NAAN MUDHALVAN

PROFESSIONAL READING FOR INNOVATION, EMPOYABILITY AND ENTEREPRENEURSHIP

PROJECT REPORT

Team Id	NM2023TMID01941
Project Name	**A**utomated Weather Classification Using Transfer Learning

S.NO	TEAM MEMBERS	NAME	REG.NO
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2	**Team Member 1**	**BHARATHI M**	**420420104004**
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4	**Team Member 3**	**HEM KUMAR V**	**420420104306**

Partial fulfillment of the award of the degree

Of

BACHELOR OF ENGINEERING

COMPUTER SCIENCE AND ENGINEERING

ADHIPARASAKTHI ENGINEERING COLLEGE

MELMARUVATHUR – 603 319

ANNA UNIVERSITY: CHENNAI - 600 025

MAY 2023

BONAFIDE CERTIFICATE

Certified that this project "Automated Weather Classification Using Transfer Learning " is the bonafide work of **VIGNESHKUMAR(420420104058), BHARATHI M(420420104004) , GOWTHAM RAJ S(420420104014) , HEM KUMAR V (420420104306)** who carried out the project work under my supervision.

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TABLE OF CONTENT

CHAPTER-1
INTRODUCTION

1.1 Project Overview

This project, titled “Automated Weather Classification using Transfer Learning”, The goal of this project is to build an automated weather classification system using transfer learning. The objective is to train a deep learning model to classify weather conditions based on input images. Transfer learning is a technique that allows us to leverage pre-trained models, which are trained on largescale datasets such as ImageNet, and apply them to new tasks with smaller datasets. By using transfer learning, we can benefit from the knowledge learned by the pretrained models and achieve good performance even with limited data.

1.2 Purpose

The purpose of Automated Weather Classification using Transfer Learning is to develop a system that can automatically classify weather conditions based on input images. By leveraging transfer learning, we can utilize pre-trained models that have been trained on large-scale datasets to classify weather conditions accurately and efficiently, even with limited training data. The automated weather classification system can have various practical applications, including weather monitoring, weather forecasting, agriculture and farming, climate studies and environmental monitoring. Overall, the purpose of Automated Weather Classification using Transfer Learning is to provide an efficient and accurate method for classifying weather conditions, enabling various industries and sectors to make informed decisions based on current and predicted weather conditions.

CHAPTER-2
LITERATURE SURVEY

2.1 Existing problem

Addressing these challenges requires a combination of improving dataset availability, model robustness, interpretability, and adapting to changing weather patterns. Ongoing research and collaboration between meteorologists, machine learning experts, and data scientists are vital to advancing Automated Weather Classification using Transfer Learning and overcoming these existing problems.

2.2 References

Paper 1

Authors: Mohamed Elhoseiny1 Sheng Huang2 Ahmed Elgammal1 Mishra

Year: 2019

Title: WEATHER CLASSIFICATION WITH DEEP CONVOLUTIONAL NEURAL NETWORKS.

Methodology: Weather Classification with Deep Convolutional Neural Networks is a methodology that aims to automatically categorize weather conditions based on input images. It involves collecting a diverse dataset of weather images and preprocessing them to ensure compatibility with the model. By leveraging pre-trained CNN models, which have learned generic features from large-scale image datasets, the methodology transfers this knowledge to extract relevant features from the weather images.

Advantage: The system is easy to comprehend and handle. Deep CNNs are known their ability to accurate image data sets.

Disadvantage: It include Lack of Flexibility.

Paper 2

Authors: Shweta Mittal, Om Prakash Sangwan, Guru Jambeshwar , Hisar.

Year: 2023

Title: Classifying Weather Images using Deep Neural Networks for Large Scale Datasets

Methodology: The methodology for classifying weather images using deep neural networks for large-scale datasets involves collecting a diverse dataset of weather images and preprocessing them for compatibility. A pre-trained deep neural network model, such as a CNN, is selected and adapted for weather classification through transfer learning. The model is trained on a labeled dataset, and its performance is evaluated using a separate validation set.

Advantage: Once trained and deployed, deep neural networks can provide real-time weather classification, allowing for quick decision-making in various applications such as weather forecasting and analysis.

Disadvantage: Deep neural networks typically require a large amount of labeled training data to achieve optimal performance. Collecting and annotating such datasets can be time-consuming and resource-intensive.

Paper 3

Authors: Qasem Abu Al-Haija*, Mahmoud A. Smadi, and saleh ZeinSabatto Mukwakungu.

Year: 2020

Title: Multi-Class Weather Classification Using ResNet-18 CNN for Autonomous IoT and CPS Applications.

Methodology: Data Collection and Preparation, Testing and Evaluation, Load the dataset of weather images.

Advantage: ResNet-18 is a deep learning architecture that has demonstrated high accuracy in image recognition tasks. By using this architecture for weather classification, the model can achieve high accuracy in predicting weather conditions.

Disadvantage: This requires large dataset in weather classification.

Paper 4

Authors: Zhiqiang Li, Yingxiang Li, Jiandan Zhong, Yongqiang Chen , , Musashino-shi, , Minatoku.

Year: 2021

Title: Multi-class weather classification based on multi-feature weighted fusion method

Methodology: Data collection and preparation, Feature extraction, Extract multiple features from each weather image, such as texture, colour, and shape.

Advantage: By using multiple features and a weighted fusion method, the accuracy of weather classification is improved.

Disadvantage: Implementing a multi-feature weighted fusion method can be complex and timeconsuming. It requires significant expertise in the field of computer vision and machine learning

Paper 5

Authors: Navleen Kaur, Dr Monika Sharma, Supriya Lamba Sahdev, Laraibe Siddiqui.

Year: 2020

Title: A Review of Chatbots in the Banking Sector

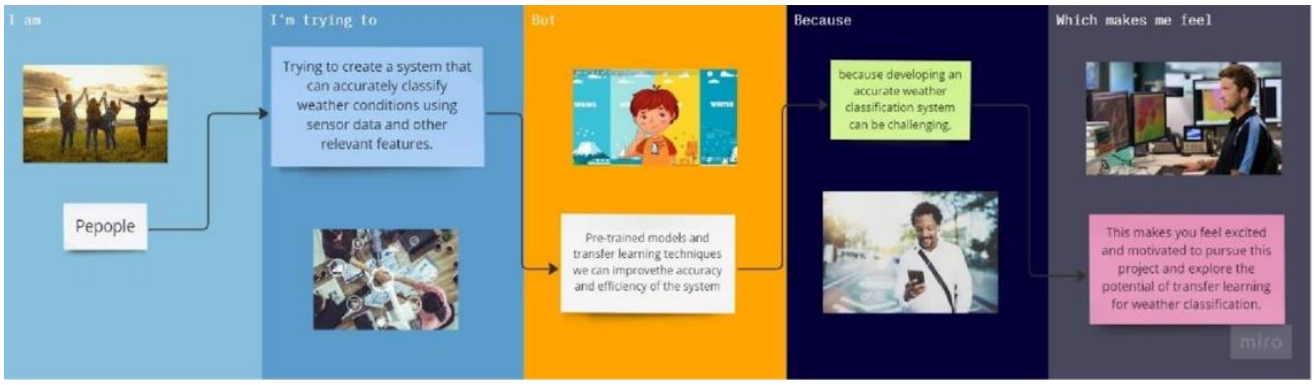
Methodology: Artificial intelligence (AI), is simulation of human intelligence in machines. Artificial intelligence consists of generally two fundamental ideas. First it involves studying human brains like how their thought process works and secondly it helps representing those processes through machine learning.

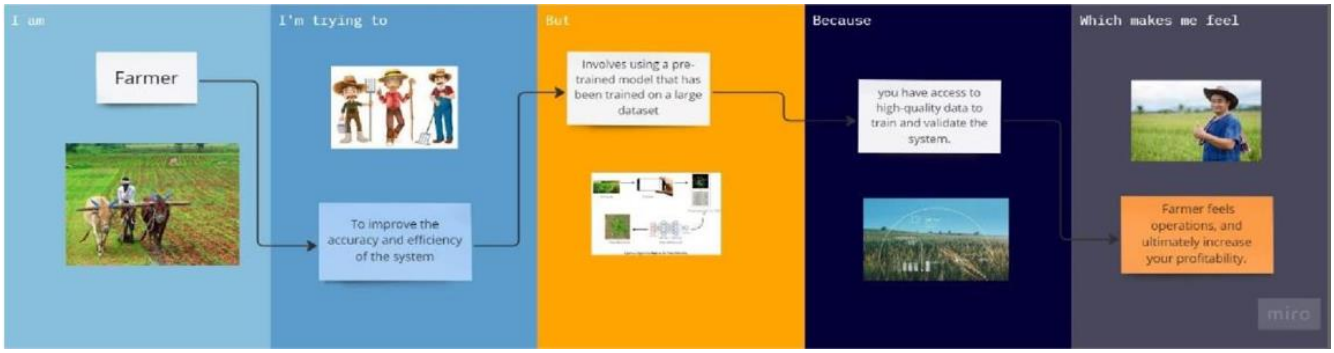
Advantage: AI is used in banking industry to minimize the chances of fraud and scam. It is also used to carry out effective decision-making

Disadvantage: 24.1% i.e. 27 people out of 112 are not sure that using artificial intelligence in banking is beneficial.4.5% i.e. 5 people out of 112 don‘t think that it is beneficial at all. 22.3% i.e. 25 people don‘t agree that it has any impact on fast services.

