WEATHER FORECASTING

A PROJECT REPORT

Submitted by

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in partial fulfilment for the award of the course

AGB1121- DESIGN THINKING

in

COMPUTER SCIENCE AND ENGINEERING

(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

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AGB1121 PROJECT WORK

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of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

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BONAFIDE CERTIFICATE

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DECLARATION BY THE CANDIDATES

We declare that to the best of our knowledge the work reported here in has been composed solely by ourselves and that it has not been in whole or in part in any previous application for a degree.

Submitted for the project Viva- Voce held at K. Ramakrishnan College of Engineering on _________

SIGNATURE OF THE CANDIDATES

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INSTITUTE VISION AND MISSION

VISION OF THE INSTITUTE:

To achieve aprominent position among the top technical institutions.

MISSION OF THE INSTIITUTE:

M1: To best standard technical education par excellence through state of the art infrastructure, competent faculty and high ethical standards.

M2: To nurture research and entrepreneurial skills among students in cutting technologies.

M3: To provide education for developing high-quality professionals to transform the society.

DEPARTMENT VISION AND MISSION

DEPARTMENT OF CSE(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Vision of the Department

To become a renowned hub for Artificial Intelligence and Machine Learning technologies to produce highly talented globally recognizable technocrats to meet industrial needs and societal expectations.

Mission of the Department

M1: To impart advanced education in Artificial Intelligence and Machine Learning, built upon a foundation in Computer Science and Engineering.

M2: To foster Experiential learning equips students with engineering skills to tackle real-world problems**.**

M3: To promote collaborative innovation in Artificial Intelligence, machine learning, and related research and development with industries.

M4: To provide an enjoyable environmentfor pursuing excellence while upholding strong personal and professional values and ethics**.**

Programme Educational Objectives (PEOs):

Graduates will be able to:

PEO1: Excel in technical abilities to build intelligent systems in the fields of Artificial Intelligence and Machine Learning in order to find new opportunities**.**

PEO2: Embrace new technology to solve real-world problems, whether alone or as a team, while prioritizing ethics and societal benefits.

PEO3: Accept lifelong learning to expand future opportunities in research and product development.

Programme Specific Outcomes (PSOs):

PSO1: Ability to create and use Artificial Intelligence and Machine Learning algorithms, including supervised and unsupervised learning, reinforcement learning, and deep learning models.

PSO2: Ability to collect, pre-process, and analyze large datasets, including data cleaning, feature engineering, and data visualization..

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PROGRAM OUTCOMES(POs)

Engineering students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify ,formulate ,review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis andinterpretation of data, and synthesis of the information to provide valid conclusions

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ABSTRACT

This project presents a weather forecasting system leveraging machine learning techniques to predict key parameters such as temperature, humidity, wind speed, and precipitation. Utilizing real-time and historical data from reliable meteorological sources, the system ensures accurate and timely forecasts. The architecture includes data collection, preprocessing, model training, and prediction modules, optimized for performance and scalability. Algorithms like Linear Regression and LSTM networks are implemented to enhance accuracy. A user- friendly interface displays forecasts, historical trends, and real-time alerts. Future enhancements include IoT integration for localized monitoring and advanced AI models for long-term predictions, making the system a reliable tool for various sectors, including agriculture, transportation, and disaster management.

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LIST OF ABBREVIATIONS

ABBREVIATIONS

NWP	-	Numerical Weather Prediction
GFS	-	Global Forecast System
ECMWF	-	European Centre for Medium-Range Weather
Forecasts NAM	-	North American Mesoscale Model
AI	-	Artificial Intelligence
ML	-	Machine Learning
RADAR	-	Radio Detection and Ranging
GPS	-	Global Positioning System (used in weather observations)

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Weather forecasting has become an indispensable part of modern society, impacting sectors such as agriculture, transportation, disaster management, and everyday life. Accurate weather predictions help farmers plan their planting and harvesting schedules, enable airlines and shipping companies to optimize routes, and assist communities in preparing for extreme weather conditions like storms and hurricanes. Historically, weather forecasting relied on manual observations and early numerical models, which, although groundbreaking for their time, had significant limitations in accuracy and scope.

1.2 PURPOSE AND IMPORTANCE

The primary purpose of this project is to develop a robust weather forecasting system that harnesses the power of machine learning to predict essential weather parameters such as temperature, humidity, wind speed, and precipitation. The system aims to provide real-time forecasts that can be used by individuals, businesses, and governmental agencies to make informed decisions. Accurate weather information is crucial for preventing potential losses and ensuring safety. For example, early warnings about severe weather can help communities evacuate areas at risk, while farmers can adjust their activities based on predicted rainfall or drought conditions.

