A Project report on

WEATHER FORECAST

A Dissertation submitted in partial fulfillment of the academic requirements for the award of thedegree.

Bachelor of Technology
In
Computer Science and Engineering

Submitted by

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY

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CERTIFICATE

This is to certify the project report on **"WEATHER FORECAST"** being submitted by **MD Awias (20H51A05A0)**, **D Sunil Kumar (20H51A0588), E Priyanka (20H51A0589), N Pranay (20H51A05A2)**, in partial fulfilment for the award of Bachelor of technology in **Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision. The results embodies in this project report have not been submit any other university or institute for the award of any degree.

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ABSTRACT

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Ancient weather forecasting methods usually relied on observed patterns of events, also termed pattern recognition. For example, it might be observed that if the sunset was particularly red, the following day often brought fair weather. However, not all of these predictions prove reliable. We use weather data and forecasts to organise our days. Visualizations assist us in better understanding the facts and make things a lot easier. To present weather data visually, in this project we will use Streamlit (a Python framework) and matplotlib to create a single-paged web application that can visualise the weather data. You will be able to get weather reports for any place with this web app. Furthermore, this app provides various visual analytic options, such as line graph/bar graph selection, pan, and toggling spike lines. Here this system will predict weather based on parameters such as temperature, humidity and wind. User will enter current temperature; humidity and wind, System will take this parameter and will predict weather (rainfall in inches) from previous data in database(dataset). The role of the admin is to add previous weather data in database, so that system will calculate weather (estimated rainfall in inches) based on these data. Weather forecasting system takes parameters such as temperature, humidity, and wind and will forecast weather based on previous record therefore this prediction will prove reliable. This system can be used in Air Traffic, Marine, Agriculture, Forestry, Military, Navy and so on.

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Weather forecasting is the application of science and technology to predict the conditions of the atmosphere for a given location and time. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere at a given place and using meteorology to project how the atmosphere will change. The role of Technology has been remarkable in the field of weather forecasting. Weather data is not only necessary for researchers or scientists, ordinary people can be benefitted from it as well. People nowadays are feeling the necessity of weather data as well. Those apps have great features and functionalities to satisfy users. However, only a few of them have a friendly user interface and human- centered interactions, which means that a lot of them might be difficult to be navigated even though they provide enough functionalities. It is not convenient for new users. therefore, we would the to do improvements, Our is a simple and easy-to-use 5-day weather forecasting web app in the weather info about any city around the globe can be acquired. for convenience, it provides a graphical view of min-max temperatures of the next 5 days.

Features

>5-day weather forecast

>Impending Weather changes

‘> Weather Graph

>Sunrise and sunset times

> Cloud Coverage

> Wind Speed

>Built using Python

> StreamiitPlotly

> Python Open Weather Map API

1.1 Objective :

Weather Report project application is a web based application through which you will able to get all the reports related to weather forecasting of any locations. Its geographical locator which will be received through your browser setting and server configuration will automatically identify the location and able to present its weather details such as temperature, direction of wind, rains, humidity etc. To change the location, you will just have to select the options provided below to get its details. Its new

avatars and feed burner will also allow its users to get the weather reports directly to their mail, when they were not able to access this particular domain or even when the server is down. Its weather watch gadgets in animated form will able to notify about weather for particular date and time also. It will also able to focus on critical weather condition for a particular gadget through this gadget. So, with one weather solutions, its users can get weather reports by getting information directly from satellite and radar via proper communication medium using java servlet coding. Its calculations and details are so accurate, that you can even check and match it from news channel. Its user's friendly tools are so simple to use, that even a child can handle it and get information on particular geographical area.