2.3 Problem Statement Definition

The problem addressed in this research is the automated classification of weather conditions using transfer learning techniques for large-scale datasets. Accurately classifying weather images is a challenging task due to the complexity and variability of weather patterns. The traditional image classification approaches often struggle to achieve high accuracy and robustness when applied to large-scale weather datasets. This problem is further compounded by the limited availability of labelled weather data for training purposes.





Example For Problem Statement

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	People	Trying to create a system that can accurately classify the weather condition.	But it involves pre trained model .	Because we developing a accurate weather classification can be challenging.	It feels to improve weather forecasting, enhance transportation safety, and aid decision making in various industries.
PS-2	Farmers	To improve accurately and efficiently in weather condition for crops.	But it involves pre trained model and also trained on large dataset.	Because you have access to high quality data to train and validate the weather conditions.	Farmers feel the operations, and ultimate increase of profitability in the crops.

CHAPTER-3

IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas:

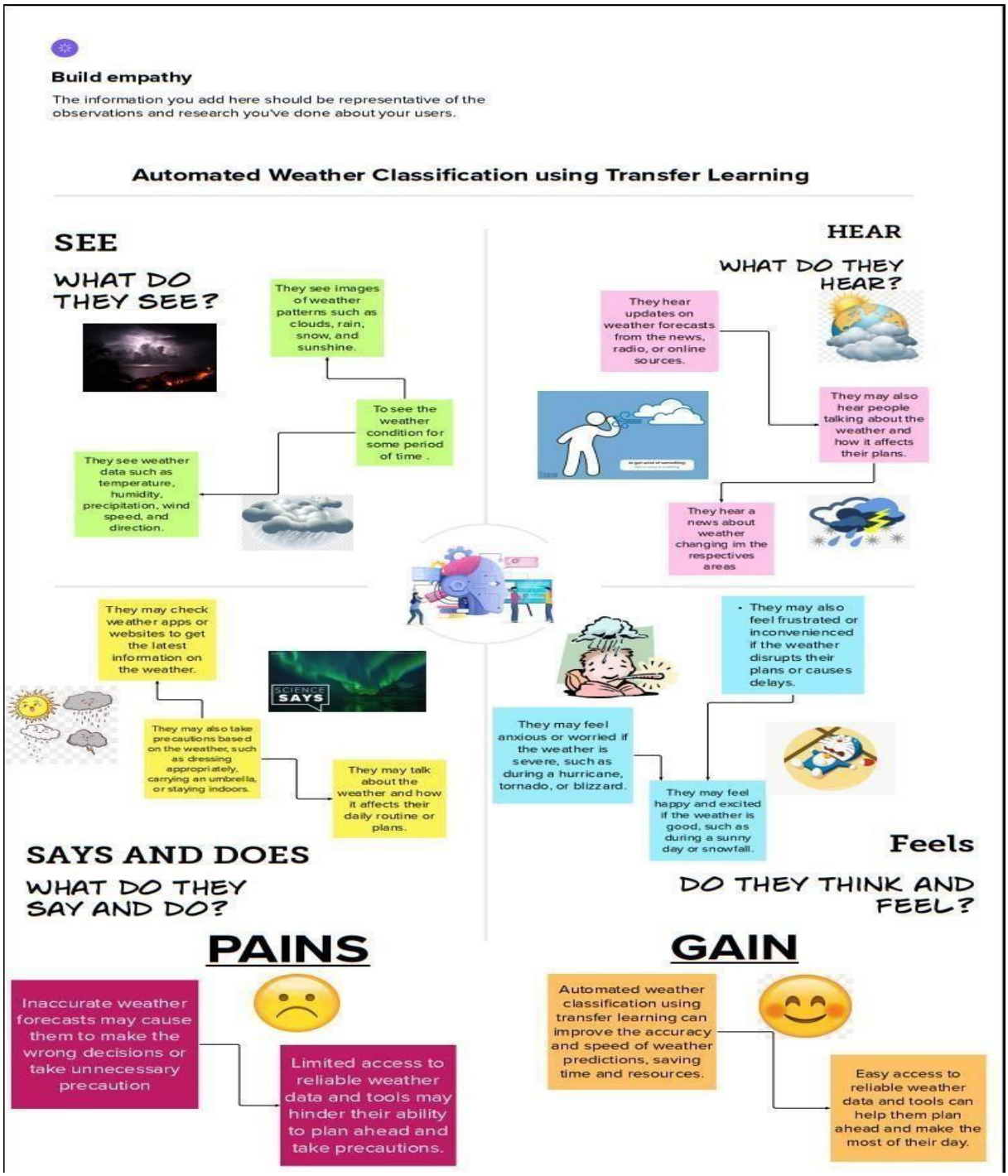


Fig1: Empathy Map

3.2 Ideation & Brainstorming

Fig 2: Idea Listing

Brainstorm:

2

Brainstorm

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

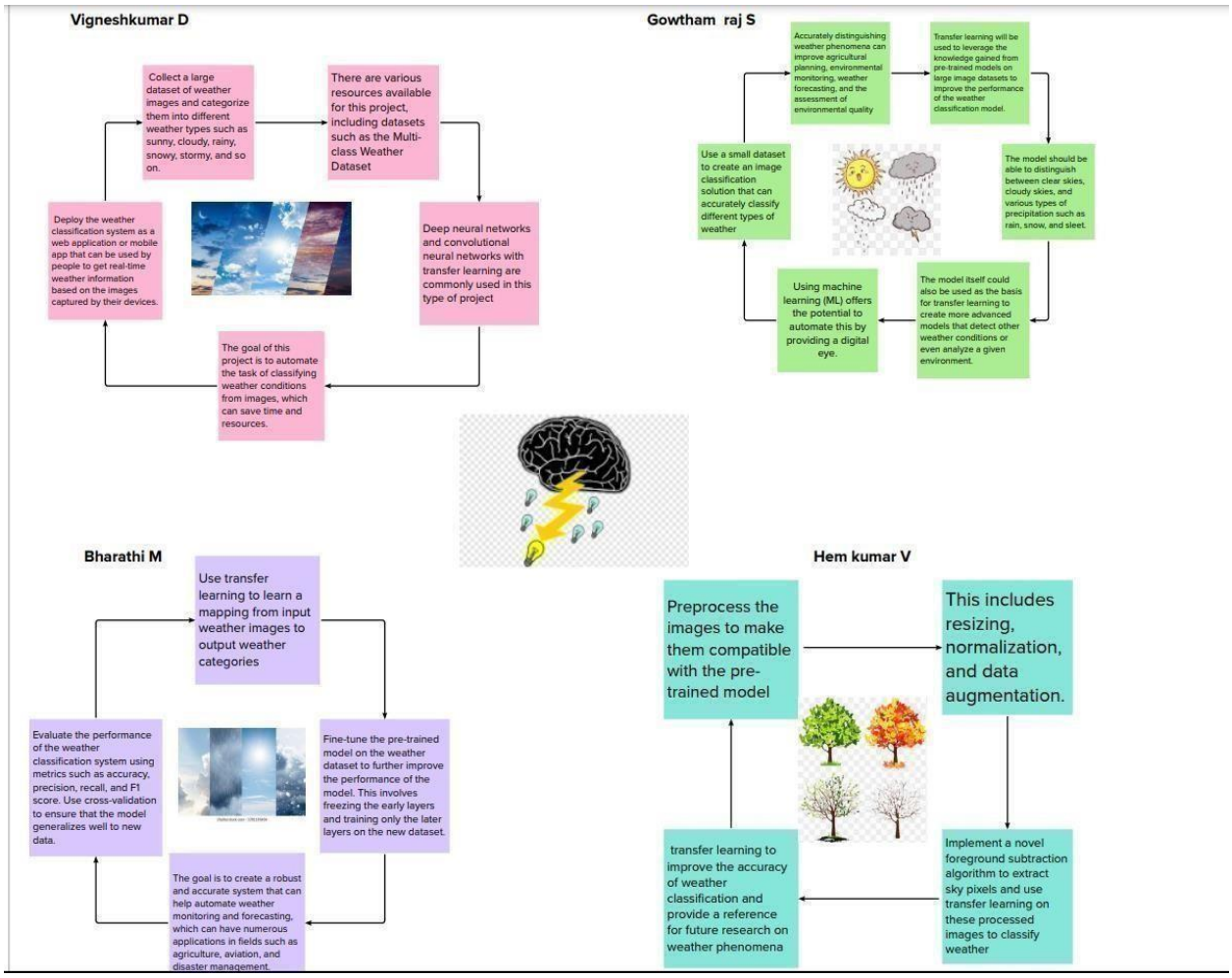


Fig 3: Brainstorm

Fig 4: Prioritize

3.3 Proposed Solution

S No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• To develop an image classification system that can accurately classify different types of weather using a small dataset. • The goal is to use transfer learning to create a solution that can classify weather images into different categories such as cloudy, sunny, rainy, foggy, and sunrise
2.	Idea / Solution description	• Choose a pre-trained convolutional neural network (CNN) model that has been trained on a large dataset, such as ResNet, VGG, or Inception • Once the model has been trained, it can be evaluated on a separate test set to measure its accuracy for classifying weather images.
3.	Novelty / Uniqueness	• Limited availability of weather image datasets. • Variability in weather conditions. • Difficulty in obtaining ground-truth labels • Limited computational resources
4.	Social Impact / Customer Satisfaction	• Improved Weather Forecasting • Improved Agriculture • Environmental Conservation • Increased Customer Satisfaction
5.	Business Model (Revenue Model)	• Subscription-based Model. • API Based model. • Pay-per use model.

