EXPLORATORY ANALYSIS OF RAINFALL DATA IN INDIA FOR AGRICULTURE

USING APPLIED DATA SCIENCE

A Project report submitted in partial fulfilment of 7th semester in degreeof

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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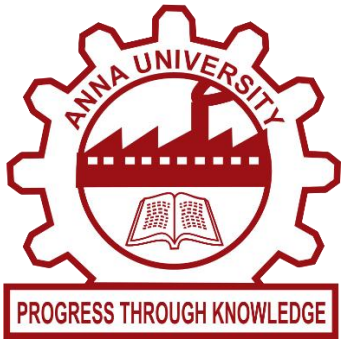

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING VSB COLLEGE OF ENGINEERING TECHNICAL CAMPUS, COIMBATORE

ANNA UNIVERSITY: CHENNAI 600025

Executed By:

IBM

BONAFIDE CERTIFICATE

Certified that this project report **"EXPLORATORY ANALYSIS OF RAINFALL DATA IN INDIA FOR AGRICULTURE"** is the bonafide record work done by **SARAVANAKUMAR K (511319104063)**, **LOKESH B** (**511319104042**), **MARTIN THOMAS Y** (**511319104047**), **MAGESH P** (**511319104046**) for **IBM-NALAIYATHIRAN** in **VII** semester of **B.E.,** degree course **in Computer Science and Engineering** branch during the academic year of 2022 -2023.

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Dr. U. V. Arivazagu

ABSTRACT

Farming is the backbone of the Indian economy, albeit it requires more assistance than any other. India has a population of over a billion people, with over 70% of the population living in the country. Agriculture is a significant industry and a crucial influencer of the Indian economy, employing 40% of the country's workers. Regardless, its commitment to the 2.3 lakh crore rupee economy is a pathetic 16% of total GDP. Rainfall is a serious problem these days. For the time being, the weather has been shifting. Rainfall forecasting is critical since it can lead to a variety of disasters. Irregular severe rainfall can destroy crops and produce flooding, which can endanger human life. It is critical to precisely determine rainfall in order to make the best use of water resources, increase crop output, and plan ahead of time for water infrastructure. This comparative study is conducted concentrating on the following aspects: modeling inputs, Visualizing the data, modeling methods, and pre-processing techniques. The results provide a comparison of various evaluation metrics of these machine learning techniques and their reliability to predict rainfall by analyzing the weather data. Agriculture in India requires institutional consideration, bank support in the form of loans and welfare schemes, and suffers from a slew of calamities such as depleting groundwater levels in rural areas, environmental change, dry seasons, floods, unwarranted value fixing of produce, relocation of farmers to urban communities in search of better-paying jobs, and much more. Agriculture is one section in responsibility of feeding everyone, but the general populace is the last to be dealt with. After coming up short on institutions, time has unquestionably wished innovation to take management of the alteration. Classification techniques such as Decision tree, Random forest, KNN, and xgboost will be used. These algorithms will be used to train and test the data. The best model is chosen and saved in pkl format. After saving the model, we connect it with the flask application and deploy it to IBM.

TABLE OF CONTENT

EXPLORATORY ANALYSIS OF RAINFALL DATA IN INDIA FOR AGRICULTURE

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Rainfall has been a major concern these days. Weather conditions have been changing for time being. Rainfall forecasting is important otherwise, it may lead to many disasters. Irregular heavy rainfall may lead to the destruction of crops, heavy floods that can cause harm to human life. It is important to exactly determine the rainfall for effective use of water resources, crop productivity, and pre-planning of water structures. This comparative study is conducted concentrating on the following aspects: modelling inputs, Visualizing the data, modelling methods, and pre-processing techniques. The results provide a comparison of various evaluation metrics of these machine learning techniques and their reliability to predict rainfall by analysing the weather data. We will be using classification algorithms such as Decision tree, Random forest, KNN, and xgboost. We will train and test the data with these algorithms. From this best model is selected and saved in pkl format. Once the model is saved, we integrate it with flask application and also deploy the model in IBM.

1.2 PURPOSE

India is an agricultural country and secondary agro based market will be steady with a good monsoon. The economic growth of each year depends on the amount of duration of monsoon rain, bad monsoon can lead to destruction of some crops, which may result in scarcity of some agricultural products which in turn can cause food inflation, insecurity and public unrest. In our analysis we are trying to understand the behavior of rainfall in India over the years, by months and different subdivisions. Agriculture is the backbone of the Indian economy. For agriculture, the most important thing is water source, i.e., rainfall. The prediction of the amount of rainfall gives alertness to farmers by knowing early they can protect their crops from rain. So, it is important to predict the rainfall accurately as much as possible. Exploration and analysis of data on rainfall over various regions of India and especially the regions where agricultural works have been done persistently in a wide range. With the help of analysis and the resultant data, future rainfall prediction for those regions using various machine learning techniques such as XGBoost classifier, SVM classifiers, Decision tree, Naive bayes classifier, Logistic regression etc.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Weather conditions changes then and often. This can lead to Severe threats to all the living beings including human beings. So predicting weather, especially Irregular heavy rainfall can cause huge floods and economic losses. This also decreases crop productivity and may lead into Food shortage. Predicting the Rainfall plays a vital role in our life time. Farmers will get benefit due to this and Our country's GDP will rise. Collection of previous 10 years data may give us an idea about the pattern of Rainfall. Using all these Datas, Appropriate farming activities can be performed. Water is the vital mineral for a life. So, these datas can help us in predicting Rainfall during summer days to save water. Agriculture definitely requires gallons of waters. We use APPLIED DATA SCIENCE to solve this problem. There are so many algorithms available such as Decision tree, Random Forest, KNN, Xgboost, etc. We will test and train the data with one of these algorithms. From these, the best algorithm is selected and the model is being developed. We visualize the data and models. The results provide us various evaluation metrics of the Machine Learning techniques.

- ✓ Understanding the variability in rainfall, analysis of Indian Summer monsoon rainfall using Spatial resolution.
- ✓ Presents about the analysis of Crop-climate relationships for India, using historic predictions.
- ✓ This Study shows that, India has two monsoon rainfall season one is north west monsoon and second one is south east monsoon.

2.2 REFERENCES

[1] Markand Oza and C.M.Kishtawal - Spatial analysis of Indian Summer monsoon Rainfall (Mar 26,2014).

[2] Anusha Gajinkar - Exploratory data Analysis of Indian Rainfall Data.

[3] K. Krishna kumar, K. Rupa Kumar, R.G. Ashrit, N.R. Deshpande and J.W. Hansen – Climate impacts on Indian Agriculture. (16 June,2004).

2.3 PROBLEM STATEMENT DEFINITION

India is an agricultural country and secondary agro based market will be steady with a good monsoon. The economic growth of each year depends on the amount of duration of monsoon rain, bad monsoon can lead to destruction of some crops, which may result in scarcity of some agricultural products which in turn can cause food inflation, insecurity and public unrest. In our analysis we are trying to understand the behavior of rainfall in India over the years, by months and different subdivisions. Rainfall occurring at the end of the monsoon season provides stored soil moisture and sometimes irrigation water for the rabi crop, which is sown in the post-monsoon season (October–November). The summer monsoon therefore is responsible for both Kharif and Rabi crop production over India. Most of the Indian agricultural land is irrigated by the southwest monsoon. Crops such as wheat, rice, pulses, which are a staple in Indian diets, need heavy rainfalls to grow. Rubber trees in the southern region require heavy and regular rain with high temperatures.
So, it is important to analyze the rainfall data for agriculture in India.