CHAPTER 2
BACKGROUND WORK

2.1 Introduction

- Weather finder is the application of science and technology to predict the conditions of the atmosphere for a given city.
- People have attempted to predict the weather informally for millennia and formally since the 19th century. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere, land, and ocean
- Weather forecasting is the prediction of the state of the atmosphere for a given location using the application of science and technology. This includes temperature, rain, cloudiness, wind speed, and humidity. Weather warnings are a special kind of short-range forecast carried out for the protection of human life

2.2 Literature survey

Weather forecasting has been one of the most challenging difficulties around the world because of both its practical value in popular scope for scientific study and meteorology. Weather is a continuous, dynamic ,multi-dimensional chaotic process, and data-intensive and these properties make weather forecasting a stimulating challenge. It is one of the most imperious and demanding operational responsibilities that must be carried out by many meteorological services all over the globe. Various organizations / workers in India and abroad have done demonstrating using supported time series data manipulation. The various methodologies viz. statistic decomposition models, Exponential smoothing models, ARIMA models and their dissimilarities like seasonal ARIMA models, vector ARIMA models using flexibletime series, ARMAX models i.e. ARIMA with following informative variables etc., which has been used for forecasting purposes. Many trainings have taken place within the analysis of pattern and circulation of rainfall in many regions of the world. Totally altered time series methods with different purposes are used to investigateweather information in many different literatures.accurate and timely weather forecasting is a major many challenge for the scientific research. Weather prediction modelling involves a combination of many computer models, observations and acquaintance of trends and designs. Using these methods, practically accurate forecasts can be made up. Regression is a statistical experimental technique and it must be widely used in many business, the behavioural sciences, social and climate recasting and many other areas

2.3 Existed systems

- Hailstrike - users can see colorized, animated maps that replay storm activity over a certain area based on detailed, verified information. Intensity of hail and duration of a storm can be analyzed.
- F5 weather - Software package options are available that give users access to weather forecast model data, specialized calculated maps
- Pc weather - For users who don't want to run a software application, custom hurricane and storm information can be delivered via email and their website. Also available are location risk analysis reports for businesses at risk of wind and storm surge.