CHAPTER-4

REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR No.	Functional Requirement	Sub Requirement (Story / Sub-Task)
FR-1	Data collection	The system should be able to collect a large amount of labeled weather data, including images or other relevant data sources, to train the transfer learning model.
FR-2	Preprocessing	The system should preprocess the collected data to remove noise, outliers, and irrelevant information. This may involve techniques such as data normalization, resizing images to a standardized resolution, and handling missing data.
FR-3	Transfer learning model selection	The system should allow for the selection and integration of a suitable pre-trained model for transfer learning. The model should have been trained on a large-scale dataset and demonstrate good performance on related tasks.
FR-4	Fine-tuning	The system should provide the capability to fine-tune the selected pre-trained model using the collected weather data. Fine-tuning involves training the model on the target weather classification task while leveraging the knowledge gained from the pre-training.
FR-5	Training and evaluation	The system should support training the transfer learning model on the preprocessed data and evaluating its performance. This includes splitting the data into training and validation sets, setting up training parameters, monitoring training progress, and evaluating metrics such as accuracy, precision, recall, and F1 score.
FR-6	Weather classification	The system should be able to take input data, such as images of weather conditions, and classify them into predefined weather categories (e.g., sunny, cloudy, rainy, foggy) using the trained transfer learning model.

4.2 Non Functional Requirement

FR.NO	NON FUNCTIONAL REQUIREMENT	DESCRIPTION
NFR-1	Usability	• The system should have a user-friendly interface that is easy to understand and operate. • It should provide clear feedback and error messages to users when necessary.
NFR-2	Security	• The system should incorporate appropriate security measures to protect the weather data and ensure that only authorized individuals can access and manipulate it.
NFR-3	Reliability	• The system should be reliable, ensuring consistent and accurate weather classification results. • It should be able to handle variations in data quality and handle failures gracefully.
NFR-4	Performance	• The system should be capable of processing weather data efficiently and provide accurate classification results within a reasonable time frame.
NFR-5	Availability	• The system should have a high level of availability, minimizing downtime and ensuring that it is accessible to users for an extended period. • This can be achieved through redundant and fault-tolerant infrastructure, load balancing, and automatic failover mechanisms.
NFR-6	Scalability	• The system should be able to handle a large volume of weather data and scale appropriately as the dataset and computational requirements increase