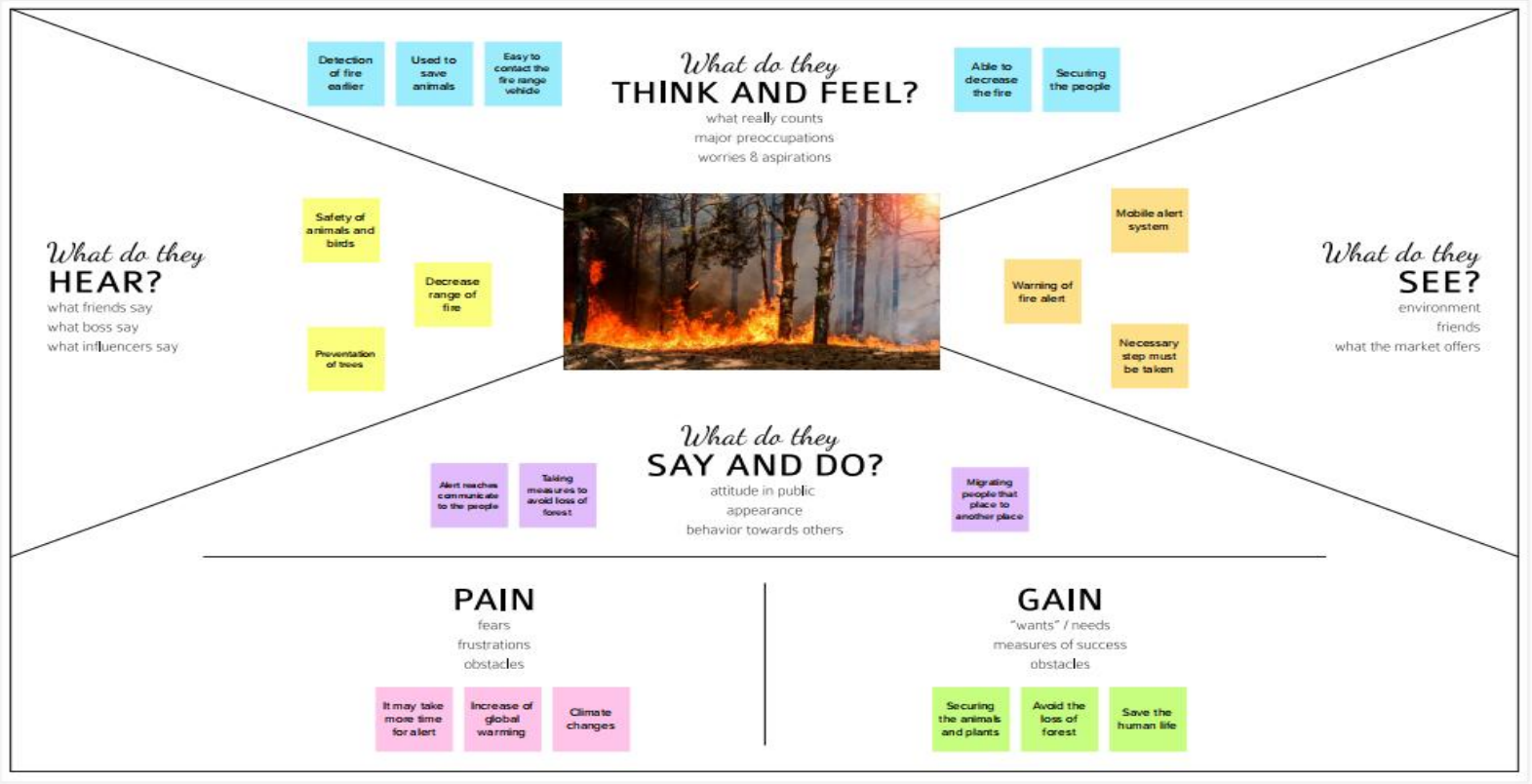
3.IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

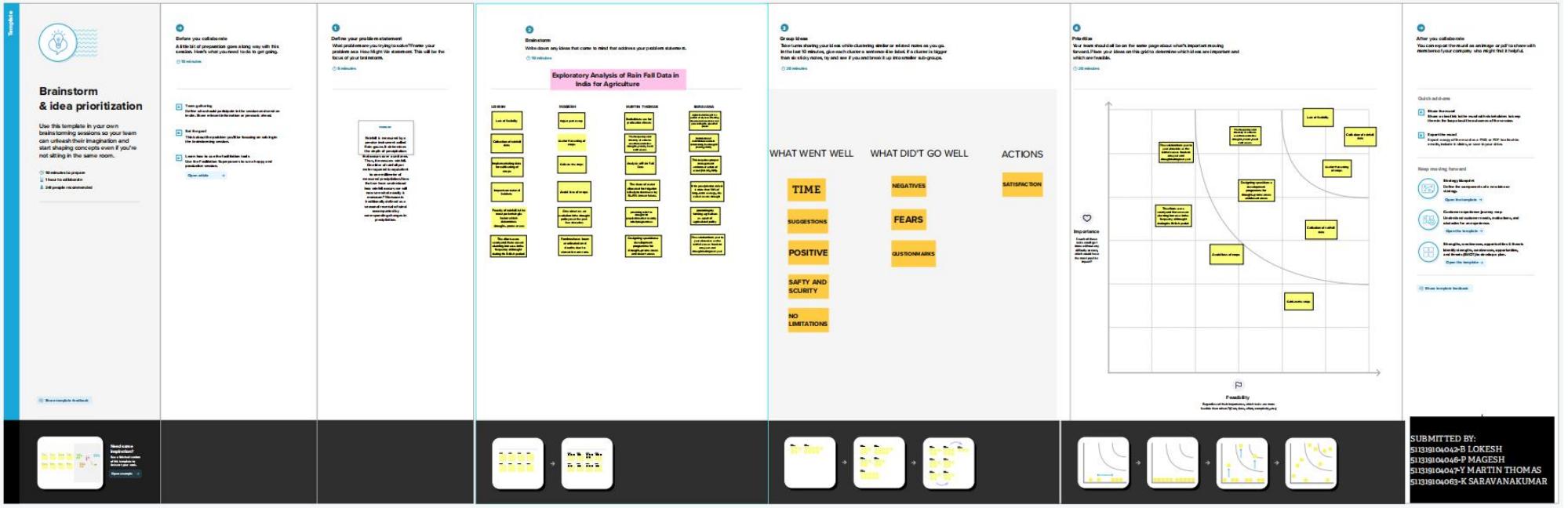
Empathy Map Canvas

Emerging Methods for Early Detection of Forest Fires

Build empathy and keep your focus on the user by putting yourself in their shoes.



3.2 IDEATION & BRAINSTORMING



3.3 PROPOSED SOLUTION

PROBLEM STATEMENT:

India is an agricultural country and secondary agro based market will be steady with a good monsoon. The economic growth of each year depends on the amount of duration of monsoon rain, bad monsoon can lead to destruction of some crops, which may result in scarcity of some agricultural products which in turn can cause food inflation, insecurity and public unrest. In our analysis we are trying to understand the behavior of rainfall in India over the years, by months and different subdivisions.

SOLUTION DESCRIPTION:

First, we will see the distribution of rainfall over months. We will see what exactly is monsoon, different types of monsoon winds in India, which subdivisions of India receives rainfall from which monsoon winds and why only particular subdivisions receive highest rainfall during this monsoon season. So basically, during the summers, the Indian subcontinent heats up more as compared to the Indian ocean as the sun is directly over the landmass. So, we receive low rainfall during summer season. So with all these information following steps to be followed.

- Collecting the dataset
- Comparing current data with previous data
- Analysis and summarizing of when the rainfall occurs.

UNIQUENESS/NOVALITY:

- Advanced app features.
- Cost of maintenance is easy.
- Regular updates of data regarding rain.
- Easy investigation of data with graphical representation.
- Easy analysis of rainfall for stabilizing the crop production.

SOCIAL IMPACT/CUSTOMER SATISFACTION:

- Determine how fast a crop will grow from seed including when it will be ready for harvesting.
- With the rainfall data we can forecast tropical cyclones.

- We can monitor flood and drought conditions.
- We can make measures to store the fresh water earlier.
- Easy for farmers for cultivating the crops.

BUSINESS MODEL (FINANCIAL BENEFIT):

The valuable information can save you from wasting water and money, while also preventing you from over-saturating the ground. A rain measuring instrument can also help you monitor if your plants and grass are getting too much water if you notice unusually large amounts of rainfall over a period of time.

SCALABILITY OF SOLUTION:

This application is used to track the rainfall data for agricultural yields. So that, it can increase the food production and we can built the storage for rainfall for increasing water supply.

3.4 PROBLEM SOLUTION FIT

PROBLEM SOLUTION FIT

TEAM ID : PNT2022TMID39901

PROJECT TITLE : Exploratory Analysis of Rain Fall Data in india for Agriculture

Define CS, fit into CL

CS

1. Customers Segment:

- ✓ Micro, small or marginal,emerging and large or commercial farmers.
- ✓ Departments of the Government or NEWS organizations seeking rainfall forecasts.

CC

6. Customer Constraints:

- ✓ Cost limitation.
- ✓ Time limitation.
- ✓ Agriculture supply limitation

AS

5. Available solution:

- ✓ A website exists which uses the previous data to predict the rainfall and various models are been developed.
- ✓ NEWS on weather forecasting.
- ✓ Prediction by the experts.

Explore AS, differentiate

Focus on PR, tap into BE, understand RC

PR

2.Problems/Jobs-to-be-done:

- ✓ Because of the long gap between rains, crops face water stress. Short term crops Their vegetative phase would be cut short and they will go into early flowering, leading to a drop in yield.