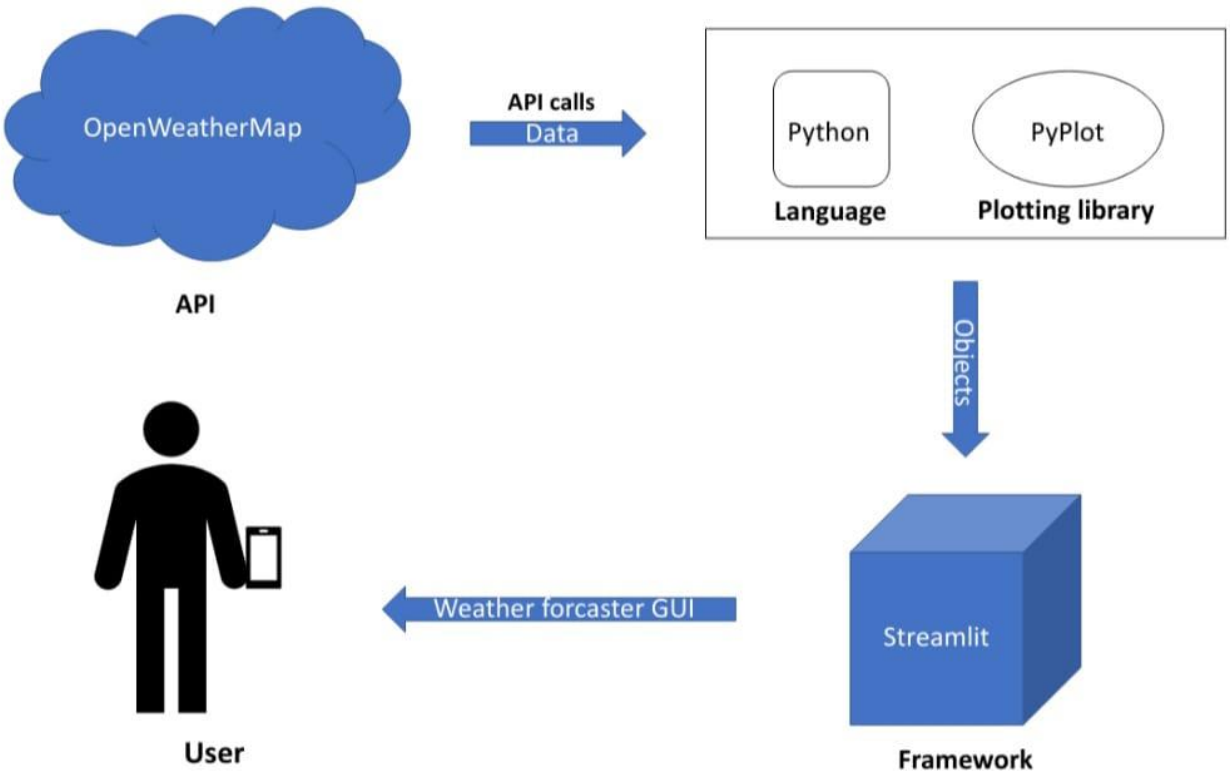
2.4 research objective

- To predict the weather at a particular area at any particular time with the help of gps which Detects the climate of the location and shows The wind speed , lat/lon of the rain. Even in remote areas where people don’t have access to internetshould also be able to get weather forecast. To be able to solve the aboveproblem, we are doing this project.
- Time compatibility for planing
- Reduce process of operating the web app
- Reduce complexity to find Vacations or travel spots

2.5 Problem Definition

- People are facing lots of problems due to weather changes and couldn’t plan vacations or travel anywhere because no correct information about the weather
- To overcome the difficulty weatherForcast involves predicting things like cloud cover, rain or snow, windspeed , and temperature before they happen. We forecast the weather by looking at current conditions, motion of air and clouds, historical patterns, pressure changes, and computer models.

2.6 Proposed system architecture



2.7 Proposed Methods

1) We can check the weather reports (i.e., prediction reports) through our proposed system.

2) We can check the weather through our proposed system.

3) This system is portable (easy to use).

2.8 SOFTWARE USED:

- Python
- Streamlit
- Plotly
- Python Open Weather Map API

2.9 Limitations of existing systems

- We cannot select celcius or Fahrenheit at our choice
- we will not get updates of weather more than 2 or 4 days
- We will not get latitude and longitude direction of wind speed
- We cannot extend the updates of weather by days

CHAPTER 3
PROPOSED SYSTEM

Proposed systems

Under web-based Weather Report project application, some exciting features has been added such as managing and handling exception error directly by the system which will be not visible by the user to make it bug free. Multiple choice provided to the user by which they can even select different weather channel as per their requirement and interest in it. Its pattern recognition system will able to notify abut bad weather condition previously before it begins with digital graphics is another added advantage of this system. Once location selected by the user for its system use, it will make it default location and remembered by the system so that users do not have to change every time they use this system.

3.1 Proposed Solution:

User will enter current temperature; humidity and wind, System will take this parameter and will predict weather from previous data in database. The role of the admin is to add previous weather data in database, so that system will calculate weather based on these data. Weather forecasting system takes parameters such as temperature, humidity, and wind and will forecast weather based on previous record therefore this prediction will prove reliable