CHAPTER-5
PROJECT DESIGN

5.1 Data Flow Diagrams

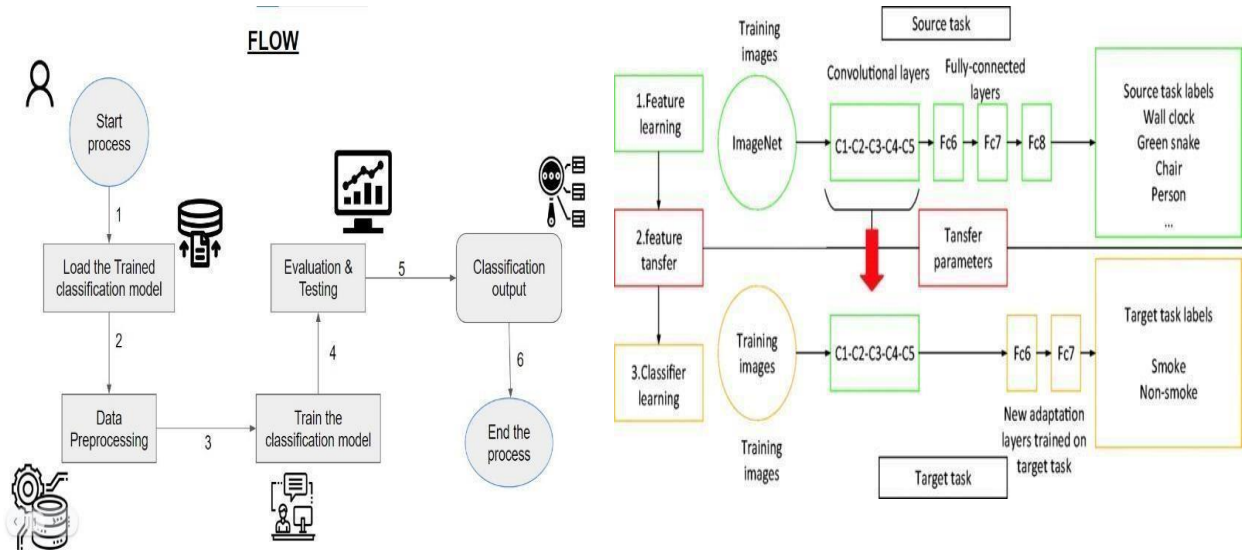


Fig 5: Data Flow Diagrams

5.2 Solution & Technical Architecture

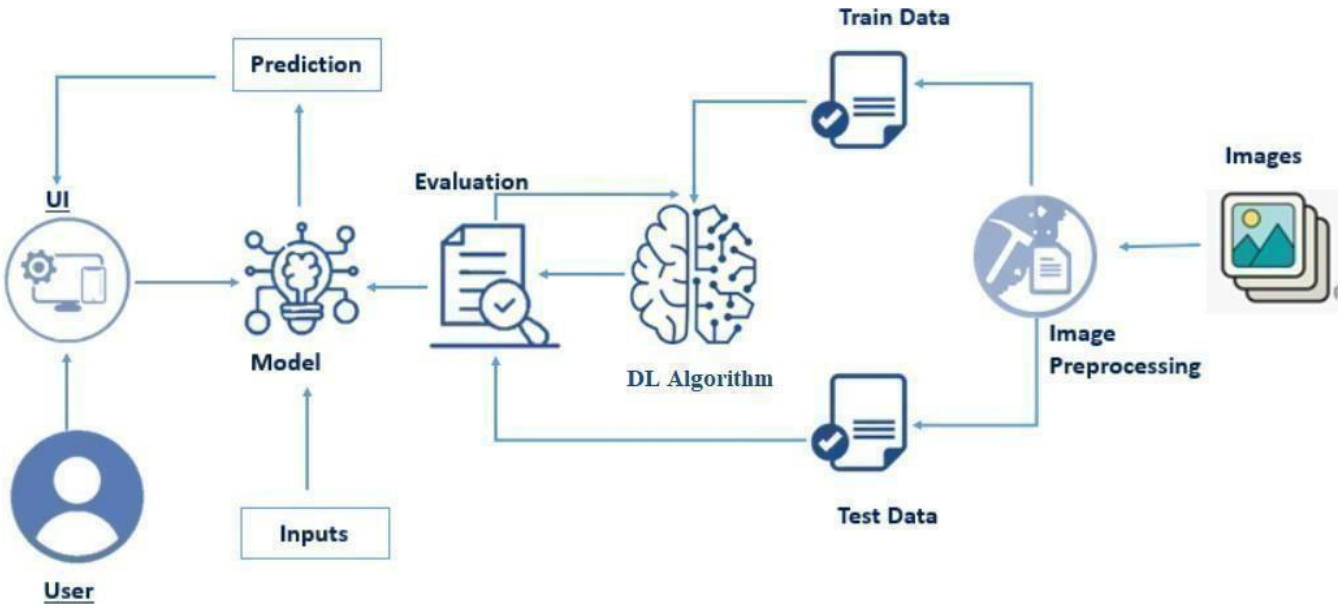


Fig 6: Solution Architecture

Technical Architecture

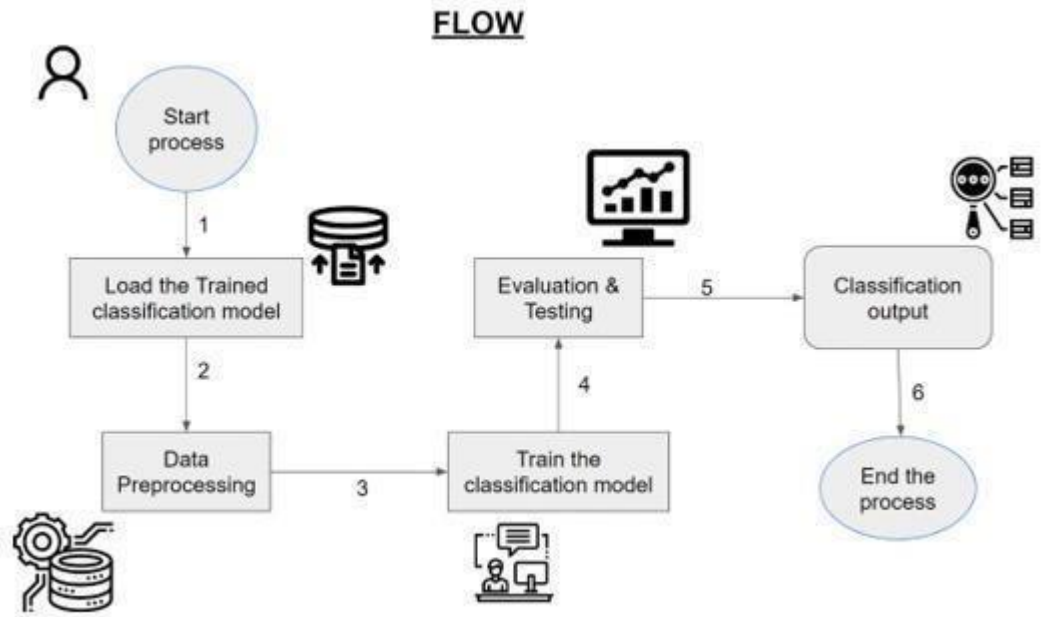


Fig 7:Technical Architecture

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Priority	Team Member
Meteorologists	Real-time Weather Classification	USN-1	As a meteorologist, I want to use an Automated Weather Classification system to quickly and accurately classify weather conditions based on input data, saving me time and effort in manual analysis.	High	Vignesh
Weather Data Analysts	Data Collection and Acquisition	USN-2	As a weather data analyst, I want to leverage Transfer Learning techniques to enhance the accuracy of weather classification models, allowing me to provide more reliable weather forecasts to users.	High	Bharathi
Weather Application Developers	Weather Data Integration	USN-3	As a weather application developer, I want to integrate an Automated Weather	High	Gowtham

			Classification system into my application, enabling users to receive real-time weather updates with precise weather labels and conditions.		
Climate Change Scientists	Data Collection and Analysis	USN-4	As a climate change scientist, I want to analyze historical weather data using Automated Weather Classification to identify long-term trends and patterns, aiding in understanding climate variations and their potential impacts.	Medium	Hem
Customer (Web user)	User-Friendly Interface	USN-5	The web application should have an intuitive and user-friendly interface that allows customers to easily interact with the system. Users should be able to upload weather images or provide image URLs effortlessly.	High	Vignesh
Customer Care Executive	Customer Support Interface	USN-6	The Customer Care Executive should have access to a dedicated interface or software that allows them to interact with customers efficiently and effectively.	medium	Gowtham
Administrator	User Management	USN-6	The Administrator should have the ability to manage user accounts, including creating new accounts, modifying user roles and permissions, and deactivating or deleting user accounts as needed.	High	Vignesh

CHAPTER-6

CODING & SOLUTIONING

6.1 Feature 1

Python Flask :

Python Flask is used to develop chatbot applications using python. Flask is mainly used to render and integrate the chatbot application in the browser by providing API. By running the python application, the suitable server domain link is obtained and run in the browser.

```
import numpy as np

import os

from flask import Flask, request, render_template

from tensorflow.keras.models import load_model

from tensorflow.keras.preprocessing import image

from tensorflow.keras.applications.vgg19 import preprocess_input


model = load_model("C:/Users/vignesh/OneDrive/Desktop/Automated Weather Classification using Transfer Learning/project/wcv.h5")


app = Flask(__name__)


@app.route('/')

def index():

   return render_template('index.html')


@app.route('/home')

def home():

   return render_template("index.html")


@app.route('/input')
```

```
def input1():
    return render_template("output.html")


@app.route('/predict', methods=["GET", "POST"])
def res():
    if request.method == "POST":
        f = request.files['image']
        basepath = os.path.dirname(__file__)
        filepath = os.path.join(basepath, 'uploads', f.filename)
        f.save(filepath)


        img = image.load_img(filepath, target_size=(224, 224))
        img_data = image.img_to_array(img)
        img_data = np.expand_dims(img_data, axis=0)
        img_data = preprocess_input(img_data)


        prediction = np.argmax(model.predict(img_data), axis=1)


        index = ['alien_test', 'cloudy', 'foggy', 'rainy', 'shine',
'sunrise']
        result = index[prediction[0]]


        return render_template('output.html', prediction=result)
if __name__ == "__main__":
    app.run(debug=True) import numpy as np
import os
from flask import Flask, request, render_template
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
```

```
from tensorflow.keras.applications.vgg19 import preprocess_input


model = load_model("C:/Users/vignesh/OneDrive/Desktop/Automated Weather Classification using Transfer Learning/project/wcv.h5")


app = Flask(__name__)


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


@app.route('/home')
```

index.HTML:

```
<!DOCTYPE html>
<html>
<head>
    <title>Automated Weather Classification</title>
    <style>
body {
  background-image: url('https://images.unsplash.com/photo-1592685450751-d0303925804c?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8MjB8fGJlYXV0aWZ1bCUyMHdlYXRoZXJ8ZW58MHx8MHx8fDA%3D&auto=format&fit=crop&w=500&q=60');
  background-repeat: no-repeat;
  background-size: cover;}


        .container {
            text-align: center;
            padding: 50px;
```

```
}
h1 {
    font-size: 36px;
    margin-bottom: 20px;
}
.btn {
    display: inline-block;
    padding: 10px 20px;
    margin: 10px;
    background-color: #4CAF50;
    color: white;
    text-decoration: none;
    border-radius: 5px;
    font-size: 18px;
}
.btn:hover {
    background-color: #45a049;
}
.image-container {
    display: flex;
    justify-content: center;
    flex-wrap: wrap;
    margin-top: 50px;
}
.image-container img {
    margin: 10px;
    width: 200px;

    height: 200px;
    object-fit: cover;
    border-radius: 5px;
```

```
        }
        .image-container p {
            margin: 10px;
            font-size: 16px;
            font-weight: bold;
        }
        .prediction-container {
            margin-top: 50px;
        }
        .prediction-container p {
            font-size: 24px;
            font-weight: bold;
        }
    </style>
</head>
<body>
    <div class="container">
        <h1>Welcome to Automated Weather Classification!</h1>
        <a href="#few-details" class="btn">Few Details</a>
        <a href="#types-of-weather" class="btn">Types of Weather</a>
    </div>

    <div id="few-details" class="container">
        <h1>Few Details</h1>
```

<p>Weather classification refers to the process of categorizing weather conditions or phenomena into different classes or categories based on various parameters and characteristics. It is an important task in meteorology and

weather forecasting, as it helps in understanding and predicting weather patterns, making informed decisions, and communicating weather information to the public.

<h1>Types of Weather</h1>

<img src="https://plus.unsplash.com/premium_photo-1669562729042-b0a3d23afcf1?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8MXx8Zm9nZ3klMjB3ZWF0aGVyfGVufDB8fDB8fHww&auto=format&fit=crop&w=500&q=60" alt="Foggy">

Foggy

<img src="https://images.unsplash.com/photo-1646071178918-4d342e36ac75?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8NXx8Y2xvZHklMjB3ZWF0aGVyfGVufDB8fDB8fHww&auto=format&fit=crop&w=500&q=60" alt="cloudy">

Cloudy

<img src="https://media.istockphoto.com/id/105934727/photo/rain.jpg?s=612x612&w=0&k=20&c=rJcjz9o_7spWniAhZ-oFOVQ9gBJCy2tY_s__RqsseVw=" alt="Rainy">

Rainy

<img src="https://media.istockphoto.com/id/1165680176/photo/beach-of-the-ocean-and-red-sunrise.jpg?s=612x612&w=0&k=20&c=RULckd7mBK10ny50FxJ2DkOupr_9ujIviUIRGqttGZ4=" alt="sunrise">

Sunrise

<img src="https://media.istockphoto.com/id/1401500101/photo/aerial-drone-view-of-foggy-mountain-central-province-sri-lanka.jpg?s=612x612&w=0&k=20&c=Aksw-FlRvehbl0WYkVe-XsONFBk990mZjm370QdZF4c=" alt="Foggy">

Foggy

<img src="https://media.istockphoto.com/id/517643357/photo/thunderstorm-lightning-with-dark-cloudy-sky.jpg?s=612x612&w=0&k=20&c=x3G3UijRPVGFMFExnlYGbnQtnlH6-oUoMU48BTkc0Os=" alt="cloudy">