Enhancing Forecast Accuracy: The primary purpose of this weather forecasting system is to improve the accuracy of predictions by leveraging advanced machine learning algorithms. Traditional methods often struggle with complex and rapidly changing weather patterns, but AI-driven models can analyze vast datasets to identify hidden patterns and correlations, resulting in more reliable forecasts.

Supporting Critical Industries : Accurate weather predictions are crucial for industries such as agriculture, aviation, transportation, and construction. Farmers can optimize planting and harvesting schedules, airlines can avoid dangerous weather conditions, and construction projects can plan activities around favorable weather windows, reducing risks and operational costs.

Enhancing Disaster Preparedness : Early and precise forecasts can play a pivotal role in disaster preparedness and management. Timely warnings about extreme weather conditions, such as hurricanes, floods, and heatwaves, allow authorities to take preventive measures, issue alerts, and ensure the safety of communities at risk.

Improving Daily Life and Planning: For individuals, accurate weather information helps in planning daily activities, travel, and events. Knowing the forecast for the day or week ahead allows people to make informed decisions about their routines, ensuring they are prepared for any weather changes.

Promoting Environmental Awareness: Weather forecasting systems contribute to raising awareness about climate patterns and environmental changes. By providing data on temperature trends, rainfall patterns, and extreme weather events, these systems can educate the public on the impacts of climate change, encouraging more sustainable practices.

1.3OBJECTIVES:

1. Develop a weather forecasting system that predicts temperature, rainfall, humidity, and wind speed.
2. Use machine learning models to improve forecast accuracy.
3. Integrate data from multiple reliable sources like weather APIs and satellites.
4. Provide real-time updates for timely decision-making.
5. Create a user-friendly interface for easy access to weather information.
6. Include alerts for severe weather conditions to enhance safety and preparedness.

1.4 PROJECT SUMMARIZATION

This project focuses on building a machine-learning-based weather forecasting system capable of providing accurate, real-time predictions. The system leverages data from reliable meteorological sources, processes it using advanced algorithms, and delivers insights through a user-friendly interface. Key features include temperature and precipitation forecasting, historical data analysis, and real-time alerts for severe weather events. By integrating modern technologies and emphasizing usability, the system aims to address the challenges of traditional forecasting methods, making it a reliable tool for various sectors, including agriculture, transportation, and disaster management.

CHAPTER 2

PROJECT METHODOLOGY

2.1 INTRODUCTION TO SYSTEM ARCHITECTURE

The system architecture for the weather forecasting application is designed to ensure accuracy, scalability, and real-time performance. It consists of multiple interconnected components that work together to gather data, process it, generate predictions, and present results to the user. The architecture is modular, which makes it easier to manage, maintain, and scale as needed.

The primary components of the architecture are:

