### SOURCE CODE

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/T2uDLTpkwGzCiq6soy8tYa1lGyVh/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">
      
    </div>
  </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/T2uDLTpkwGzCiq6soy8tYa1lGyVh/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>
      </ul>
    </div>
  </nav>
</form>

```

```

    <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" class="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>
    </div>
  </div>
</form>
</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>
        </ul>
      </div>
    </nav>
  </form>
</html>
```

```

    <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" class="btn btn-dark btn-primary" style="width:100%;"
type="submit">Login</button>
    </div>
    {{pred}}
  </div>
</form>
</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" >
  
</div>
</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/T2uDLTpkwGzCiq6soy8tYa1lGyVh/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;
    }
  </style>

```

```

        .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>

```

---

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, session
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('d3ffc21a-c9d1-4276-a7c3-d7a48a949e1f-bluemix',
                      'oS6rF9Lb8-d8IyJW4VEdHx5kiIN9ehQnNoj8ygKXFjzu', connect=True)
# Create a database using an initialized client
my_database = client.create_database('my_db')
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")

# 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'])):
                session['user'] = user
                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():

```

```

    session.pop('user',None)
    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=(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 = 'ACe84a385fa5539d372c1a924452f489a3'
auth_token = '359788a4ddfb510ac8ecd2fa948b924e'

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_='+17088347950',
    body='Results: '+ result,
    to ='+919500680243'
)

return render_template('prediction.html', prediction=result, fname = filepath)
else:
    return render_template("prediction.html")

@app.route('/index')
def home():
    login=False
    if 'user' in session:
        login=True
    return render_template("index.html", pred="Login", vis ="visible",login=login)

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

```

GitHub → <https://github.com/IBM-EPBL/IBM-Project-2226-1658467109>

Project Demo video link →

[https://drive.google.com/file/d/1GGfylE3VLH-eaqU2zpA5gGIYnJF7NIfw/view?usp=share\\_link](https://drive.google.com/file/d/1GGfylE3VLH-eaqU2zpA5gGIYnJF7NIfw/view?usp=share_link)