Cloudy

<img src="https://media.istockphoto.com/id/691761646/photo/woman-hand-with-umbrella-in-the-rain.jpg?s=612x612&w=0&k=20&c=4w0HEfH1_OFGQA9em7sqgetg_PW7GlwjpbcSMzD7LVQ=" alt="Rainy">

Rainy

<img src="https://media.istockphoto.com/id/900629836/photo/carrot-field-in-the-mountains-under-beautiful-sunrise.jpg?s=612x612&w=0&k=20&c=vUIOpndIBDAH6O60I4nH3oLvQwmC0GA08NdcSRFESO8=" alt="sunrise">

Sunrise

<h1>Weather Classification</h1>

<form action="/predict" method="POST" enctype="multipart/form-data">

<input type="file" name="image" accept="image/*" required>

<input type="submit" value="Classify">

</form>

```
    <div class="container prediction-container">
        <h1>Prediction Result</h1>
        {% if prediction %}
            <p>The predicted weather is: {{ prediction }}</p>
        {% endif %}
    </div>
</body>
</html>


<!DOCTYPE html>
<html>
<head>
    <title>Automated Weather Classification</title>
    <style>
body {
  background-image:       url('https://images.unsplash.com/photo-
1592685450751-d0303925804c?ixlib=rb-
4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8MjB8fGJlYXV
0aWZ1bCUyMHdlYXRoZXJ8ZW58MHx8MHx8fDA%3D&a
uto=format&fit=crop&w=500&q=60');
  background-repeat: no-repeat;
  background-size: cover;
}
        .container {
            text-align: center;

            padding: 50px;
        }
        h1 {
            font-size: 36px;
            margin-bottom: 20px;
```

```
}
.btn {
    display: inline-block;
    padding: 10px 20px;
    margin: 10px;
    background-color: #4CAF50;
    color: white;
    text-decoration: none;
    border-radius: 5px;
    font-size: 18px;
}
.btn:hover {
    background-color: #45a049;
}
.image-container {
    display: flex;
    justify-content: center;
    flex-wrap: wrap;
    margin-top: 50px;
}
.image-container img {
    margin: 10px;
    width: 200px;
    height: 200px;
    object-fit: cover;

    border-radius: 5px;
}
.image-container p {
    margin: 10px;
    font-size: 16px;
```

```
            font-weight: bold;
        }
        .prediction-container {
            margin-top: 50px;
        }
        .prediction-container p {
            font-size: 24px;
            font-weight: bold;
        }
    </style>
</head>
<body>
    <div class="container">
        <h1>Welcome to Automated Weather Classification!</h1>
        <a href="#few-details" class="btn">Few Details</a>
        <a href="#types-of-weather" class="btn">Types of Weather</a>
    </div>
<div id="few-details" class="container">
        <h1>Few Details</h1>
        <p>Weather classification refers to the process of categorizing weather conditions or phenomena into different classes or categories based on various parameters and characteristics. It is an important task in meteorology and weather forecasting, as it helps in understanding and predicting weather patterns, making informed decisions, and communicating weather information to the public.</p>

    </div>

    <div id="types-of-weather" class="container">
        <h1>Types of Weather</h1>
        <div class="image-container">
```

```
<img src="https://plus.unsplash.com/premium_photo-1669562729042-b0a3d23afcf1?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8MXx8Zm9nZ3klMjB3ZWF0aGVyfGVufDB8fDB8fHww&auto=format&fit=crop&w=500&q=60" alt="Foggy">

<p>Foggy</p>

<img src="https://images.unsplash.com/photo-1646071178918-4d342e36ac75?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8NXx8Y2xvZHklMjB3ZWF0aGVyfGVufDB8fDB8fHww&auto=format&fit=crop&w=500&q=60" alt="cloudy">

<p>Cloudy</p>

<img src="https://media.istockphoto.com/id/105934727/photo/rain.jpg?s=612x612&w=0&k=20&c=rJcjz9o_7spWniAhZ-oFOVQ9gBJCy2tY_s__RqsseVw=" alt="Rainy">

<p>Rainy</p>

<img src="https://media.istockphoto.com/id/1165680176/photo/beach-of-the-ocean-and-red-sunrise.jpg?s=612x612&w=0&k=20&c=RULckd7mBK10ny50FxJ2DkOupr_9ujIviUIRGqttGZ4=" alt="sunrise">

<p>Sunrise</p>

<img src="https://media.istockphoto.com/id/1401500101/photo/aerial-drone-view-of-foggy-mountain-central-province-sri-lanka.jpg?s=612x612&w=0&k=20&c=Aksw-FlRvehbl0WYkVe-XsONFBk990mZjm370QdZF4c=" alt="Foggy">

<p>Foggy</p>

<img src="https://media.istockphoto.com/id/517643357/photo/thunderstorm-lightning-with-dark-cloudy-sky.jpg?s=612x612&w=0&k=20&c=x3G3UijRPVGFMFExnlYGbnQtnlH6-oUoMU48BTkc0Os=" alt="cloudy">

<p>Cloudy</p>

<img src="https://media.istockphoto.com/id/691761646/photo/woman-hand-with-umbrella-in-the-
```

```
rain.jpg?s=612x612&w=0&k=20&c=4w0HEfH1_OFGQA9em
7sqgetg_PW7GlwjpbcSMzD7LVQ=" alt="Rainy">
        <p>Rainy</p>
<img
src="https://media.istockphoto.com/id/900629836/photo/carrot-
field-in-the-mountains-under-beautiful-
sunrise.jpg?s=612x612&w=0&k=20&c=vUIOpndIBDAH6O60
I4nH3oLvQwmC0GA08NdcSRFESO8=" alt="sunrise">
        <p>Sunrise</p>



    </div>
  </div>


  <div class="container">
    <h1>Weather Classification</h1>
    <form action="/predict" method="POST"
enctype="multipart/form-data">
      <input type="file" name="image" accept="image/*"
required><br><br>
      <input type="submit" value="Classify">
    </form>
  </div>




 <div class="container prediction-container">
    <h1>Prediction Result</h1>
    {% if prediction %}
      <p>The predicted weather is: {{ prediction }}</p>
    {% endif %}
  </div>
</body>
```

```
</html>
```

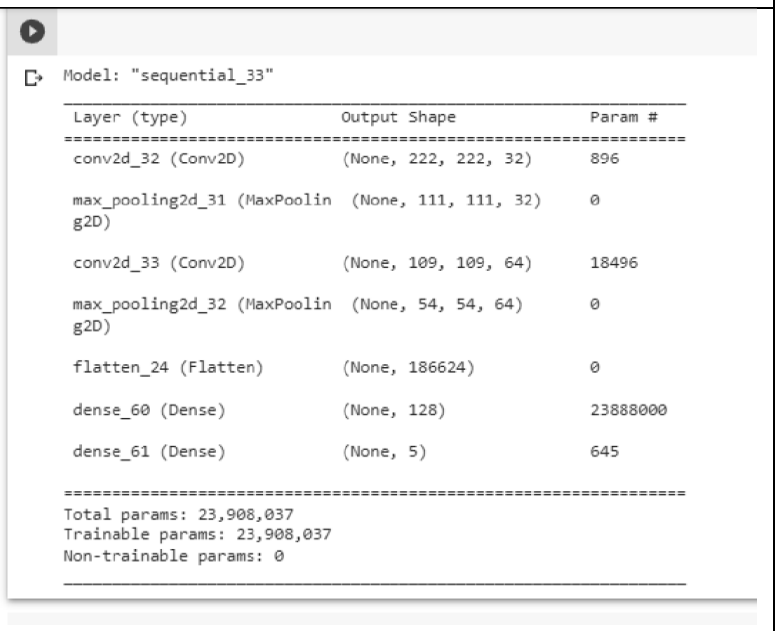
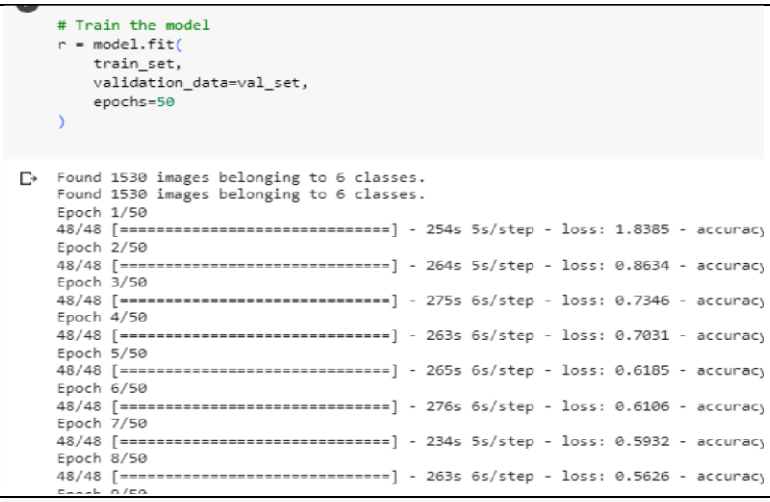
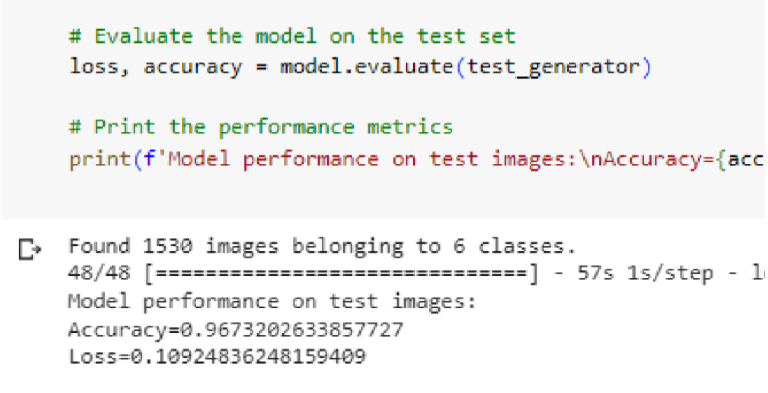
Output.html:

```
<!DOCTYPE html>
<html>
<head>
   <title>Weather Classification - Output</title>
<style>
body {
 background-image: url('https://images.unsplash.com/photo-1496450681664-3df85efbd29f?ixlib=rb-4.0.3&ixid=M3wxMjA3fDB8MHxzZWFyY2h8MjB8fHdlYXRoZXJ8ZW58MHx8MHx8fDA%3D&auto=format&fit=crop&w=500&q=60');
 background-repeat: no-repeat;
 background-size: cover;
}
</style>

</head>
<body>

   <h1>Weather Classification Result</h1>
   <p>The predicted weather is: {{ prediction }}</p>
   <p><a href="{{ url_for('input1') }}">Try Another Image</a></p>
</body>
</html>
```