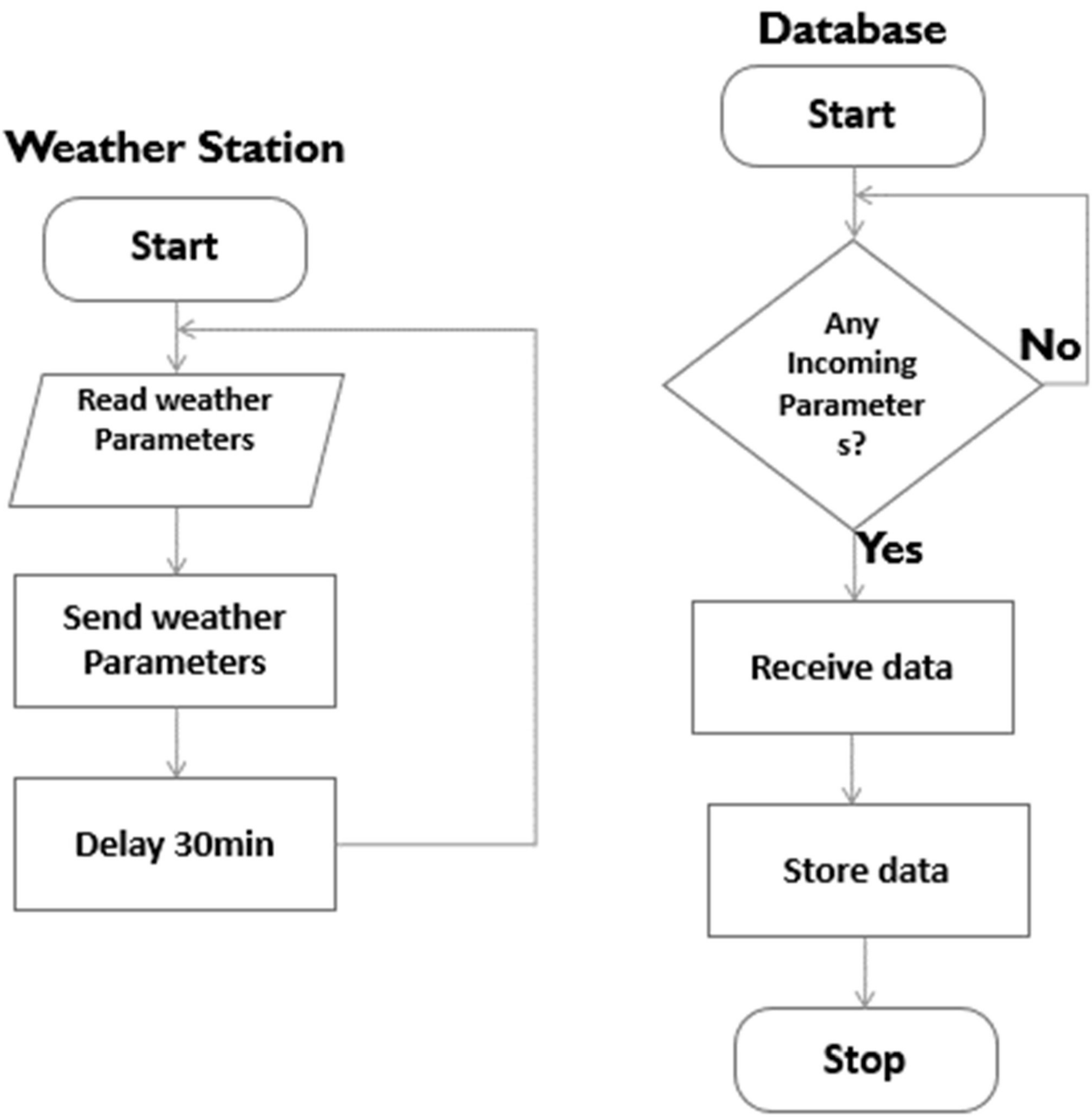
1. **Data Collection**: This component is responsible for gathering real-time weather data from external sources such as weather APIs, meteorological stations, and satellite data. APIs like OpenWeatherMap or NASA provide continuous streams of data that serve as the foundation for predictions.
2. **Data Preprocessing**: After the raw data is collected, it is cleaned and processed for analysis. This step involves handling missing values, normalizing data, and transforming variables so they are ready for the machine learning models. It ensures the data is consistent, accurate, and structured in a way that maximizes model efficiency.
3. **Model Training**: Machine learning models, such as Linear Regression, Random Forest, and Long Short-Term Memory (LSTM) networks, are used to train the system. These models analyze historical weather data to recognize patterns and make predictions. The system is trained using supervised learning, where the models are fed labeled data to improve their ability to predict future weather events accurately.

4. **Prediction Engine**: This is the core of the system, where trained models generate forecasts based on real-time input. It uses the latest available data, applies the machine learning models, and generates predictions for temperature, humidity, wind speed, and precipitation for various locations and timeframes.

5. User Interface (UI): The UI is designed to be intuitive and easy to use. It allows users to interact with the system, input location details, and access weather forecasts. The interface displays results in the form of charts, graphs, and maps, making it easy for users to understand and interpret the forecast data. Users can also set preferences for notifications related to severe weather conditions.

6. Real-Time Alerts: This component is responsible for sending real-time notifications to users about upcoming weather changes, such as thunderstorms, hurricanes, or other extreme conditions. Alerts can be customized by the user, allowing them to receive notifications only for specific conditions, regions, or thresholds.

2.2 DETAILED SYSTEM FLOW DIAGRAM



1.Data Acquisition

The first step is collecting real-time weather data from reliable sources like weather APIs and local stations. This data includes information such as temperature, humidity, wind speed, and precipitation. The system continuously fetches the most up-to-date weather data from these sources.

2. Data Preprocessing

Once the data is collected, it needs to be cleaned and prepared for analysis. This involves removing any errors or missing values, adjusting the data to be in a usable format, and creating new features (like wind chill or heat index) that can help improve the accuracy of predictions.

3. Model Training

Next, the system uses machine learning models to analyze historical weather data. The models learn patterns in the data, helping the system make accurate predictions about future weather conditions. This step involves training the models to understand the relationship between different weather factors (e.g., how temperature affects humidity).

4.Prediction Engine

The prediction engine takes the trained models and uses them to generate weather forecasts. When new data is received, the engine applies the models to predict weather conditions like temperature, humidity, and rainfall for the coming hours or days.

5. User Interface (UI)

The user interface is the part of the system where users interact with the application. It displays the weather forecasts in an easy-to-understand format, such as graphs or maps. Users can input their location and see the weather predictions for that area. The interface is designed to be simple and user-friendly.