3.2 Source Code:

```
import os
import pytz
import pyowm
import streamlit as st
from matplotlib import dates
from datetime import datetime, tzinfo
from matplotlib import pyplot as plt
import plotly.graph_objects as go

API_KEY = os.getenv("API_KEY")
owm = pyowm.OWM(API_KEY)
mgr = owm.weather_manager()

degree_sign = u'\N{DEGREE SIGN}'

st.title("5 Day Weather Forecast")
```

```
st.write("### Write the name of a City and select the Temperature Unit and Graph Type")

place = st.text_input("NAME OF THE CITY :", "")

if place == None:
   st.write("Input a CITY!")

unit = st.selectbox("Select Temperature Unit", ("Celsius", "Fahrenheit"))

g_type = st.selectbox("Select Graph Type", ("Line Graph", "Bar Graph"))

if unit == 'Celsius':
   unit_c = 'celsius'
else:
   unit_c = 'fahrenheit'


def get_temperature():
   days = []
   dates = []
   temp_min = []
   temp_max = []
   forecaster = mgr.forecast_at_place(place, '3h')
   forecast = forecaster.forecast
   for weather in forecast:
      day = datetime.utcfromtimestamp(weather.reference_time())
      #day = gmt_to_eastern(weather.reference_time())
      date = day.date()
      if date not in dates:
         dates.append(date)
         temp_min.append(None)
         temp_max.append(None)
         days.append(date)
      temperature = weather.temperature(unit_c)['temp']
      if not temp_min[-1] or temperature < temp_min[-1]:
         temp_min[-1] = temperature
      if not temp_max[-1] or temperature > temp_max[-1]:
         temp_max[-1] = temperature
   return (days, temp_min, temp_max)


def init_plot():
   plt.figure('PyOWM Weather', figsize=(5, 4))
   plt.xlabel('Day')
   plt.ylabel(f'Temperature ({degree_sign}F)')
   plt.title('Weekly Forecast')
```

```
def plot_temperature_bars(days, temp_min, temp_max):
    # days = dates.date2num(days)
    fig = go.Figure(
        data=[
            go.Bar(name='min', x=days, y=temp_min),
            go.Bar(name='max', x=days, y=temp_max)
        ]
    )
    fig.update_layout(barmode='group')
    return fig

def plot_temperature_lines(days, temp_min, temp_max):
    fig = go.Figure()
    fig.add_trace(go.Scatter(x=days, y=temp_min, name='min'))
    fig.add_trace(go.Scatter(x=days, y=temp_max, name='max'))
    return fig

def label_xaxis(days):
    plt.xticks(days)
    axes = plt.gca()
    xaxis_format = dates.DateFormatter('%m/%d')
    axes.xaxis.set_major_formatter(xaxis_format)

def draw_bar_chart():
    days, temp_min, temp_max = get_temperature()
    fig = plot_temperature_bars(days, temp_min, temp_max)
    # write_temperatures_on_bar_chart(bar_min, bar_max)
    st.plotly_chart(fig)
    st.title("Minimum and Maximum Temperatures")
    for i in range(0, 6):
        st.write("### ", days[i].strftime("%d %b"), temp_min[i],
                 degree_sign, ' --- ', temp_max[i], degree_sign)

def draw_line_chart():
    days, temp_min, temp_max = get_temperature()
    fig = plot_temperature_lines(days, temp_min, temp_max)
    st.plotly_chart(fig)
    st.title("Minimum and Maximum Temperatures")
    for i in range(0, 6):
        st.write("### ", days[i].strftime("%d %b"), temp_min[i],
                 degree_sign, ' --- ', temp_max[i], degree_sign,)

def impending_weather_changes():
    forecaster = mgr.forecast_at_place(place, '3h')
```

```
    st.title("Impending Weather Changes :")
    if forecaster.will_have_fog():
        st.write("### FOG")
    if forecaster.will_have_rain():
        st.write("### Rain")
    if forecaster.will_have_storm():
        st.write("### Storm Alert!")
    if forecaster.will_have_snow():
        st.write("### Snow")
    if forecaster.will_have_tornado():
        st.write("### Tornado Alert!")
    if forecaster.will_have_hurricane():
        st.write("### Hurricane Alert!")
    if forecaster.will_have_clouds():
        st.write("### Cloudy Skies")
    if forecaster.will_have_clear():
        st.write("### Clear Weather!")

def updates():
    obs = mgr.weather_at_place(place)
    weather = obs.weather
    st.title("Status")
    st.write("### ", weather.detailed_status)
    impending_weather_changes()
    cloud_cov = weather.clouds
    winds = weather.wind()['speed']
    visibility = weather.visibility(unit='miles')
    st.title("Other weather updates :")
    st.write("### The Visibility in", place, "is", visibility, "miles")
    st.write('### The Cloud Coverage in', place, 'is', cloud_cov, '%')
    st.write('### The Wind Speed in', place, 'is', winds, 'meters/sec')
    st.title("Sunrise and Sunset Times :")
    ss = datetime.fromtimestamp(weather.sunset_time(),
pytz.timezone("Asia/Kolkata")).strftime("%I:%M %p")
    sr = datetime.fromtimestamp(weather.sunrise_time(),
pytz.timezone("Asia/Kolkata")).strftime("%I:%M %p")
    st.write("### Sunrise time in", place, "is", sr)
    st.write("### Sunset time in", place, "is", ss)
    creators = '<p style="font-family:Source Sans Pro; color:#09ab3b; font-size:20px; text-
align:right;">Made by</p><p style="font-family:Source Sans Pro; color:#09ab3b; font-size:
15px; text-align:right;">Awais, Sunil, Priyanka, and Pranay</p>'
    st.markdown(creators, unsafe_allow_html=True)

if __name__ == '__main__':

    if place != "":
```

```
if g_type == 'Line Graph':
    draw_line_chart()
else:
    draw_bar_chart()
updates()
```