RC

9. Problem Root Cause:

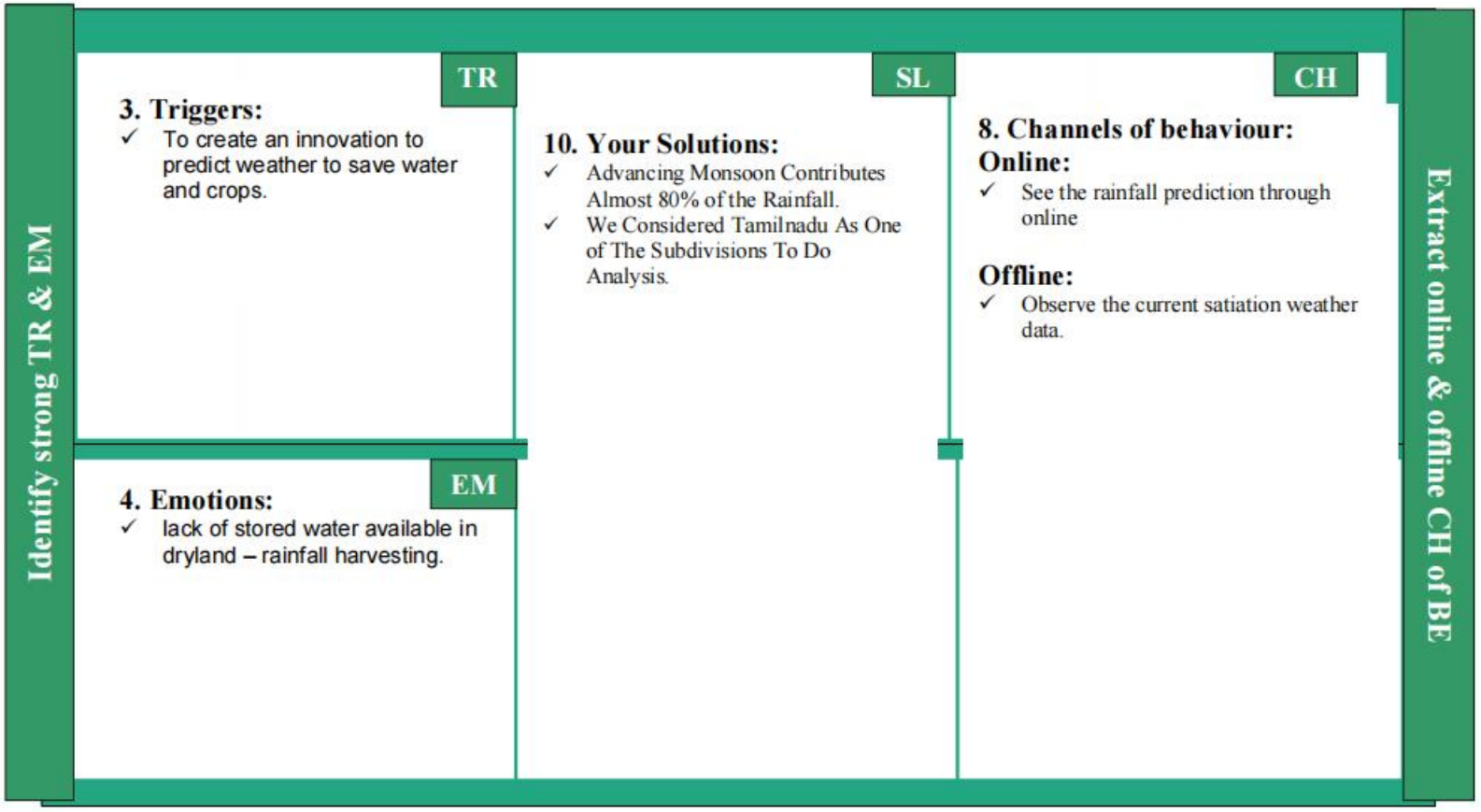
- ✓ Irregular rainfall in various regions of India
- ✓ Drastic variability in climate change
- ✓ Biodiversity loss
- ✓ Unpredictable weather
- ✓ Formation of cyclones in costal areas

BE

7. BEHAVIOUR

- ✓ Customers draw a petition to the Government to solve their problems.
- ✓ Online report submission system are available.
- ✓ They report to the experts in the field.

Focus on PR, tap into BE, understand RC


Identify strong TR & EM
TR
3. Triggers:
✓ To create an innovation to predict weather to save water and crops.
EM
4. Emotions:
✓ lack of stored water available in dryland – rainfall harvesting.
SL
10. Your Solutions:
✓ Advancing Monsoon Contributes Almost 80% of the Rainfall.
✓ We Considered Tamilnadu As One of The Subdivisions To Do Analysis.
CH
8. Channels of behaviour:
Online:
✓ See the rainfall prediction through online
Offline:
✓ Observe the current satiation weather data.
Extract online & offline CH of BE

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

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

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Login	Registration through Form Registration through Google Registration through Github
FR-2	User details confirmation	Confirmation via Email
FR-3	Prediction details	User should enter the current location to get the predicted result.
FR-4	Forecasting Accuracy	Retrieve the forecasted weather conditions and measure the accuracy.
FR-5	Forecast	Forecasted flood probability from the rainfall amount is displayed on the webpage.
FR-6	Snapshots	The web page will display the condition as a report and pictures.

4.2 NON-FUNCTIONAL REQUIREMENTS

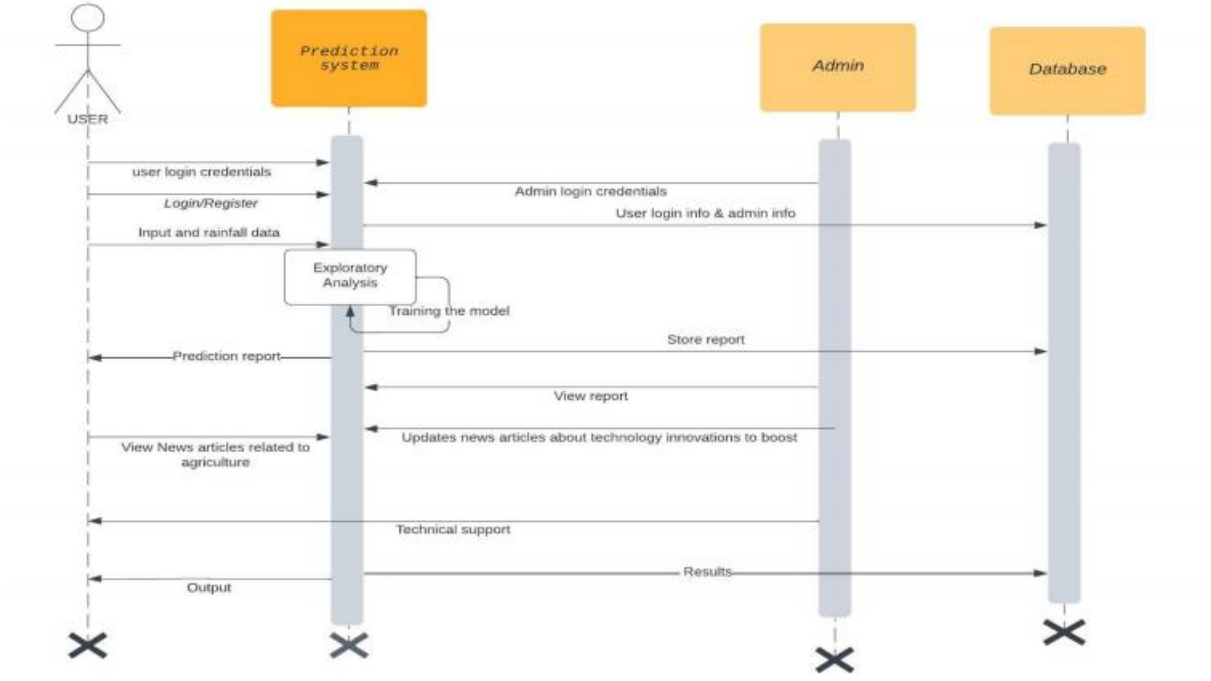
Non-functional Requirements:
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The usability of the website is to make all users wi be satisfied with the our requirements of the product The user should reach the summarized text or resul with one button press if possible
NFR-2	**Security**	The security of the project is to develop the website that prevents SQL injection attack, XSS attack and DOS attack
NFR-3	**Reliability**	The reliability of the system is to make sure the website does not go offline. The users can be reach and use program at any time, so maintenance should not be a big issue.
NFR-4	**Performance**	The performance of the website is to provide data to all users without unnecessary delay and provide 24*7 availability

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

A Data Flow Diagram 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.



1. User logins to the application using his or her credentials.
2. Verification of credentials is done using the data stored in the database.
3. Application getting the response from the database.
4. Approval of login or else an error message for incorrect credentials.
5. Prediction request for the particular area or region is sent by the user.
6. Application getting the dataset of previous year/month/day rainfall data from the database/cloud.
7. The result has been sent to the user as an output after the prediction has been made using the machine learning model in the application.