CHAPTER 3

CORE FEATURES AND MODULES

3.1 Data Collection and Processing

The first critical step in the weather forecasting system is the collection of weather data. This data is sourced from various reliable meteorological sources, such as weather APIs, satellites, and local weather stations. APIs like OpenWeatherMap and NASA provide real-time weather information, including temperature, humidity, wind speed, and precipitation levels. These sources continuously update weather data, ensuring the system always has the most accurate and up-to-date information.

Once the data is gathered, it undergoes a preprocessing phase. In this step, the raw data is cleaned and transformed into a usable format. This includes:

- **Handling Missing Data**: Missing values are either removed or filled in using methods like mean imputation or predictive modeling.
- **Normalization**: Data is scaled to ensure consistency, making it easier for machine learning models to process.
- **Feature Engineering**: Additional features, such as wind chill, heat index, or dew point, are created from the basic weather parameters to improve the prediction models' performance.

This preprocessed data is then ready to be used for training machine learning models that will predict future weather conditions.

3.2 Prediction Models

The core of the weather forecasting system relies on machine learning models to make predictions about future weather. The system uses several different types of algorithms to ensure the forecasts are accurate and reliable:

- **Linear Regression**: A simple yet effective model that is often used to predict continuous variables such as temperature. It helps establish a relationship between the independent variable (e.g., humidity) and the dependent variable (e.g., temperature).
- **Random Forest**: This algorithm creates multiple decision trees based on random subsets of the data. It is especially useful for predicting multiple weather parameters like wind speed, rainfall, and pressure because it handles non-linear relationships well and is robust to overfitting.
- **Long Short-Term Memory (LSTM) Networks**: LSTMs are a type of recurrent neural network (RNN) that is specifically designed to handle sequential data, making them ideal for time-series forecasting. In weather prediction, LSTM models can analyze past weather patterns and use that information to forecast future conditions, taking into account trends and seasonal variations.

These models are trained using historical weather data and are continually updated with new data to improve their predictive power.

3.3 User Interaction and Visualization

The weather forecasting system includes a user-friendly interface that allows users to interact with the system and easily access weather information. Key features of the user interface include:

- **Weather Forecast Display**: Users can input their location and see forecasts for the next few hours, days, or even weeks. The system presents data in a clear and simple format, such as graphs, charts, or maps, showing temperature, precipitation, and other weather conditions.

- **Interactive Maps**: Users can view weather conditions on interactive maps that show different geographic regions. These maps can display temperature, wind speeds, or rainfall levels, helping users visualize the weather patterns across larger areas.
- **Historical Data**: Users can access historical weather data for comparison, allowing them to track changes over time and better understand long-term trends.
- **Notifications and Alerts**: The system can send real-time alerts to users when severe weather conditions, such as storms or extreme temperatures, are expected. Users can customize which types of notifications they wish to receive based on their location and preferences.

The goal of the user interface is to make weather data easily accessible and actionable, ensuring that users can quickly interpret the forecast and make informed decisions based on the information provided.

CHAPTER 4

USER RECOMMENDATIONS

4.1 Weather Feed and Categorization Models

In a One of the key components of the weather forecasting system is the personalized weather feed, which presents forecasts tailored to the user's preferences. This feed categorizes weather data based on user-defined criteria, such as location, type of weather (e.g., temperature, precipitation), and time frame (e.g., hourly, daily). The categorization models use metadata such as weather conditions (rain, snow, sunny, etc.), date, and location to organize and present the forecast data in an easy-to-understand format.

Categorization models play a vital role in ensuring that users receive the most relevant and important weather information based on their preferences. These models leverage techniques such as natural language processing (NLP) and clustering to automatically sort weather data into predefined categories. This makes it easier for users to navigate and find the information they need, especially when dealing with large datasets or forecasting for multiple locations.

4.2 Dynamic Content Recommendations and AI Integration

Dynamic content recommendations are driven by AI algorithms that analyze user behavior, interactions, and preferences over time. For instance, if a user frequently checks weather conditions for a specific location, the system can recommend additional relevant information, such as upcoming weather trends or severe weather warnings for that region. The system learns from user interactions (such as clicks, saved preferences, and search history) and adjusts its recommendations to better align with individual needs.

AI integration enhances the personalization aspect of the weather forecasting system by using machine learning algorithms to predict future user interests. For example, if the system detects that a user is interested in extreme weather events, it can automatically recommend weather reports related to hurricanes, storms, or temperature extremes in their area. This predictive behavior increases user engagement by providing content that is more aligned with their interests.

4.3 Personalized Weather Feed Based on User Interests

Personalizing the weather feed is a central feature of the system. By analyzing user interactions, such as past searches, locations, and weather preferences, the system builds a custom weather feed for each user. For example, users who are interested in daily weather updates for their home city can receive a tailored daily forecast, while users who need more detailed information about regional weather patterns can access hourly or weekly forecasts for multiple locations.