CHAPTER-7

TESTING

7.1 Performance Metrics

S.No.	Parameter	Values	Screenshot
1.	Model Summary	The values for the trainable and nontrainable parameters can vary depending on the specific pre-trained model and the number of layers added on top. In this example, most of the parameters come from the VGG19 model itself, while the custom classification head has significantly fewer trainable parameters. Total params, Trainable params, Non-trainable params	
2.	Accuracy	Training Accuracy - To obtain the training accuracy during the training process, you would need to track the training accuracy metric explicitly in your code.	
3.	Validation accuracy	Validation Accuracy - After training, the validation_accuracy variable will contain the validation accuracy values for each epoch. These values represent the accuracy of the model on the validation dataset during the training process.	

CHAPTER-8
RESULTS

Index.html:

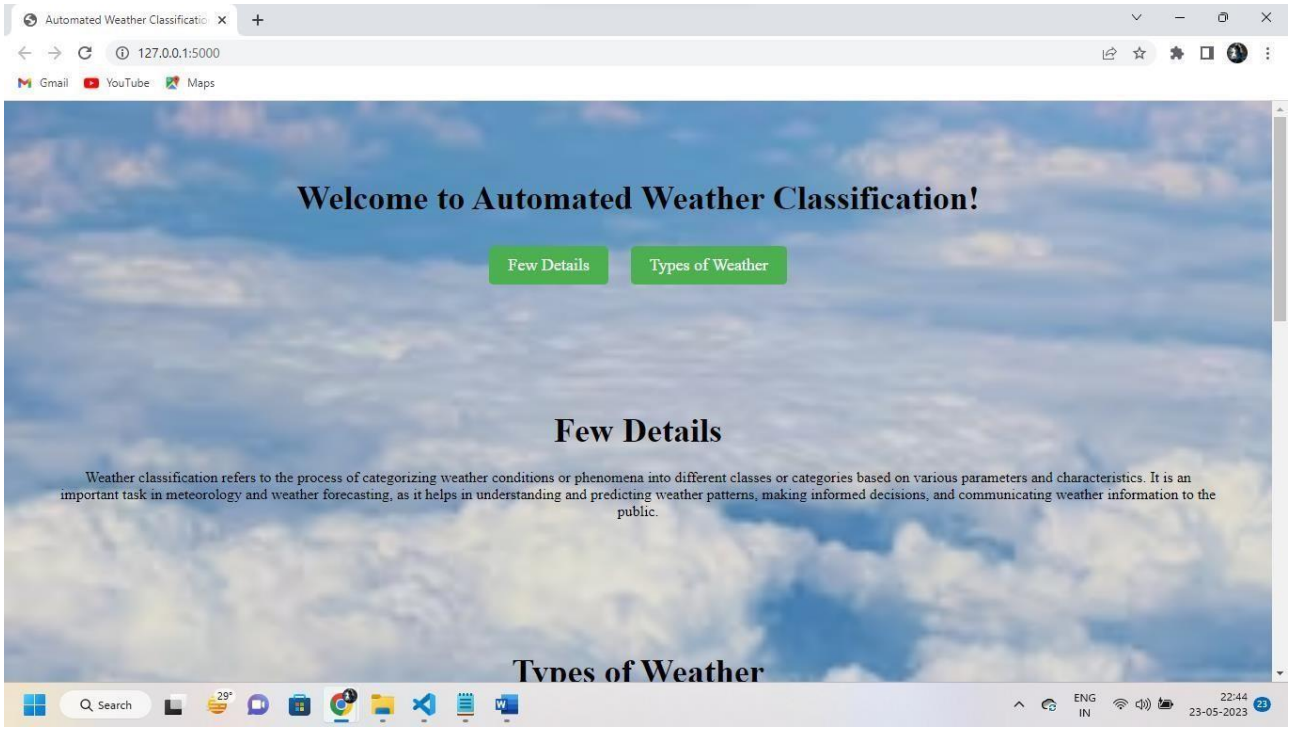


Fig 7: Index.html

Few Details Page:

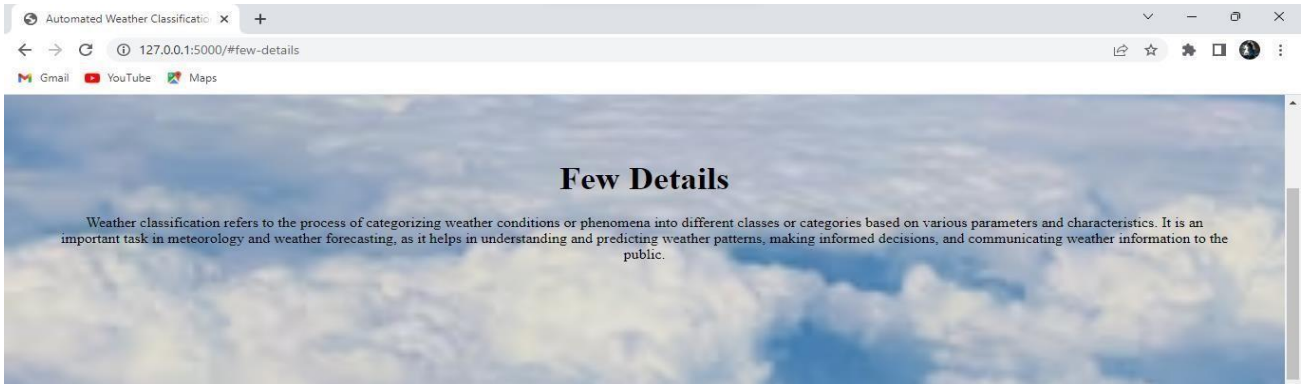


Fig 8: Few Details Page

Types Of Weather:

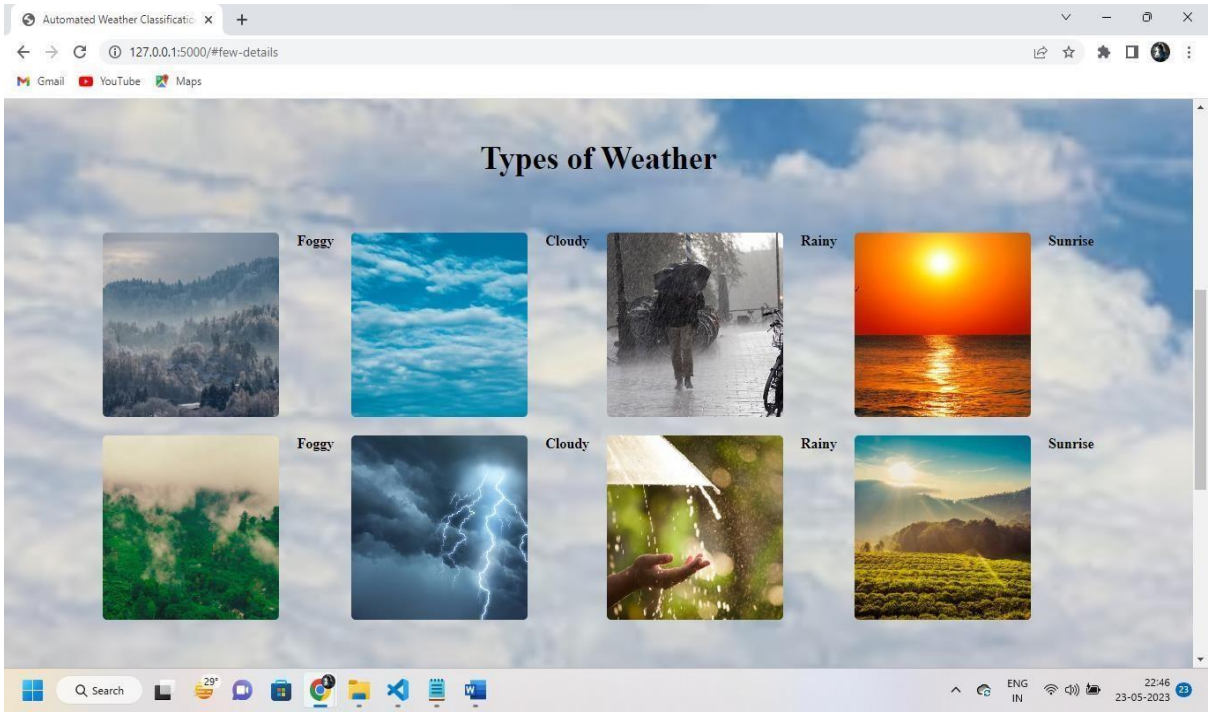


Fig 9:Types Of Weather

Prediction for weather classification:

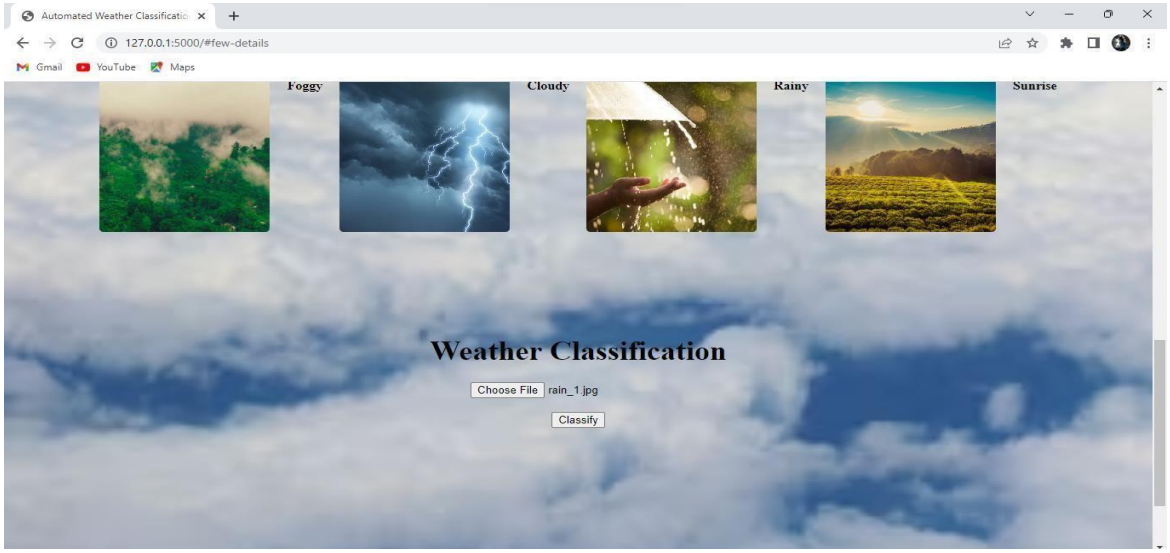


Fig 10: Prediction For Weather Classification

Predicted output:

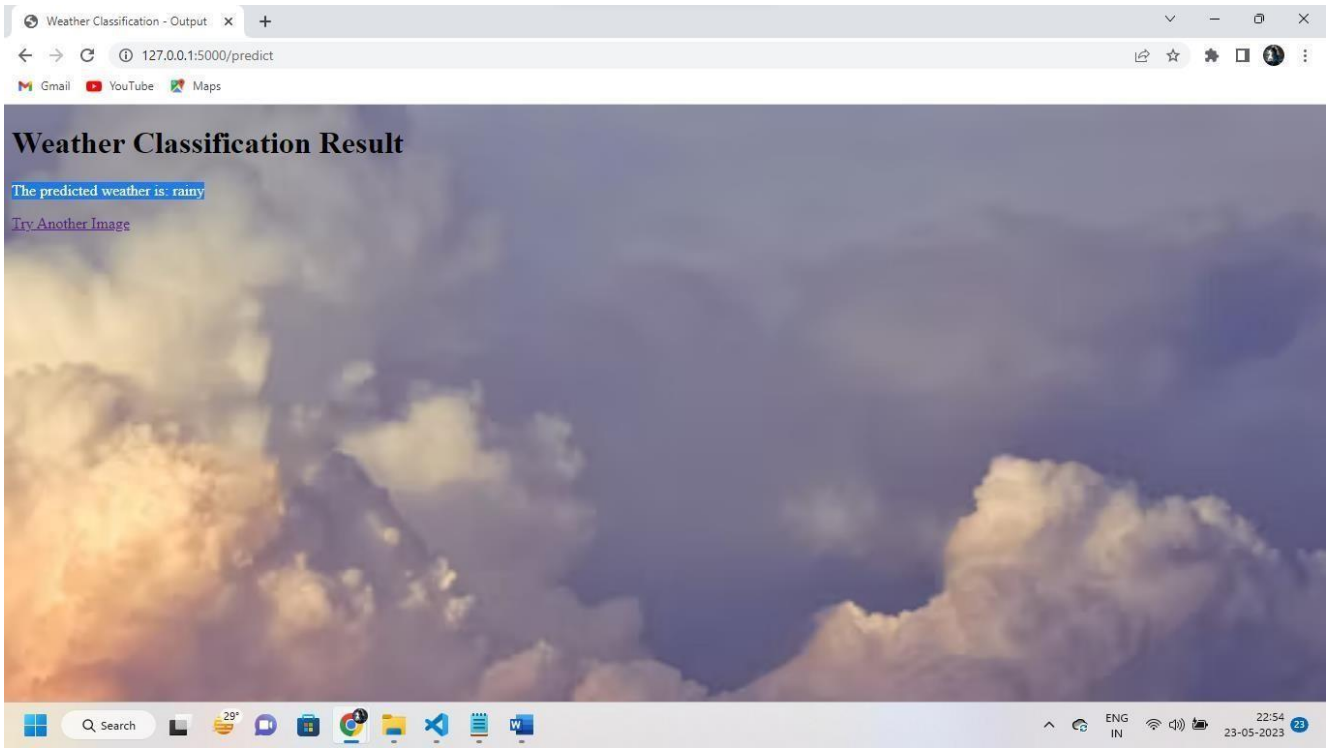


Fig 11: Predicted Output

CHAPTER 9
ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

- **Efficiency:** Transfer learning allows you to leverage pre-trained models that have already learned rich representations from large-scale datasets.
- **Improved Performance:** Pre-trained models are usually trained on massive datasets, which can capture a wide range of weather patterns and features.
- **Reduced Data Requirements**: Training deep learning models for weather classification typically requires large amounts of labeled dataThis reduces the need for extensive labeled datasets, making it more feasible to develop accurate models with limited data.
- **Domain Adaptation:** Transfer learning allows you to adapt a pre-trained model from a different domain (e.g., image recognition) to weather classification.

DISADVANTAGES:

- **Lack of Domain Specificity:** Pre-trained models may not be specifically designed for weather classification tasks. This can result in suboptimal performance and the need for additional fine-tuning or training on domain-specific data.
- **Limited Adaptability:** Transfer learning assumes that the source and target domains share similar characteristics. It is crucial to carefully evaluate the compatibility between the pre-trained model and the weather classification task.
- **Biased Representations:** Pre-trained models can have biases inherent in the datasets on which they were trained. When transferring these models to weather classification, these biases may persist and affect the accuracy and fairness of the predictions.
- **Limited Flexibility:** While transfer learning offers efficiency and performance benefits, it limits your control over the model architecture and feature representation.Fine-tuning or adapting the model may help address this limitation to some extent.

CHAPTER-10
CONCLUSION

- In conclusion, automated weather classification using transfer learning offers several advantages and opportunities for improving the accuracy and efficiency of weather classification systems.

- By leveraging pre trained model and their learned representations, the approach enables enhanced accuracy, reduced training time, adaptability to limited data, and the ability to generalize to new weather patterns.

- It provides a valuable tool for various applications such as weather forecasting, disaster management, agriculture, renewable energy optimization, and more.

CHAPTER-11
FUTURE SCOPE

The field of automated weather classification using transfer learning holds significant potential for future advancements and expansion. Here are some potential future scopes and directions for research and development in this area.

1. Enhanced weather prediction

By incorporating automated weather classification into existing weather prediction models, we can improve the accuracy and reliability of weather forecasts. Transfer learning can help extract relevant features from weather data and enable more precise predictions of weather patterns, leading to better preparedness for severe weather events.