3.4 SYSTEM REQUIREMENTS

The system shall be able to produce minimum, maximum and the average data of a particular weather parameter when it is requested by an operator.

 The system shall provide the following weather parameters: temperature, pressure, wind speed & direction, rainfall, and humidity,sunrise &sunset time.

CHAPTER 4
DESIGNING

4.1Proposed System Architecture:

Among modeling languages Unified Modeling Language (UML) has become most popular. UML is commonly used in the design and implementation of any system and software architectures. To achieve functional and non-functional requirements of the system, UML model helps. In order to initiate the programming phase of building software, UML tools help in the creation of source code from UML diagram. The main objective of this paper to model a Weather Prediction System (Linear Regression approach) using UML. Weather prediction is a challenging area. The future weather conditions are predicted by trained regression model. In this chapter, we proposed a UML model for Weather Prediction using linear regression which provide a technique for predicting weather. This proposed enhanced method for weather prediction has advantages over other techniques

4.1.1 Introduction

In software industries, Object Oriented Development process is widely used. Object-Oriented Programming has heavily contributed toward a standardized method of modeling known as the Unified Modeling Language (UML). UML has become synonym for software modeling. UML is commonly used to model the software architecture as per the requirements and it includes a set of graphic notation techniques to create visual models of software-intensive systems. With the help of different UML diagrams for building the software, source code can be easily generated. The correctness of source code depends on the UML specification which needs to be standard, complete, precise, and unambiguous. A good UML specification leads to clearly defined semantics and an efficient code can be generated. The project is based upon the predicting Weather's condition.

4.1.2 Proposed approach

The proposed System using an enhanced approach is tested using the dataset of last 6 years from (2014-2019). The results are compared with previous methods results. The proposed enhanced method for weather prediction has advantages over the traditional techniques. This model produces the most accurate forecasts in comparison with previous techniques. This system can help the meteorologist to predict the future weather easily with accuracy.

4.1.3 Weather Prediction System Architecture

The system is developed in python along with javascript. Daily data sets of last 6 years (2014-2019) has been fetched to train our model. The system takes input from the datasets and produces the result.

The system building process consists of following sequential steps:

1. Fetching the dataset

2. Cleaning the dataset

4. Selection of the features of dataset

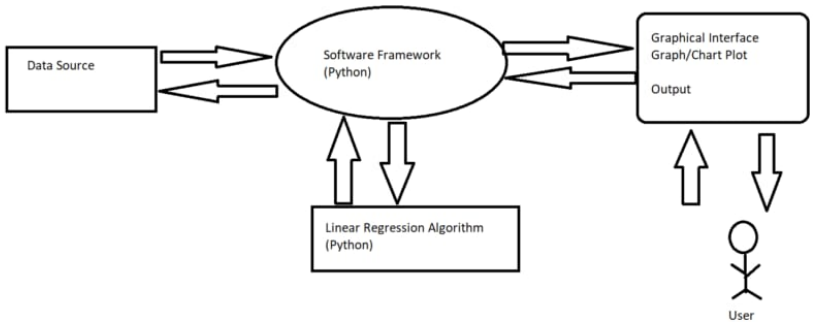
4. Train Model

5. Use the model to predict results.

4.1.4 Use-Case Diagram

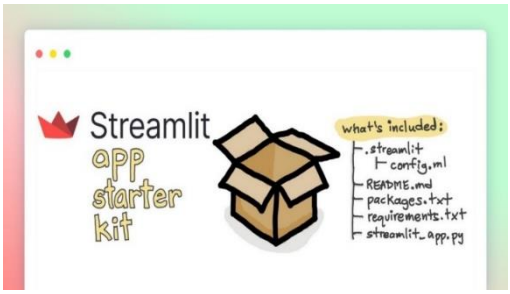
An interaction between a user and a system is described by use case diagram. Use case diagrams describe what a system does from the standpoint of an external observer. The emphasis is on what a system does rather than how. Use case diagrams are closely connected to scenarios. A scenario is an example of what happens when someone interacts with the system. A use case diagram is a collection of actors, use cases, and their communications.

For initial development we can use this use case. In this use case diagram we can see following use cases and actor. Use cases are self explanatory and they represent the main functions of Weather Prediction System.

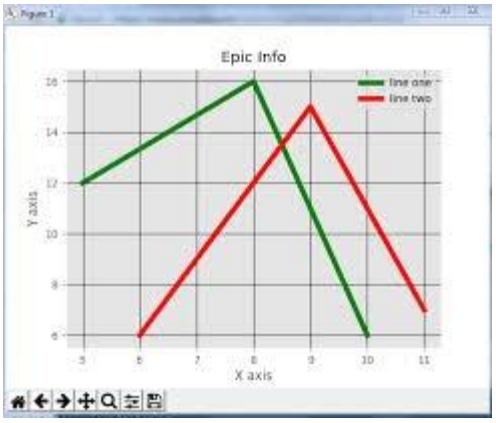


4.2 Diagram of Components:

streamlit==1.13.0



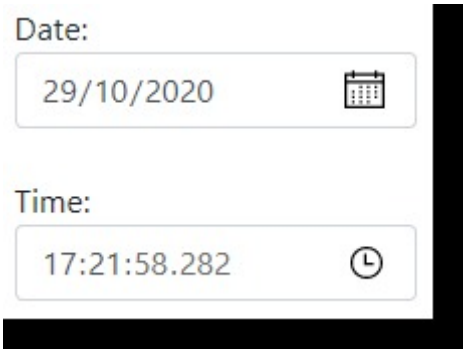
atplotlib==3.6.1



numpy==1.23.4

```
[[package]]
name = "numpy"
version = "1.21.5"
description = "NumPy
category = "main"
optional = false
python-versions = ">=
```

DateTime==4.7



pyowm==3.3.0

plotly==5.10.0


Dashboard - Test Data
Risks by Business Unit
Number of Action Items by Business Unit by Year
Number of Action Items by Business Unit
2020
2021
Top Risks
Breakdown of Risk by Risk Type - 2021

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Results

1. Time to time update weather
2. Temperature Update
3. Last 5 days data Predict
4. change weather in every hours as according to weather changes.
5. provide accurate data information about weather.
6. user can search weather anytime and anywhere.
7. any places data can be search and provide information as according to weather.
8. help user to travel.
9. help User to future plans for holidays.