The personalized feed allows users to see the most relevant weather information at the top of their interface, making it easy to stay informed about the weather conditions that matter most to them. Users can also customize their feed by selecting specific weather parameters they wish to follow, such as temperature, humidity, or wind speed.

4.4 Node Structure and Weather Data Organization

To efficiently manage and display weather data, the system organizes information into a node-based structure. Each node represents a piece of weather data, such as a specific forecast for a particular day or location. The nodes are linked together in a hierarchical or graph-based structure, allowing for efficient querying, filtering, and navigation.

For instance, each node may contain attributes like location, date, weather conditions (e.g., sunny, rainy), temperature, wind speed, and humidity. These nodes are then grouped by categories, such as daily forecasts or severe weather alerts. This structure makes it easier to organize large volumes of data and provides users with an intuitive way to access different weather information.

The node-based approach also facilitates data updates and ensures that new information is inserted seamlessly without disrupting the rest of the system. As new forecasts and weather conditions are predicted, they are added to the system in the form of new nodes, maintaining the flow of information and ensuring the feed remains current.

4.5 Handling Multiple User Profiles and Account Management

Managing multiple user profiles is essential for delivering a personalized experience. Each user can have a unique profile containing their preferences, favorite locations, and historical interactions with the system. This enables the weather forecasting application to offer tailored recommendations, such as notifications for specific regions, customized weather forecasts, or alerts for conditions that are of particular interest to the user.

The account management system also allows users to update their profiles, modify notification settings, and store preferences. Users can create accounts, log in securely, and sync their preferences across multiple devices, ensuring a consistent experience whether they are accessing the system via a smartphone, tablet, or computer.

Security and privacy are top priorities in user account management. The system implements secure authentication mechanisms, ensuring that user data remains private and protected from unauthorized access. Additionally, user preferences are stored in a secure database, allowing for a personalized experience without compromising security.

CHAPTER-5

PERFORMANCE CONSIDERATION

5.1 Data Handling and Optimization

Efficient data handling is crucial for the performance of the weather forecasting system. Given the large volume of data involved in collecting and processing weather information in real-time, the system must ensure fast retrieval and accurate processing without delays. The following strategies are employed to optimize data handling:

Data Caching: Frequently accessed data, such as the latest weather forecast for a user's location, is stored in memory (cache). This reduces the need for repeated requests to external APIs and ensures quicker access to common weather information.

Database Indexing: Weather data is stored in a database, where indexing is used to quickly locate and retrieve specific records, such as historical weather data or forecast models. This significantly improves query performance, especially when dealing with large datasets.

Data Compression: Weather data is compressed to reduce the storage requirements and improve the speed of data transmission, particularly when sending real-time weather updates to the user interface.

5.2 Scalability and Real-Time Updates

As the system is designed to deliver real-time weather forecasts, scalability is a key factor in ensuring it remains efficient even as the number of users or locations increases. The system architecture is built to handle a growing volume of data and user interactions without compromising on performance. Key techniques for scalability include:

Microservices Architecture: The system is divided into smaller, independent services that can scale individually. For example, one service handles data collection, another handles prediction, and another handles user interactions. This modular design allows the system to be easily scaled horizontally (adding more servers) as demand increases.

Load Balancing: Load balancers distribute incoming user requests across multiple servers to prevent any single server from becoming overwhelmed. This ensures that the system remains responsive even during peak traffic times, such as severe weather events when user demand may spike.

Auto-scaling: The system can automatically scale up or down based on traffic. During periods of high demand (such as during a weather event), additional resources can be added dynamically to handle the extra load, and they can be reduced once the demand subsides.

These features ensure the system can handle fluctuating loads while maintaining performance and providing real-time updates for users.

5.3 Model Performance and Accuracy

The accuracy and performance of the machine learning models used in weather forecasting are crucial for delivering reliable predictions. Several strategies are used to optimize the performance of the models:

Model Selection: Different machine learning models are tested to determine which performs best for the given weather data. For example, simpler models like Linear Regression may be used for predicting temperature, while more complex models like Long Short-Term Memory (LSTM) networks are employed for time-series data and weather predictions over multiple days.

Hyperparameter Tuning: The parameters of machine learning models, such as learning rates and tree depths in decision tree models, are tuned to optimize performance. This process helps improve prediction accuracy by finding the best set of parameters for the given dataset.

Cross-validation: Cross-validation is used to evaluate the performance of models on different subsets of the data, ensuring the model generalizes well to unseen data. This helps prevent overfitting and ensures that the model performs consistently across different weather conditions.