5.2 SOLUTION & TECHNICAL ARCHITECTURE

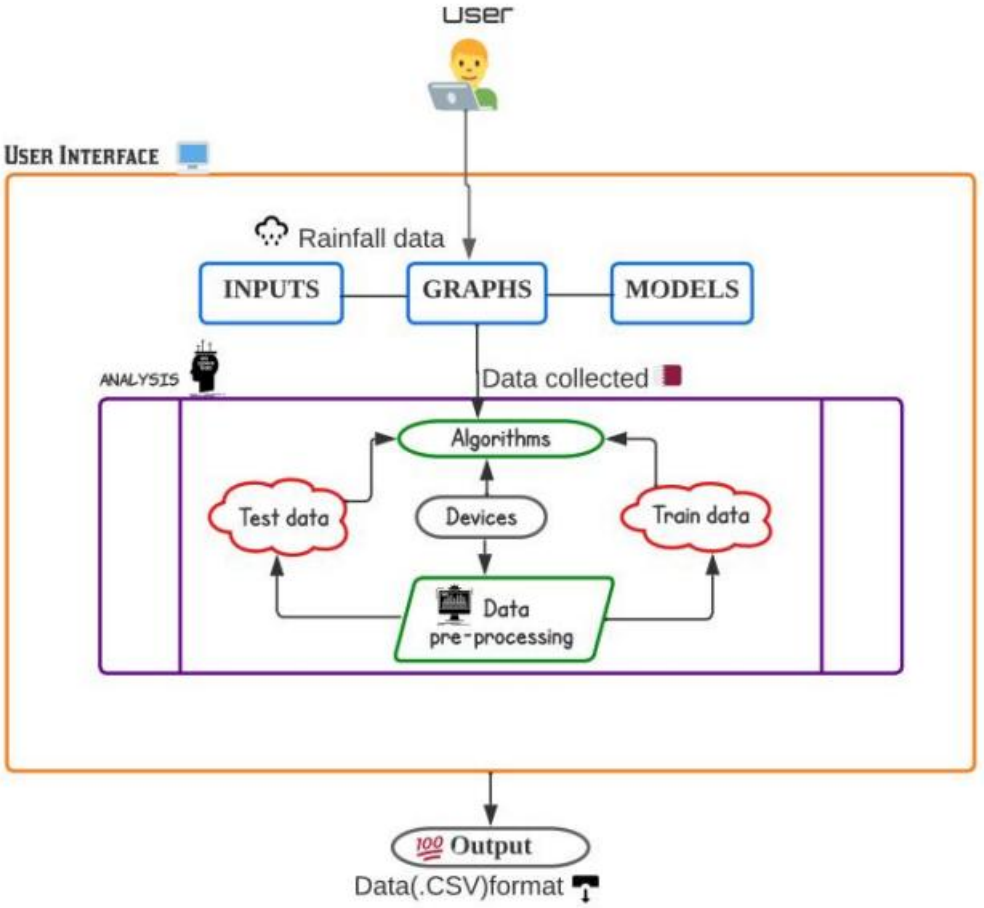


Table-1 : Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	The user interacts with the application through a web UI and a chatbot	HTML, CSS, python, flask
2.	Application Logic-1	Logic for a Registration	Python

3.	Application Logic-2	Logic for a login the application	Python
4.	Application Logic-3	Integrating machine learning model and the webpage	Flask
5.	Database	Numeric data	MySQL
6.	File Storage	To store files such as prediction report	Local Filesystem
7.	External API-1	Allows developers access to critical forecasts, alerts, and observations, along with other weather data.	IBM Weather API, etc.
8.	Machine Learning Model	Predictive modeling is a statistical technique using machine learning and data mining to predict and forecast likely future outcomes with the aid of historical and existing data	Predictive Model, etc.
9.	Infrastructure (Server)	Application Deployment on Local System Local Server Configuration: built-in flask web server	Flask web server

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Flask	Micro web framework written in Python
2.	Security Implementations	Basic HTTP authentication, Session based authentication, User Registration, Login Tracking	Flask security
3.	Scalable Architecture	Size is everything, and Flask's status as a microframework means that you can use it to grow a tech project such as a web app incredibly	Flask

S. No	Characteristics	Description	Technology
		quickly. Its simplicity of use and few dependencies enable it to run smoothly even as it scales up and up.	
4.	Availability	Higher compatibility with latest technologies and allows customization	Flask
5.	Performance	1. Integrated support for unit testing. 2. RESTful request dispatching. 3. Uses Jinja templating. 4. Support for secure cookies (client side sessions) 5. 100% WSGI 1.0 compliant.	Flask

5.2 USER STORIES

User Stories:

User Type	Functional Requirements nt (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer(web user)	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
Customer(web user)	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	Medium	Sprint-2
Customer(web user)	Login	USN-3	As a user, I can log into the application by entering email & password	I can access the system	High	Sprint-1
Customer(web user)	Dashboard	USN-4	As a user, I can view the details about the system and can navigate through the pages.	I can navigate through pages	High	Sprint-3
Customer(web user)	Prediction	USN-5	As a user, I can enter the rainfall amount and get the prediction results	I can get the prediction result	High	Sprint-4
Customer(web user)	News	USN-6	As a user, I can view latest news articles related to agriculture	I can view the articles	Medium	Sprint-3
Customer Care Executive	Contact	USN-7	As a user, I can ask queries regarding the system	I can clarify my doubts	High	Sprint-3
Customer Care Executive	Chat bot	USN-8	As a user, I can interact with chatbot to ask queries	I can get my queries clear instantly	Low	Sprint-4
Admin	Login	USN-9	As a user, I can register for the application by entering my email, password, and confirming my password.	I can view and update the system	High	Sprint-1
Web user	Prediction	USN-10	As a user, I can see the prediction result from the model trained by the system administrator	I can train the prediction model	High	Sprint-3

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Rainfall Prediction Model	USN-1	Collecting weather dataset, data preprocessing the data and do a data visualization	5	High
Sprint-1		USN-2	Train Model using Different machine learningAlgorithms	5	High
Sprint-1		USN-3	Test the best model and save best model by pickle library	10	High
Sprint-2	Registration	USN-4	As a user, they can register for the applicationthrough Gmail. Password is set up.	5	Medium
Sprint-2	Login	USN-5	As a user, they can log into the application byentering email & password	5	Medium
Sprint-2		USN-6	Credentials should be used for multiple systems and verified	4	Medium
Sprint-2	Dashboard	USN-7	Attractive dashboard forecasting live weather	6	Low

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Rainfall PredictionML Model (Dataset)	USN-1	Weather Dataset Collection, Data preprocessing, Data Visualization.	5	High
Sprint-1		USN-2	Train Model using Different machine learningAlgorithms	5	High
Sprint-1		USN-3	Test the model and give best	10	High
Sprint-2	Registration	USN-4	As a user, they can register for the applicationthrough Gmail. Password is set up.	5	Medium
Sprint-2	Login	USN-5	As a user, they can log into the application byentering email & password	5	Medium
Sprint-2		USN-6	Credentials should be used for multiple systems and verified	4	Medium
Sprint-2	Dashboard	USN-7	Attractive dashboard forecasting live weather	6	Low

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	31Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-2	20	6 Days	05 Nov 2022	10 Nov 2022	20	10 Nov 2022
Sprint-3	20	6 Days	10 Nov 2022	15 Nov 2022	20	15 Nov 2022
Sprint-4	20	6 Days	15 Nov 2022	21 Nov 2022	20	21 Nov 2022

VELOCITY:

Imagine we have a 5-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) periteration unit (story points per day)

AV= Sprint duration/ Velocity = 20/5 =4

Total Average Velocity=4

BURNDOWN CHART:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such asScrum. However, burn down charts can be applied to

any project containing measurable progress over time.