Output :-

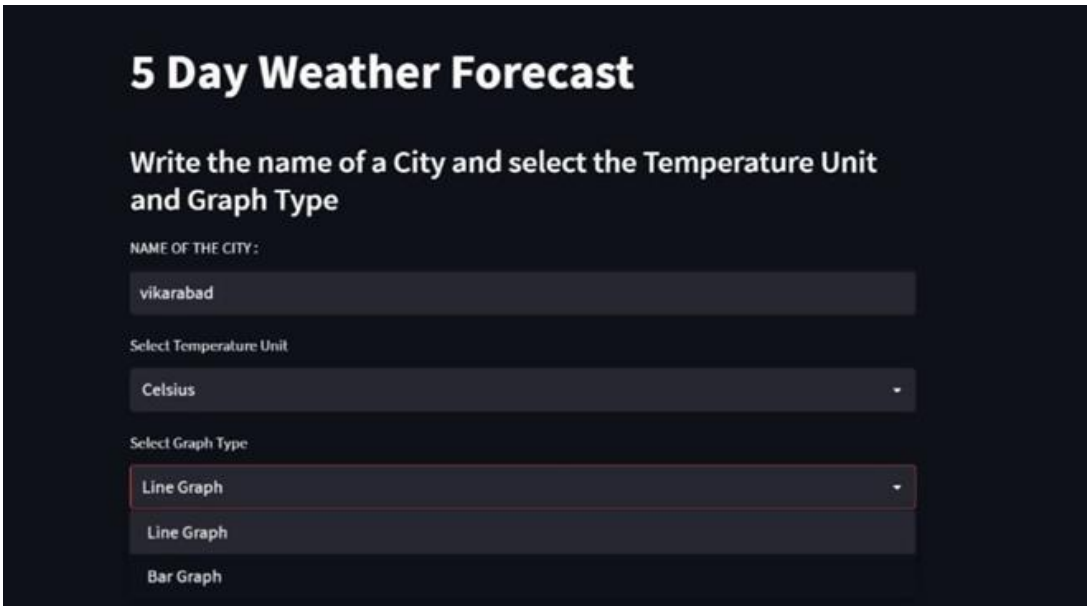


Fig 1. Input given by user

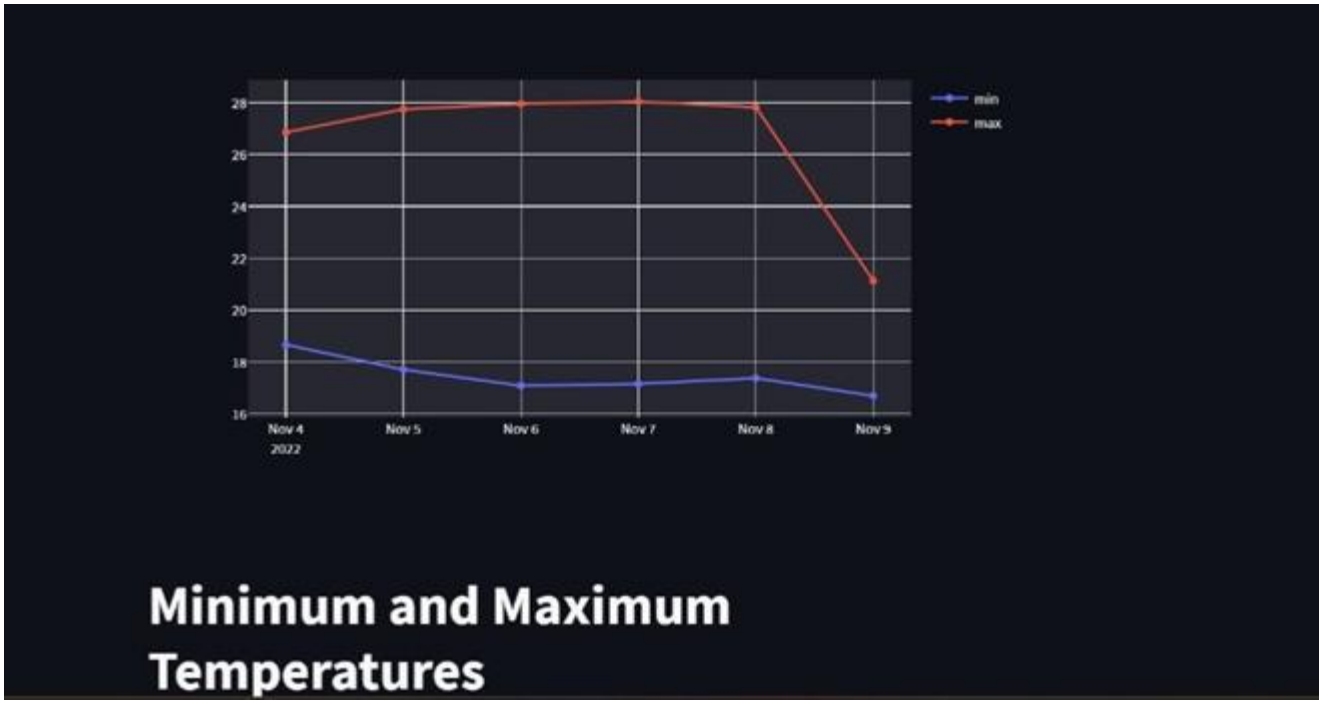


Fig.2 Max and Min