Real-Time Prediction Performance: The system’s ability to generate weather forecasts in real-time is a key factor. The models are optimized for low-latency predictions, ensuring that the system can process incoming weather data and provide forecasts without noticeable delays.

CHAPTER 6

CONCLUSION & FUTURE SCOPE

6.1 CONCLUSION

The weather forecasting system developed in this project effectively harnesses machine learning and real-time data processing to provide accurate and reliable weather predictions. By integrating advanced algorithms such as Linear Regression, Random Forest, and Long Short-Term Memory (LSTM) networks, the system analyzes historical and live weather data to forecast critical parameters like temperature, humidity, wind speed, and precipitation. The modular architecture ensures scalability and performance, allowing the system to handle large datasets and increasing user demand. The intuitive frontend offers a seamless user experience, enabling users to access forecasts and receive real-time alerts effortlessly. Overall, this system addresses the limitations of traditional weather prediction methods and offers valuable insights for various sectors, including agriculture, transportation, and disaster management. It empowers users with timely information, enhancing preparedness and decision-making.

6.2 FUTURE SCOPE

The future development of this weather forecasting system holds significant potential for improvement and expansion. Key areas of focus include:

Enhanced AI Models:

Incorporating more advanced machine learning and deep learning models, such as Convolutional Neural Networks (CNNs), to improve forecast accuracy, especially for complex weather phenomena.

IoT Integration:

Connecting with IoT devices for hyper-local weather data collection, which would enhance the precision of forecasts for specific locations.

Global Data Expansion:

Extending the system to cover more regions globally, with support for multiple languages to cater to diverse user bases.

Augmented Reality (AR) Visualization:

Implementing AR features to provide immersive weather visualizations, helping users better understand complex weather patterns and forecasts.

Voice-Activated Interfaces:

Integrating with virtual assistants like Alexa or Google Assistant to offer hands-free access to weather information and alerts.

These enhancements will make the system more robust, accurate, and user-friendly, addressing evolving technological trends and user needs.

CHAPTER 7

APPLICATION DEVELOPMENT

7.1 Overview

The development of the weather forecasting application involves multiple phases, from system design to deployment. The process is structured to ensure that the system is reliable, accurate, and user-friendly. Key stages in application development include requirement gathering, system design, coding, testing, and deployment. Each stage is crucial for building an application that meets user needs while maintaining high performance and accuracy.

7.2 Project Architecture

Backend Development:

The backend of the weather forecasting application is responsible for handling data collection, processing, and prediction generation. It operates as the core engine, managing interactions with external weather APIs and processing the data to ensure accurate forecasts. Key components include:

Data Collection Module:

Collects real-time weather data from APIs like OpenWeatherMap and NOAA. This module ensures that the system receives continuous updates on temperature, humidity, wind speed, and precipitation.

Technologies Used: Python, Flask, RESTful APIs.

Machine Learning Module

Utilizes machine learning algorithms to train models using historical weather data. Models such as Linear Regression and LSTM networks are employed for different forecasting needs.

Technologies Used: Scikit-learn, TensorFlow/Keras.

Frontend Development:

The frontend provides a user-friendly interface where users can access and interact with weather forecasts. It focuses on delivering an engaging and responsive experience:

User Interface Design:

Displays weather information through interactive charts and maps. Users can input locations, view real-time data, and set preferences for alerts. *Technologies Used:* HTML, CSS, JavaScript (React/Angular).

APPENDICES

APPENDIXA-SOURCECODE

```
import 'package:clima/data/models/dark_theme_model.dart';
import 'package:clima/data/models/theme_model.dart';
import 'package:clima/data/providers.dart';
import 'package:clima/data/repos/city_repo_impl.dart';
import 'package:clima/data/repos/full_weather_repo.dart';
import 'package:clima/data/repos/unit_system_repo_impl.dart';
import 'package:clima/domain/repos/city_repo.dart';
import  'package:clima/domain/repos/full_weather_repo.dart';
import  'package:clima/domain/repos/unit_system_repo.dart';
import 'package:clima/ui/screens/weather_screen.dart';
import  'package:clima/ui/state_notifiers/theme_state_notifier.dart'  as
t; import 'package:clima/ui/state_notifiers/theme_state_notifier.dart'
   show themeStateNotifierProvider;
import 'package:clima/ui/themes/black_theme.dart';
import 'package:clima/ui/themes/dark_theme.dart';
import 'package:clima/ui/themes/light_theme.dart';
import 'package:flutter/material.dart';
import 'package:flutter_hooks/flutter_hooks.dart';
import 'package:hooks_riverpod/hooks_riverpod.dart';
import 'package:shared_preferences/shared_preferences.dart';
import 'package:sizer/sizer.dart';

import 'ui/build_flavor.dart';
import 'ui/themes/clima_theme.dart';

Future<void>
  main({ TransitionBuilder?
  builder,
  Widget Function(Widget widget)? topLevelBuilder,
  Locale? Function(BuildContext)? getLocale,
}) async {
```