Tool : Jira Software

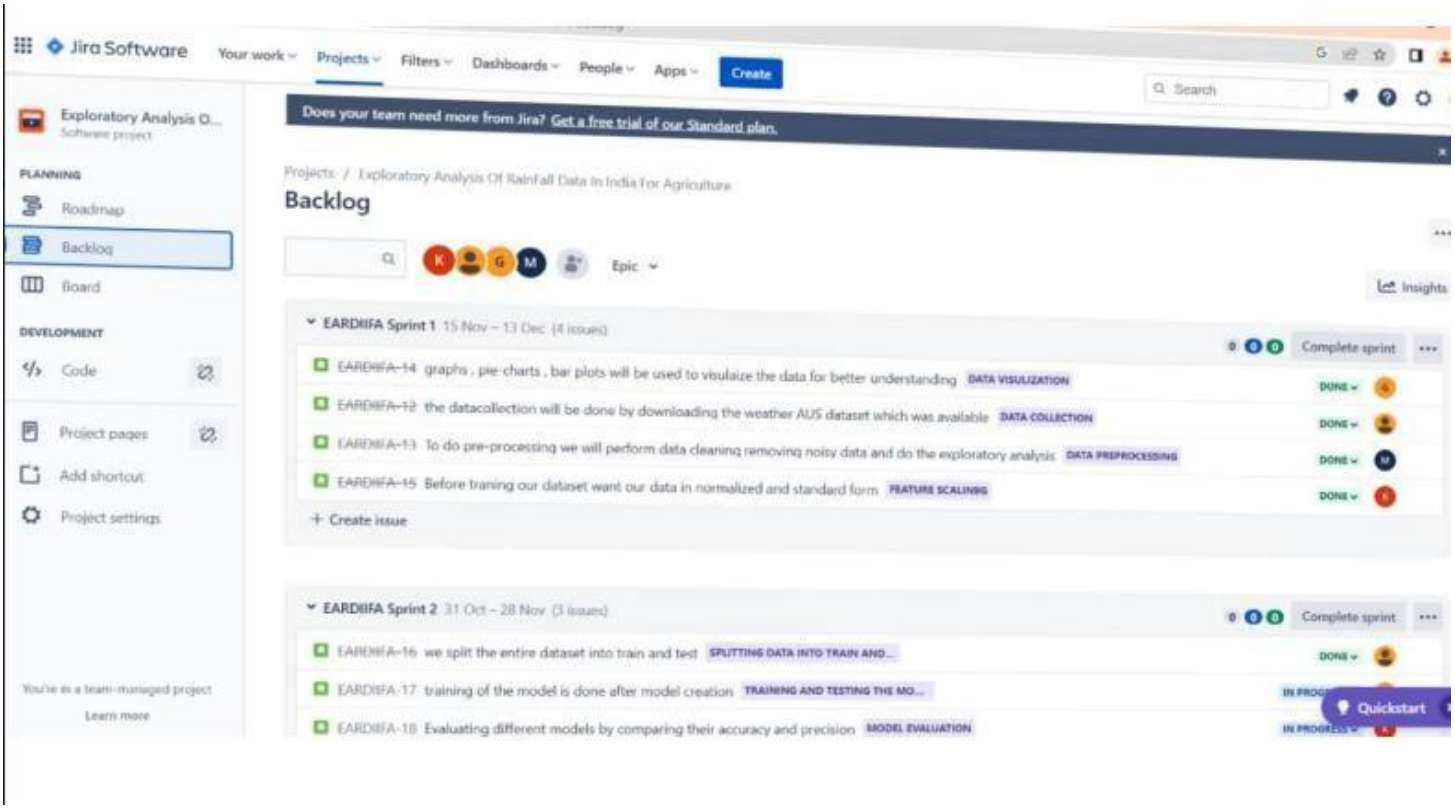
6.2 SPRINT DELIVERY SCHEDULE

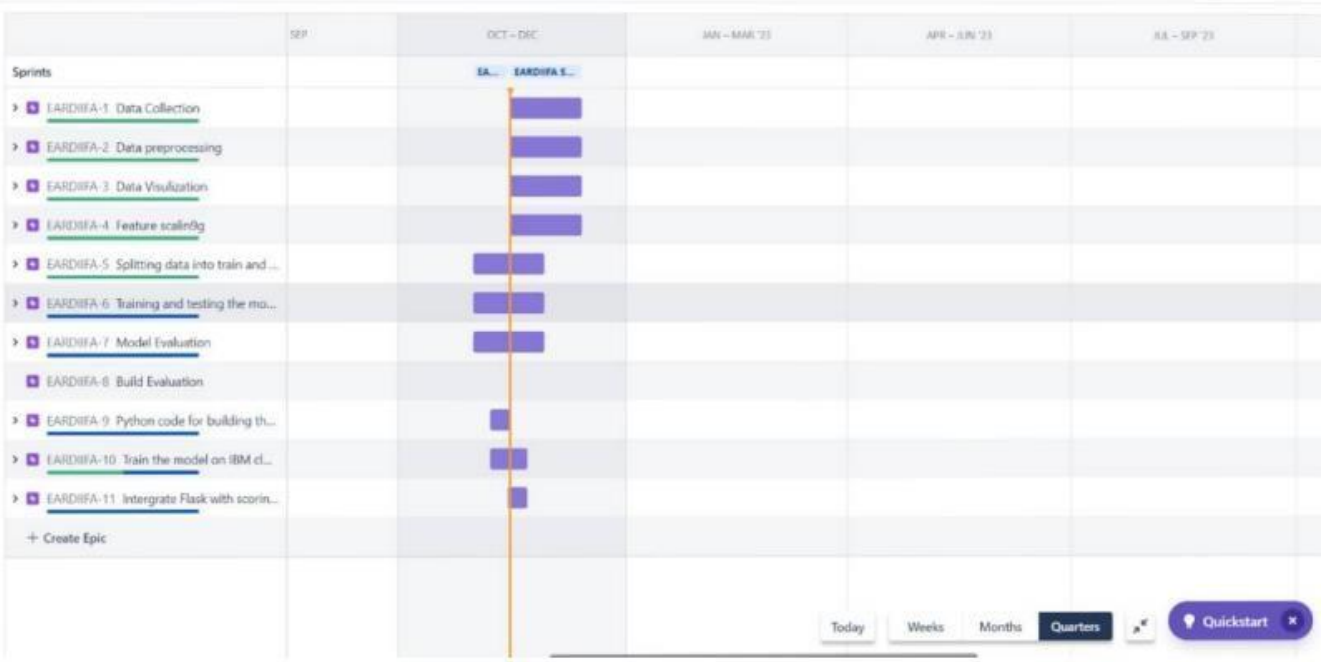
TITLE	DESCRIPTION	DATE
Literature survey & information gathering	Collect the relevant use cases and refer to existing solutions.	19 SEPTEMBER 2022
Prepare empathy map	Prepare Empathy Map canvas and list of problem statements	19 SEPTEMBER 2022
Ideation	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance	19 SEPTEMBER 2022

Problem solution fit	Prepare problem - solution fit document & solution architecture	07 OCTOBER 2022
Proposed Solution	Preparing the new idea for our problem statement	07 OCTOBER 2022
Solution Architecture	Prepare Solution Architecture document	14 OCTOBER 2022
Customer journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	17 OCTOBER 2022
Solution requirement	Prepare the Functional Requirement Document	17 OCTOBER 2022
Data flow diagrams	Prepare the Data Flow Diagrams	17 OCTOBER 2022
Technology architecture	Prepare Technology Architecture of the solution	17 OCTOBER 2022
Prepare Milestone & activity list	Prepare the Milestone & activity list of the project	26 OCTOBER 2022
Sprint Delivery Plan	Prepare the plan for all the sprints in the project	26 OCTOBER 2022

Project development – delivery of sprint – 1,2,3 & 4	Develop & submit the developed code by testing it	In process ...

6.2 REPORTS FROM JIRA


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Exploratory Analysis O...
Software project
PLANNING
Roadmap
Backlog
Board
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
You're in a team-managed project
Learn more
Does your team need more from Jira? Get a free trial of our Standard plan.
Projects / Exploratory Analysis Of Rainfall Data In India For Agriculture
Backlog
Epic
Insights
EARDIIFA Sprint 1 15 Nov – 13 Dec (4 issues)
Complete sprint
EARDIIFA-14 graphs , pie-charts , bar plots will be used to visulaize the data for better understanding DATA VISULIZATION DONE
EARDIIFA-12 the datacollection will be done by downloading the weather AUS dataset which was available DATA COLLECTION DONE
EARDIIFA-13 To do pre-processing we will perform data cleaning removing noisy data and do the exploratory analysis DATA PREPROCESSING DONE
EARDIIFA-15 Before training our dataset want our data in normalized and standard form FEATURE SCALING DONE
+ Create issue
EARDIIFA Sprint 2 31 Oct – 28 Nov (3 issues)
Complete sprint
EARDIIFA-16 we split the entire dataset into train and test SPLITTING DATA INTO TRAIN AND... DONE
EARDIIFA-17 training of the model is done after model creation TRAINING AND TESTING THE MO...
EARDIIFA-18 Evaluating different models by comparing their accuracy and precision MODEL EVALUATION
Quickstart


SEP
OCT – DEC
JAN – MAR '23
APR – JUN '23
JUL – SEP '23
Sprints
EARDIIFA-1 Data Collection
EARDIIFA-2 Data preprocessing
EARDIIFA-3 Data Visulization
EARDIIFA-4 Feature scaling
EARDIIFA-5 Splitting data into train and ...
EARDIIFA-6 Training and testing the mo...
EARDIIFA-7 Model Evaluation
EARDIIFA-8 Build Evaluation
EARDIIFA-9 Python code for building th...
EARDIIFA-10 Train the model on IBM cl...
EARDIIFA-11 Intergrate Flask with scorin...
+ Create Epic
Today
Weeks
Months
Quarters
Quickstart

7.CODING & SOLUTIONING

7.1 FEATURE 1

The application has an interactive user interface where user needs to upload all the necessary details to predict the rainfall.

index page.html

```
<!DOCTY
PE
<html>
            <html lang="en">


            <head>
              <meta charset="UTF-8">
              <title>Dashboard</title>
              <link rel="stylesheet"
            href="https://cdnjs.cloudflare.com/ajax/libs/font-
            awesome/4.7.0/css/font-awesome.min.css">
              <link rel="stylesheet" href="/static/dashbord.css">
            </head>


            <body style="background:url('data:image/jpeg');">
              <div class="user">
                <div id="menu" class="container" onclick="myFunction(this)">
                  <div class="bar1"></div>
                  <div class="bar2"></div>
                  <div class="bar3"></div>


                  <div id="drop" class="profile">
                    <a href="profile.html">
                      <h3>Profile</h3>
                    </a>
                    <a href="">
```

```
                <h3>Logout</h3>
            </a>
        </div>
    </div>
</div>
<script>
    var drop = document.getElementById('drop');
    var a = 0;
    function myFunction(x) {
        if (a == 0) {
            x.classList.toggle("change");
            drop.style.display = 'block';
            a++;
        }
        else {
            x.classList.toggle("change");
            drop.style.display = 'none';
            a--;
        }


    }
</script>
<div class="login">


    <center>
        <h1 style="color:white;font-size:60px;">Rainfall
Prediction</h1>


        <form action="#" method="post" class="predict">
            <table>
                <tr>
                    <th><label
for="Location"><b>Location</b></label></th>
                    <td>
```

```
        <select id="Location" name="Location" required>
          <option value="">Select Location</option>
          <option value="1">Andhra Pradesh</option>
          <option value="2">Arunachal Pradesh</option>
          <option value="3">Assam</option>
          <option value="4">Bihar</option>
          <option value="5">Chhattisgarh</option>
          <option value="6">Goa</option>
          <option value="7">Gujarat</option>
          <option value="8">Haryana</option>
          <option value="9">Himachal Pradesh</option>
          <option value="10">Jharkhand</option>
          <option value="11">Karnataka</option>
          <option value="12">Kerala</option>
          <option value="13">Madhya Pradesh</option>
          <option value="14">Maharashtra</option>
          <option value="15">Manipur</option>
          <option value="16">Meghalaya</option>
          <option value="17">Mizoram</option>
          <option value="18">Nagaland</option>
          <option value="19">Odisha</option>
          <option value="20">Punjab</option>
          <option value="21">Rajasthan</option>
          <option value="22">Sikkim</option>
          <option value="23">Tamil Nadu</option>
          <option value="24">Telangana</option>
          <option value="25">Tripura</option>
          <option value="26">Uttarakhand</option>
          <option value="27">Uttar Pradesh</option>
          <option value="28">West Bengal</option>
        </select>
      </td>
    </tr>


    <tr>
```

```
                <th><label for="date"><b>Enter
Date</b></label></th>
                <td><input type="date" placeholder="Enter Date"
id="date" required></td>
            </tr>


            <tr>
                <th><label for="mintemp"><b>Min
Temp</b></label></th>
                <td><input type="number" placeholder="Enter Temp
in °C" id="mintemp" required></td>
            </tr>


            <tr>
                <th><label for="maxtemp"><b>Max
Temp</b></label></th>
                <td><input type="number" placeholder="Enter Temp
in °C " id="maxtemp" required></td>
            </tr>


            <tr>
                <th><label for="windir"><b>Wind
Direction</b></label></th>
                <td><input type="text" placeholder="Enter Wind
Direction" id="windir" required></td>
            </tr>


        </table>


 <br>
```

```
<button type="submit"class="btn"><b>Predict</b></button>
</form></center></div></body></html>
```