2. Real-time weather monitoring

Automated weather classification systems can be integrated with sensor networks and weather monitoring devices to provide real-time weather updates and alerts. By continuously analysing incoming data, these systems can rapidly identify and classify changing weather conditions, facilitating timely responses and early warnings.

3. Fine-grained weather classification

Current weather classification focuses on broad weather categories such as sunny, cloudy, or rainy. Future research can explore fine-grained classification to identify more specific weather conditions such as fog, haze, snow, or thunderstorms. Fine-grained classification can be valuable for various applications, including aviation, agriculture, and urban planning.

4. Multi-modal data fusion

Weather classification can benefit from combining data from multiple sources and modalities, such as satellite imagery, radar data, atmospheric measurements, and social media feeds.

APPENDIX

GITHUB LINK:

https://github.com/naanmudhalvan-SI/PBL-NT-GP--5713-1680798956

PROJECT DEMO LINK:

https://youtu.be/pS2UpK791es

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[4] Pan, S. J., & Yang, Q. (2010). A survey on transfer learning. IEEE Transactions on Knowledge and Data Engineering, 22(10), 1345-1359.
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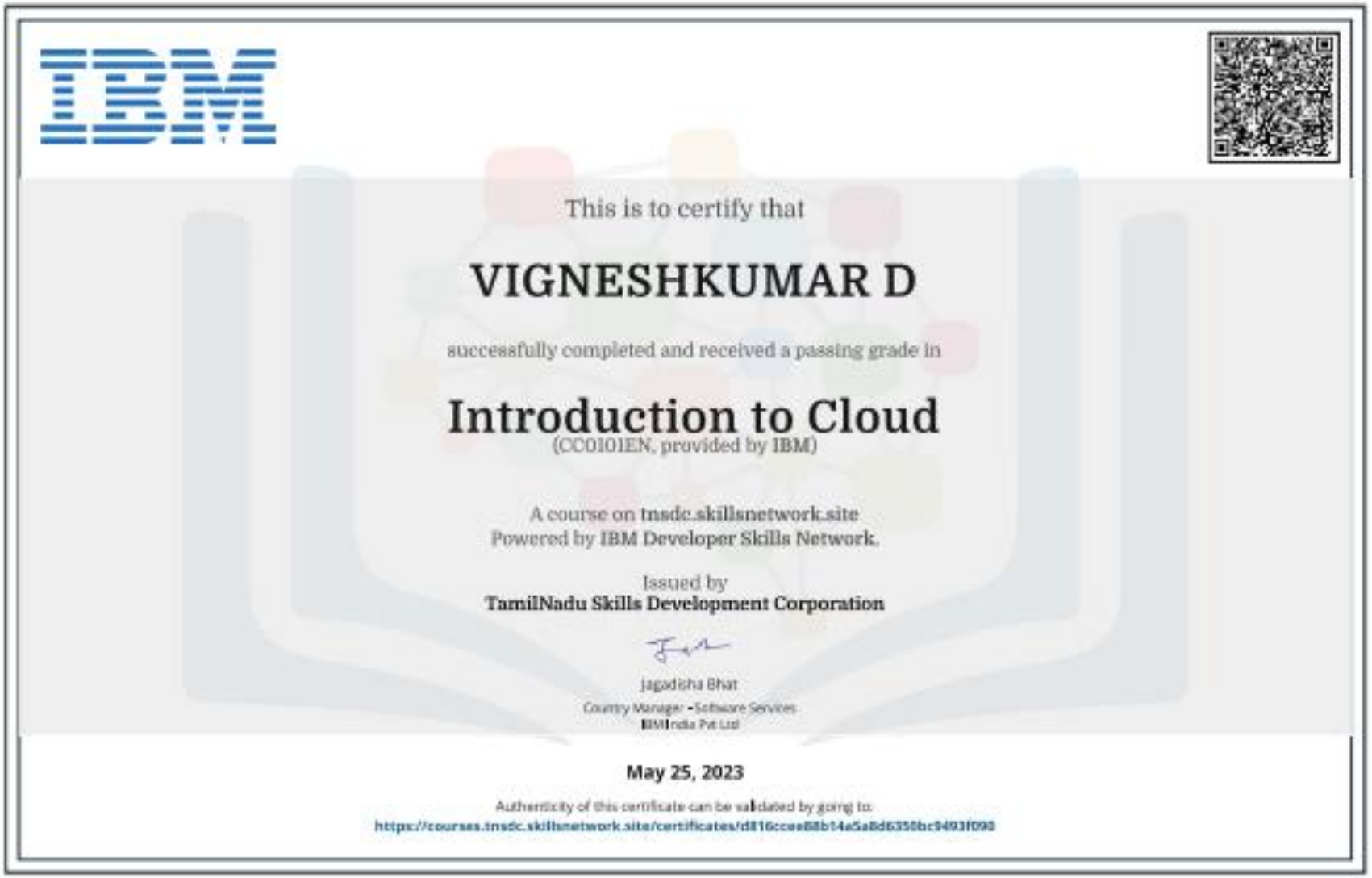

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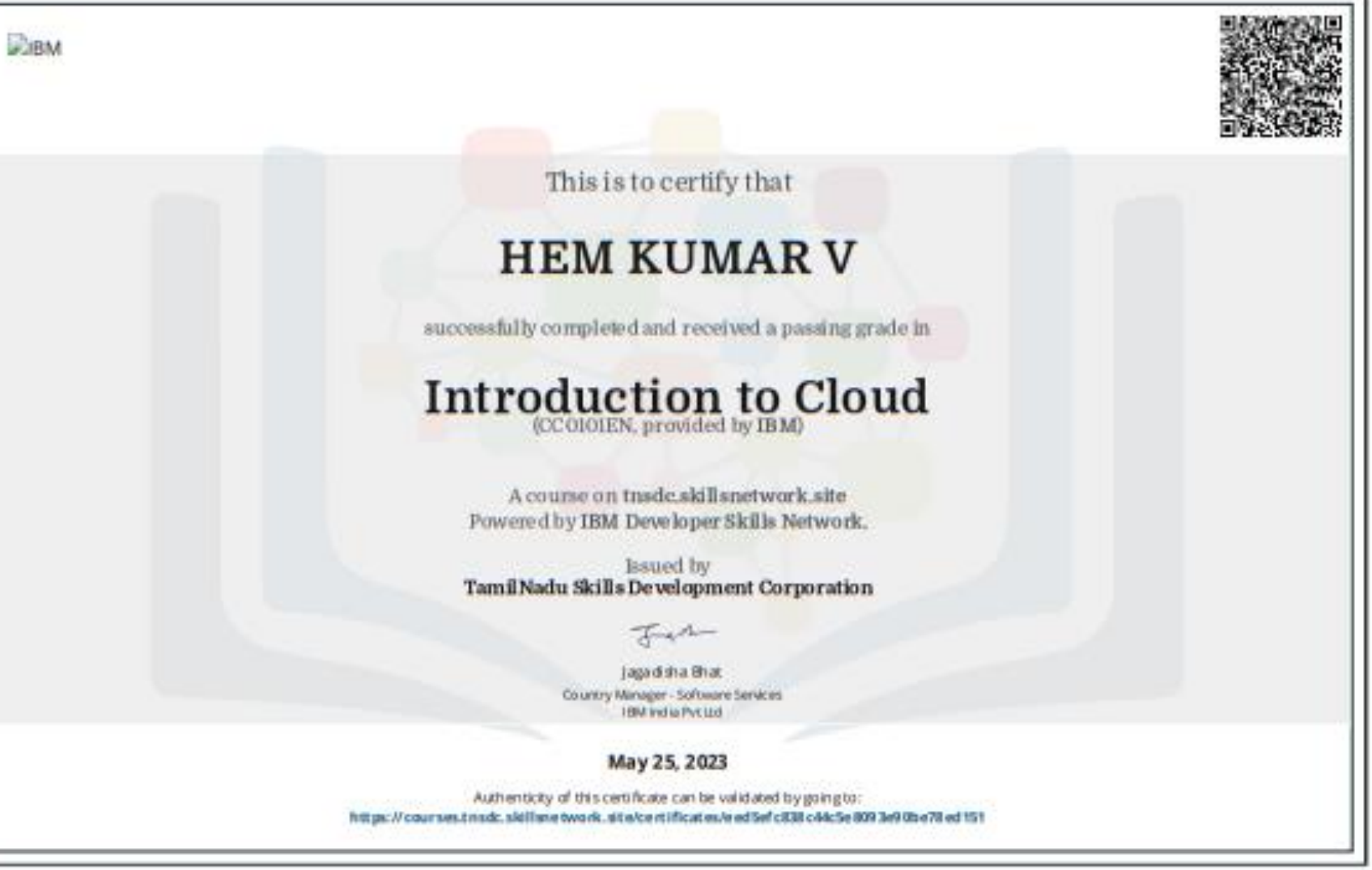

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