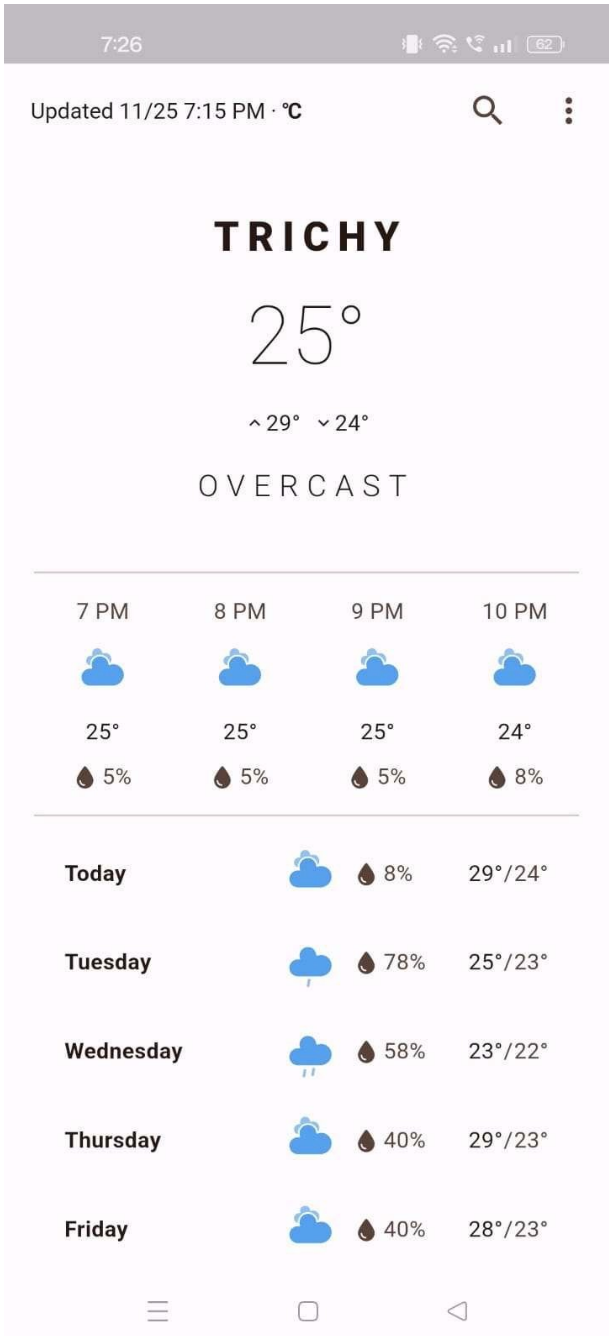
```
  // Unless you do this, using method channels (like `SharedPreferences` does)
  // before running `runApp` throws an error.
  WidgetsFlutterBinding.ensureInitialized();

  final sharedPreferences = await

  SharedPreferences.getInstance(); final widget = ProviderScope(
    overrides: [
      sharedPreferencesProvider.overrideWithValue(sharedPreferences),
      cityRepoProvider.overrideWithProvider(
        Provider((ref) => ref.watch(cityRepoImplProvider)),
      ),
      unitSystemRepoProvider.overrideWithProvider( Provider((ref
        ) => ref.watch(unitSystemRepoImplProvider)),
      ),
      fullWeatherRepoProvider.overrideWithProvider( Provider((ref
        ) => ref.watch(fullWeatherRepoImplProvider)),
      ),
    ],
    child: _App(builder: builder, getLocale: getLocale),
  );

  runApp(topLevelBuilder?.call(widget) ?? widget);
}

class _App extends HookConsumerWidget
  { const _App({this.builder, this.getLocale});

  final TransitionBuilder? builder;

  final Locale? Function(BuildContext)? getLocale;

  @override
  Widget build(BuildContext context, WidgetRef ref) {
    validateBuildFlavor();

    final themeStateNotifier = ref.watch(themeStateNotifierProvider.notifier);
```