7.2 FEATURE 2

app.py

```
import numpy as np
import  pickle
import  joblib
import matplotlib
import matplotlib.pyplot as plt
import time
import pandas
import os
from sklearn import *
from flask import
Flask,request,jsonify,render_template,redirect,url_for
app = Flask(__name__, static_folder='static')
model = pickle.load(open("./rainfall.pkl","rb"))
scale= pickle.load(open("./scale.pkl","rb"))
encoder = pickle.load(open("encoder.pkl","rb"))
@app.route('/')
def home():
return render_template('index.html')
@app.route('/pred',methods=["POST","GET"])
def pred():
inp_feature = [x for x in request.form.values()]
inp_feature=inp_feature[:18] print(inp_feature)
feature_values = [np.array(inp_feature)]
names = [['Location', 'MinTemp', 'MaxTemp', 'Rainfall',
'WindGustSpeed',
'WindSpeed9am', 'WindSpeed3pm', 'Humidity9am', 'Humidity3pm',
'Pressure9am', 'Pressure3pm', 'Temp9am', 'Temp3pm', 'risk',
'RainToday',
'WindGustDir', 'WindDir9am', 'WindDir3pm']]
data = pandas.DataFrame(feature_values,columns=names)
data = scale.fit_transform(data)
```

```
print(data)
data = pandas.DataFrame(data,columns=names)
print(data)
prediction = model.predict(data)
if prediction == "Yes":
return render_template("predict1.html")
else:
return   render_template("predict2.html")
if__name__== '__main__':
app.run(debug= True)
```

8.TESTING

8.1 TEST CASES

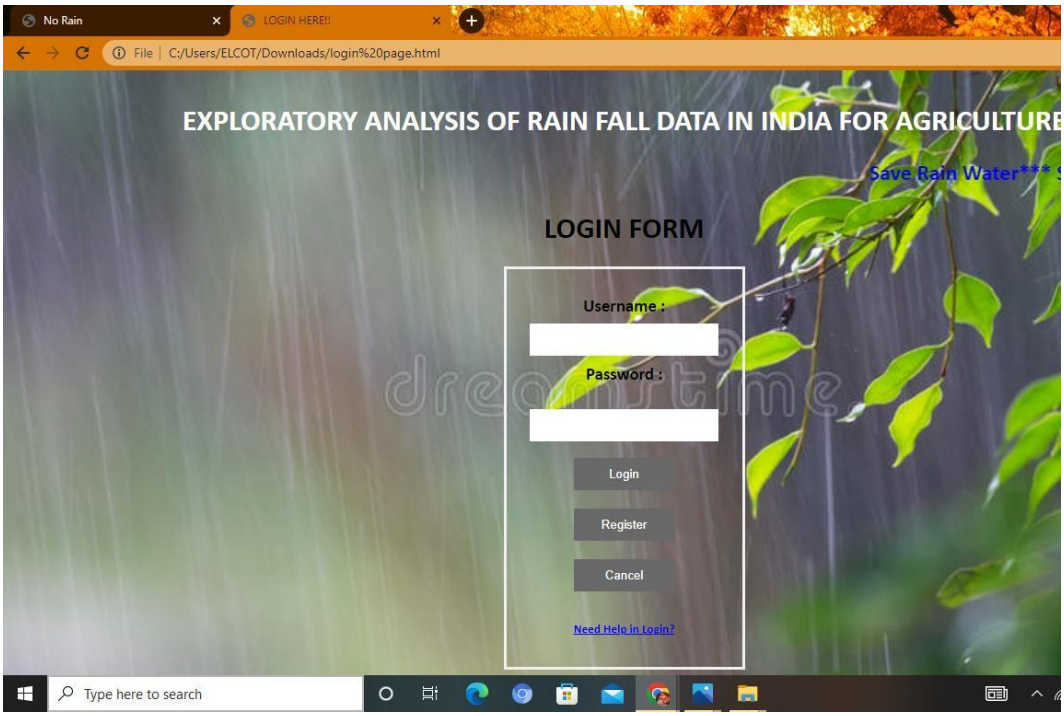
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Output	4	0	0	4