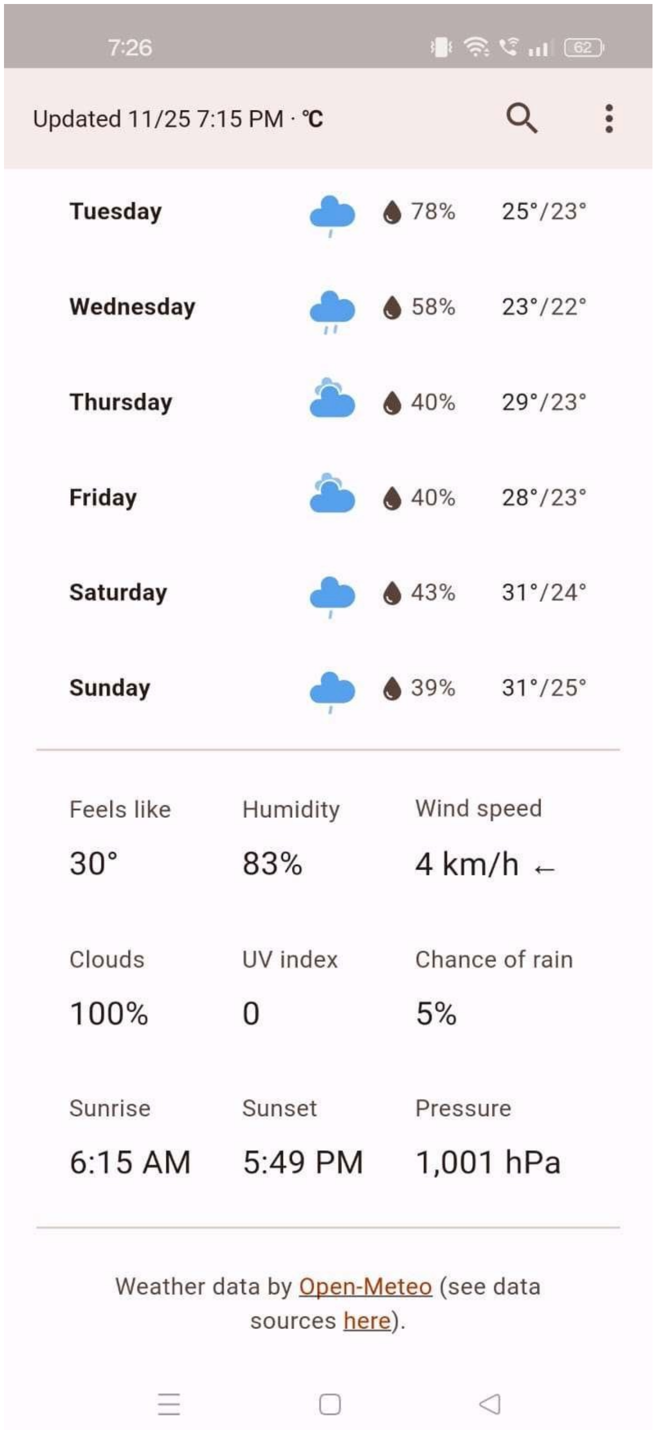
```
useEffect(
  () {
    themeStateNotifier.loadTheme();

    return null;
  },
  [themeStateNotifier],
);

final themeState = ref.watch(themeStateNotifierProvider);

if (themeState is t.EmptyState || themeState is t.Loading)
  { return const SizedBox.shrink();
}

return Sizer(
  builder: (context, orientation, screenType) =>
    MaterialApp( locale: getLocale?.call(context),
    builder: (context, child) {
      final ClimaThemeData climaTheme;

      switch (Theme.of(context).brightness)
        { case Brightness.light:
          climaTheme = lightClimaTheme;
          break;

        case Brightness.dark:
          climaTheme = {
            DarkThemeModel.black: blackClimaTheme,
            DarkThemeModel.darkGrey: darkGreyClimaTheme,
          }[themeState.darkTheme]!;
      }

      child = ClimaTheme(data: climaTheme, child: child!);

      return builder?.call(context, child) ?? child;
```

```
      },
      home: const WeatherScreen(),
      debugShowCheckedModeBanner: false,
      theme: lightTheme,
      darkTheme: {
        DarkThemeModel.black: blackTheme,
        DarkThemeModel.darkGrey: darkGreyTheme,
      }[themeState.darkTheme],
      themeMode: const {
        ThemeModel.systemDefault: ThemeMode.system,
        ThemeModel.light: ThemeMode.light,
        ThemeModel.dark: ThemeMode.dark,
      }[themeState.theme],
    ),
  );
 }
}
```

APPENDIX B– SCREENSHOT

RESULT




7:26
Updated 11/25 7:15 PM · ℃
Tuesday 78% 25°/23°
Wednesday 58% 23°/22°
Thursday 40% 29°/23°
Friday 40% 28°/23°
Saturday 43% 31°/24°
Sunday 39% 31°/25°
Feels like
30°
Humidity
83%
Wind speed
4 km/h ←
Clouds
100%
UV index
0
Chance of rain
5%
Sunrise
6:15 AM
Sunset
5:49 PM
Pressure
1,001 hPa
Weather data by Open-Meteo (see data sources here).

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