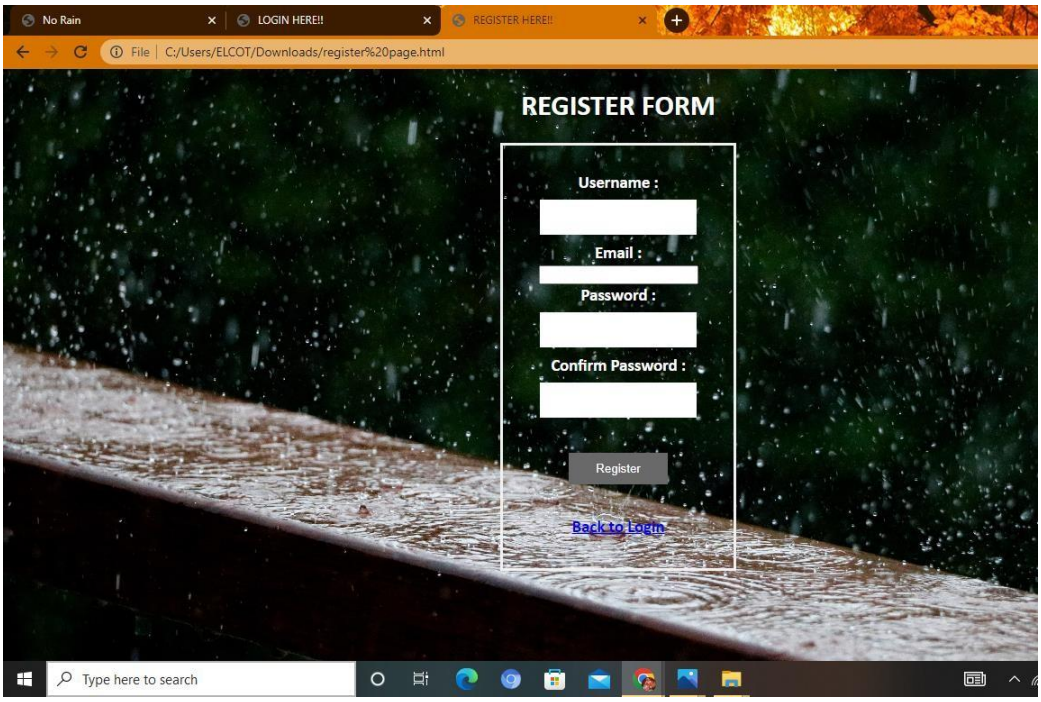
8.2 USER ACCEPTANCE TESTING

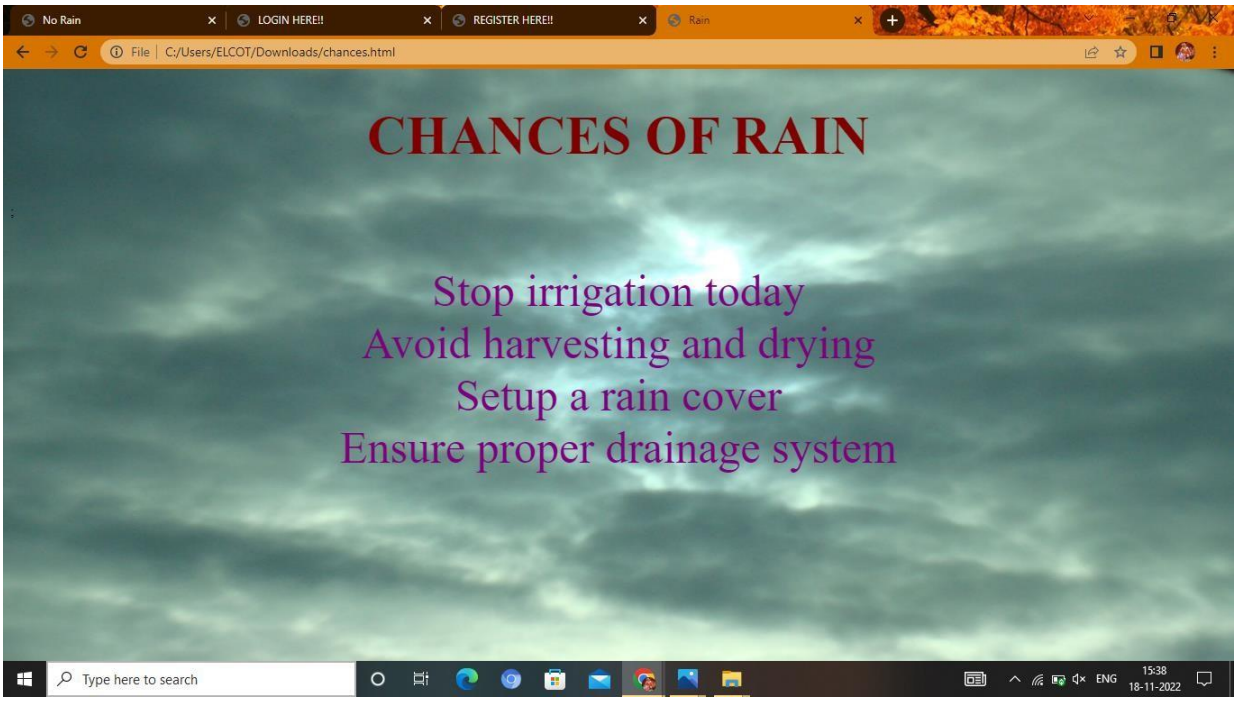
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Total	24	13	14	26	77

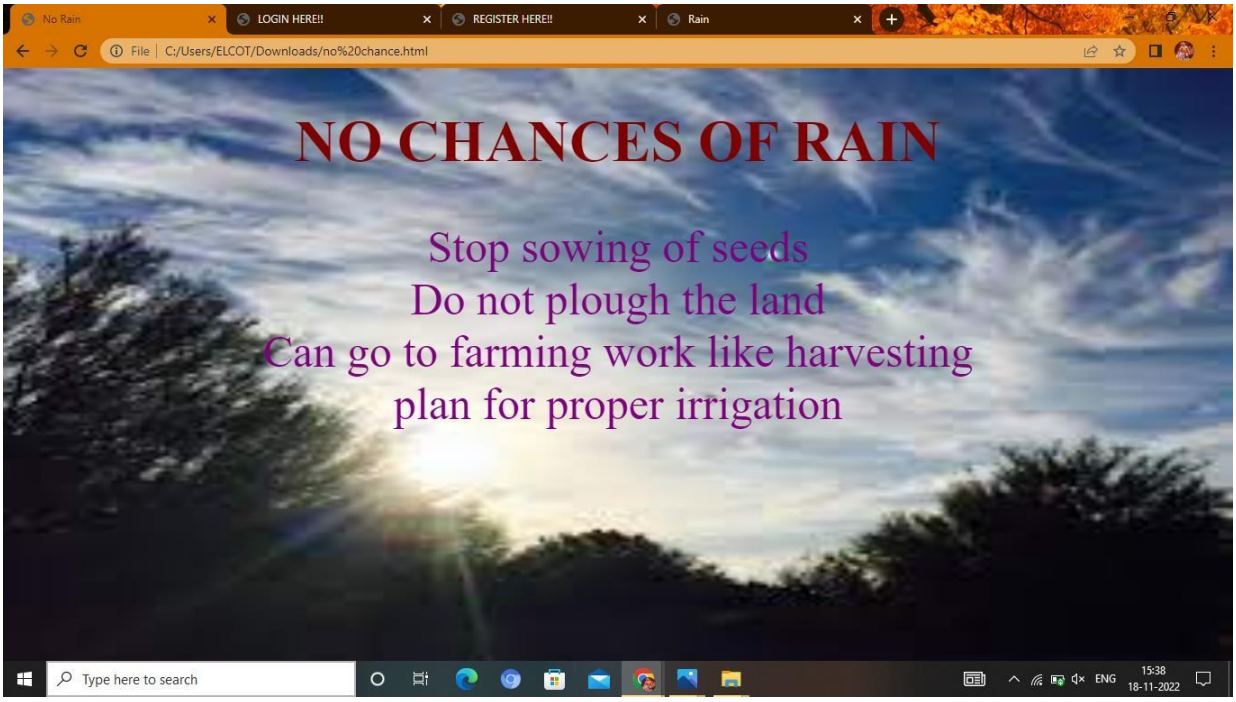
9.RESULT

9.1 PERFORMANCE METRICS






No Rain
LOGIN HERE!!
REGISTER HERE!!
Rain
File | C:/Users/ELCOT/Downloads/chances.html
CHANCES OF RAIN
Stop irrigation today
Avoid harvesting and drying
Setup a rain cover
Ensure proper drainage system
Type here to search
ENG
15:38
18-11-2022


No Rain
LOGIN HERE!!
REGISTER HERE!!
Rain
File | C:/Users/ELCOT/Downloads/no%20chance.html
NO CHANCES OF RAIN
Stop sowing of seeds
Do not plough the land
Can go to farming work like harvesting
plan for proper irrigation
Type here to search
ENG
15:38
18-11-2022

10.ADVANTAGES & DISADVANTAGES

ADVANTAGES

1. High quality of data:

One of the main advantages of weather radar is the fact that the data collected by the radar is of high quality and can be used to determine various aspects of the weather reliably.

2. Reliable weather forecasts:

The forecasting of the weather is one of the most important uses of weather radar. Through radar technology, experts have been able to reliably predict the weather and sometimes even measure the exact amount of rainfall or precipitation.

3. More accurate results:

Using weather radar to determine the weather and even to predict the weather results in much more accurate results. Radar can easily measure the exact amount or quantity of a particular weather element and use this to determine the expected forecasts.

4. Locate precipitation:

Weather radar can also be used to locate precipitation in any given area of the earth. This information comes in handy when determining the exact amount of rainfall that is expected.

5. Can calculate the speed of precipitation:

Besides locating precipitation, weather radar can also be used to calculate the exact speed of precipitation, a fete that was previously impossible using conventional means.

6. Can determine the structure of storms:

Weather radar has been used extensively by experts to determine the structure of storms. This information is then used to build the profile of expected storms and put in place mitigating measures.

7. Hail detection:

We can also use weather radar to detect hailstorms that are expected within a particular locality. This information is important in determining the exact nature of the hailstorms and helps prevent their effects.

8. Research:

Weather radar also comes in handy in the field of research where experts can use it to profile the weather of a given area and use the patterns to predict the climate of that area and help people in planning.

9. Flood forecasting:

Weather radar can also be used for flood forecasting to predict the occurrence of floods.

DISADVANTAGES

1. Cannot detect fog:

Weather radar has the limitation of not being able to detect fog. This creates a gap in weather
forecasting where an area that is likely to receive fog is not properly profiled.

2. Cannot detect wind independently:

A weather radar is not known to detect wind independently unless with the use of additional
remote sensing. This also creates a gap in weather forecasting.

3. Not entirely reliable:

Weather radar has a variety of limitations that makes it lack some of the most important
forecasting principles. This means the radar is not entirely reliable in terms of weather
forecasting.

4. Requires expertise to analyze:

The usage of weather radar to forecast the weather is not an easy thing and requires some

level of expertise to analyze the data that comes through it.

5. Relies on intense datasets:

There is a huge dataset associated with the weather radar that needs to be analyzed before any decision is made. This data is so big that it may take a considerable amount of time to analyze fully.

6. The analysis is not instant:

The weather analysis done through weather radar is not always instant and therefore the information is not real-time.

7. Weather changes all the time:

The weather is a phenomenon that changes all the time. This means that any delay in data collection may sometimes result in useless data.

8. The estimates can be wrong:

The estimates obtained from weather radar are not 100 percent accurate. This means that the data may be wrong in some cases and this may impact the final decision making.

9. Radar technology keeps growing:

Radar technology is not static. It is dynamic and it keeps growing at a really fast pace.

11. CONCLUSION

Rainfall Prediction is the application area of data science and machine learning to predict the state of the atmosphere. It is important to predict the rainfall intensity for effective use of water resources and crop production to reduce mortality due to flood and any disease caused by rain. This paper analyzed various machine learning algorithms for rainfall prediction. Three machine learning algorithms such as MLR, FR, and XGBoost were presented and tested using the dataset.

The Rainfall prediction accuracy can be improved using sensor and meteorological datasets with additional different environmental features. Hence, in future work, big data analysis can be used for rainfall prediction if the sensor and meteorological datasets are used for the daily rainfall amount prediction study.

12. FUTURE SCOPE

Apart from predicting weather,algorithms can be used to scan satellite images to automatically derive plant count and production estimates .Predicting weather accurately doesn’t just help our daily lives but has deeper impact for food security and disaster management. Good news for monsoon-dependent India is that we are getting better at predicting. New technologies, such as Internet of Things (IoT) and Artificial Intelligence are helping meteorological experts to give better information to predict agricultural output and natural disasters.

13. APPENDIX

index page.html

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


                <head>
                   <meta charset="UTF-8">
                   <title>Dashboard</title>
```

```
    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">
    <link rel="stylesheet" href="/static/dashbord.css">
</head>


<body style="background:url(‘data:image/jpeg’);">
    <div class="user">
        <div id="menu" class="container" onclick="myFunction(this)">
            <div class="bar1"></div>
            <div class="bar2"></div>
            <div class="bar3"></div>


            <div id="drop" class="profile">
                <a href="profile.html">
                    <h3>Profile</h3>
                </a>
                <a href="">
                    <h3>Logout</h3>
                </a>
            </div>
        </div>
    </div>
    <script>
        var drop = document.getElementById('drop');
        var a = 0;
        function myFunction(x) {
            if (a == 0) {
                x.classList.toggle("change");
                drop.style.display = 'block';
                a++;
            }
            else {
                x.classList.toggle("change");
                drop.style.display = 'none';
```

```
            a--;
          }


      }
    </script>
    <div class="login">


      <center>
        <h1 style="color:white;font-size:60px;">Rainfall
Prediction</h1>


        <form action="#" method="post" class="predict">
          <table>
            <tr>
              <th><label
for="Location"><b>Location</b></label></th>
              <td>
                <select id="Location" name="Location" required>
                  <option value="">Select Location</option>
                  <option value="1">Andhra Pradesh</option>
                  <option value="2">Arunachal Pradesh</option>
                  <option value="3">Assam</option>
                  <option value="4">Bihar</option>
                  <option value="5">Chhattisgarh</option>
                  <option value="6">Goa</option>
                  <option value="7">Gujarat</option>
                  <option value="8">Haryana</option>
                  <option value="9">Himachal Pradesh</option>
                  <option value="10">Jharkhand</option>
                  <option value="11">Karnataka</option>
                  <option value="12">Kerala</option>
                  <option value="13">Madhya Pradesh</option>
                  <option value="14">Maharashtra</option>
                  <option value="15">Manipur</option>
```

```
                    <option value="16">Meghalaya</option>
                    <option value="17">Mizoram</option>
                    <option value="18">Nagaland</option>
                    <option value="19">Odisha</option>
                    <option value="20">Punjab</option>
                    <option value="21">Rajasthan</option>
                    <option value="22">Sikkim</option>
                    <option value="23">Tamil Nadu</option>
                    <option value="24">Telangana</option>
                    <option value="25">Tripura</option>
                    <option value="26">Uttarakhand</option>
                    <option value="27">Uttar Pradesh</option>
                    <option value="28">West Bengal</option>
                  </select>
                </td>
              </tr>


              <tr>
                <th><label for="date"><b>Enter
Date</b></label></th>
                <td><input type="date" placeholder="Enter Date"
id="date" required></td>
              </tr>


              <tr>
                <th><label for="mintemp"><b>Min
Temp</b></label></th>
                <td><input type="number" placeholder="Enter Temp
in °C" id="mintemp" required></td>
              </tr>


              <tr>
                <th><label for="maxtemp"><b>Max
Temp</b></label></th>
```

```
                <td><input type="number" placeholder="Enter Temp
in °C " id="maxtemp" required></td>
            </tr>


            <tr>
                <th><label for="windir"><b>Wind
Direction</b></label></th>
                <td><input type="text" placeholder="Enter Wind
Direction" id="windir" required></td>
            </tr>


        </table>


 <br>
<button type="submit"class="btn"><b>Predict</b></button>
</form></center></div></body></html>
```

predict1.html

```
<!DOCTYPE html>
<html lang="en">
<link rel = "icon" href =
"/static/images/ibm.png"
type = "image/x-icon">
<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">
<title>Yes it rains</title>
<link
href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/boot
strap.min.css"
rel="stylesheet" integrity="sha384-
```

```
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy
9Bv1WTRi"
crossorigin="anonymous">
</head>
<style>
#myVideo
{ width: 100vw;
height: 100vh;
object-fit: cover;
position: fixed;
left: 0;
right: 0;
top: 0;
bottom: 0;
z-index: -1;
filter: blur(2px);
}
.content
{ position:
fixed;
background: rgba(135, 206, 235, 0.5);
color:black;
padding: 20px;
}
.header { padding:
0px; text-align:
center;
background: #1abc9c;j
color: white;
font-size: 30px;
}
</style>
<body>
<div class="header">
<p style="color: red;align-content: center;"><marquee
scrollamount="20">&#127783
&#127783 &#127783 &#127783 &#127783 &#128561 &#128561
ALERT ALERT !!
```

```
&#128561 & #128561 &#127783 &#127783 &#127783 &#127783
&#127783</marquee></p>
</div>
<video autoplay muted loop id="myVideo">
<source src="/static/images/rain.mp4" type="video/mp4">
</video>
<div class="container-fluid">
<div class="row d-flex justify-content-center">
<div class="col d-flex justify-content-center">
<img src="/static/images/rain1.jpg" alt="no rain img"
height="120%"
width="103%" >
</div>
<div class="col d-flex justify-content-center"><br><br><br><br>
<div class="content">
<p ><h1 style="color: blue;">There is a high probability of rainfall
Tomorrow!
<br>
</h1>
<h3>Instructions to Farmers:</h3>
<h4>
<ul>
&#10060 Stop irrigation today
<br> &#9989 Set up a rain cover
<br> &#9989 Ensure proper Drinage system
<br> &#10060 Avoid activities like Spraying pesticides
<br> &#10060 Avoid Harvesting and Drying
</ul>
</h4>
</p>
</div>
</div>
</div>
</div>
</body>
</html>
```

predict2.html

```
<!DOCTYPE html>
<html lang="en">
<link rel = "icon" href =
"/static/images/ibm.png"
type = "image/x-icon">
<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">
<title>no it isn't rains</title>
<link
href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.2/dist/css/boot
strap.min.css"
rel="stylesheet" integrity="sha384-
Zenh87qX5JnK2Jl0vWa8Ck2rdkQ2Bzep5IDxbcnCeuOxjzrPF/et3URy
9Bv1WTRi"
crossorigin="anonymous">
</head>
<style>
#myVideo
{ width: 100vw;
height: 100vh;
object-fit: cover;
position: fixed;
left: 0;
right: 0;
top: 0;
bottom: 0;
z-index: -1;
filter: blur(2px);
}
.content
{ position:
fixed;
background: rgba(135, 206, 235, 0.5);
```

```
color:black;
padding: 20px;
}
.header { padding:
0px; text-align:
center;
background: yellowgreen;
color: white;
font-size: 30px;
}
</style>
<body>
<div class="header">
<p style="color: red; align-content: center;"><marquee
scrollamount="20">&#127774
&#127748 &#127748 &#127748 &#127748 &#128539 &#128539
Don't Panic !! &#128539
&#128539 &#127748 &#127748 &#127748 &#127748
&#127774</marquee></p>
</div>
<video autoplay muted loop id="myVideo">
<source src="/static/images/sun1.mp4" type="video/mp4">
</video>
<div class="container-fluid">
<div class="row d-flex justify-content-center">
<div class="col d-flex justify-content-center">
<img src="/static/images/sun2.jpg" alt="no rain img"
height="120%"
width="103%">
</div>
<div class="col d-flex justify-content-center px-4"><br><br><br>
<div class="content">
<p ><h1 style="color: blue;">There will be no rainfall Tomorrow!
<br>
</h1>
<h3>Instructions to Farmers:</h3>
<h4>
```

```
<ul>
&#10060 Stop sowing of seeds
<br> &#9989 Can go to farming work like Harvesting
<br> &#9989 Plan for proper irrigation
<br> &#10060 Do not plough the land
<br> &#9989 Enjoy the Sunshine &#128512
</ul>
</h4>
</p>
</div>
</div>
</div>
</div>
</body>
</html>
```

app.py

```
import numpy as np
import  pickle
import  joblib
import matplotlib
import matplotlib.pyplot as plt
import time
import pandas
import os
from sklearn import *
from flask import
Flask,request,jsonify,render_template,redirect,url_for
app = Flask(__name__, static_folder='static')
model = pickle.load(open("./rainfall.pkl","rb"))
scale= pickle.load(open("./scale.pkl","rb"))
encoder = pickle.load(open("encoder.pkl","rb"))
@app.route('/')
def home():
```

```
return render_template('index.html')
@app.route('/pred',methods=["POST","GET"
])def pred():
inp_feature = [x for x in
request.form.values()]
inp_feature=inp_feature[:18]
print(inp_feature)
feature_values = [np.array(inp_feature)]
names = [['Location', 'MinTemp', 'MaxTemp', 'Rainfall',
'WindGustSpeed',
'WindSpeed9am', 'WindSpeed3pm',
'Humidity9am','Humidity3pm',
'Pressure9am', 'Pressure3pm', 'Temp9am', 'Temp3pm', 'risk',
'RainToday',
'WindGustDir', 'WindDir9am', 'WindDir3pm']]
data = pandas.DataFrame(feature_values,columns=names)
data = scale.fit_transform(data)
print(data)
data = pandas.DataFrame(data,columns=names)
print(data)
prediction =
model.predict(data)
print(prediction)
if prediction == "Yes":
return
render_template("predict1.html")else:
return
render_template("predict2.html")if
____name___== '__main__':
app.run(debug= True)
```

GITHUB

https://github.com/IBM-EPBL/IBM-Project-39831-1660550822

PROJECT DEMO LINK

https://youtu.be/xNF8PowKniQ