temperatures in line graph

Fig.3 Max and Min temperatures in bar graph

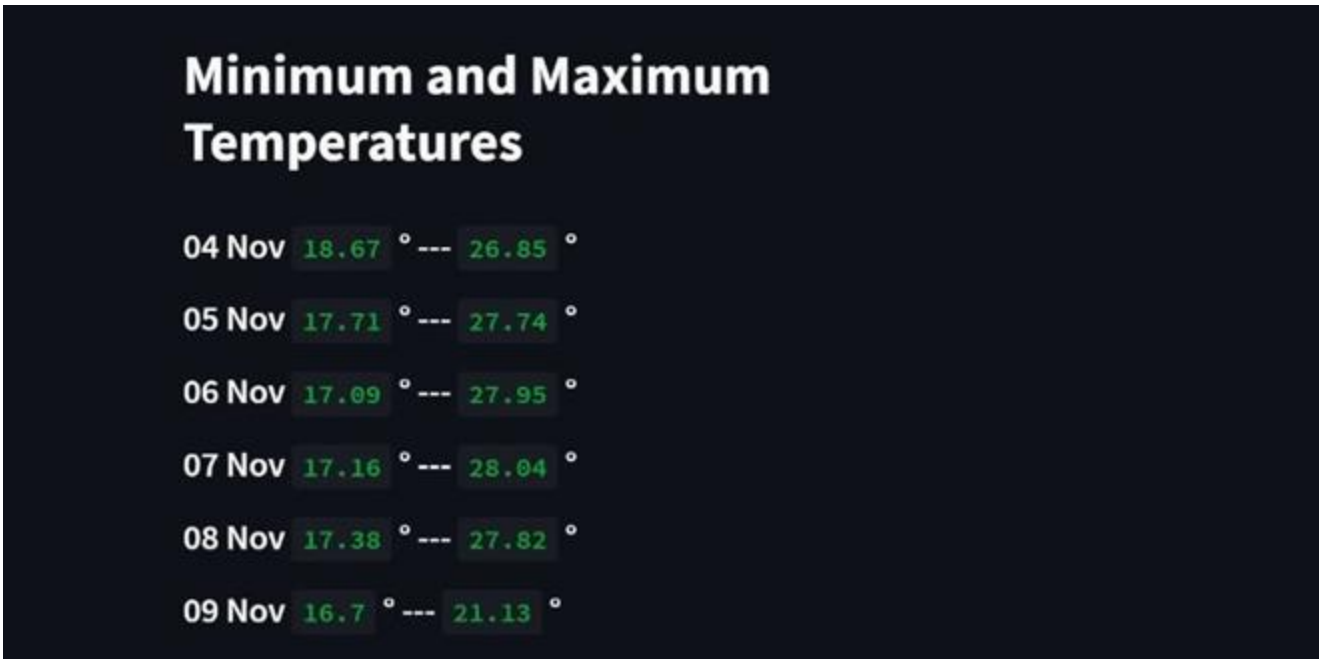


Fig 3. Min-Max temperature readings.

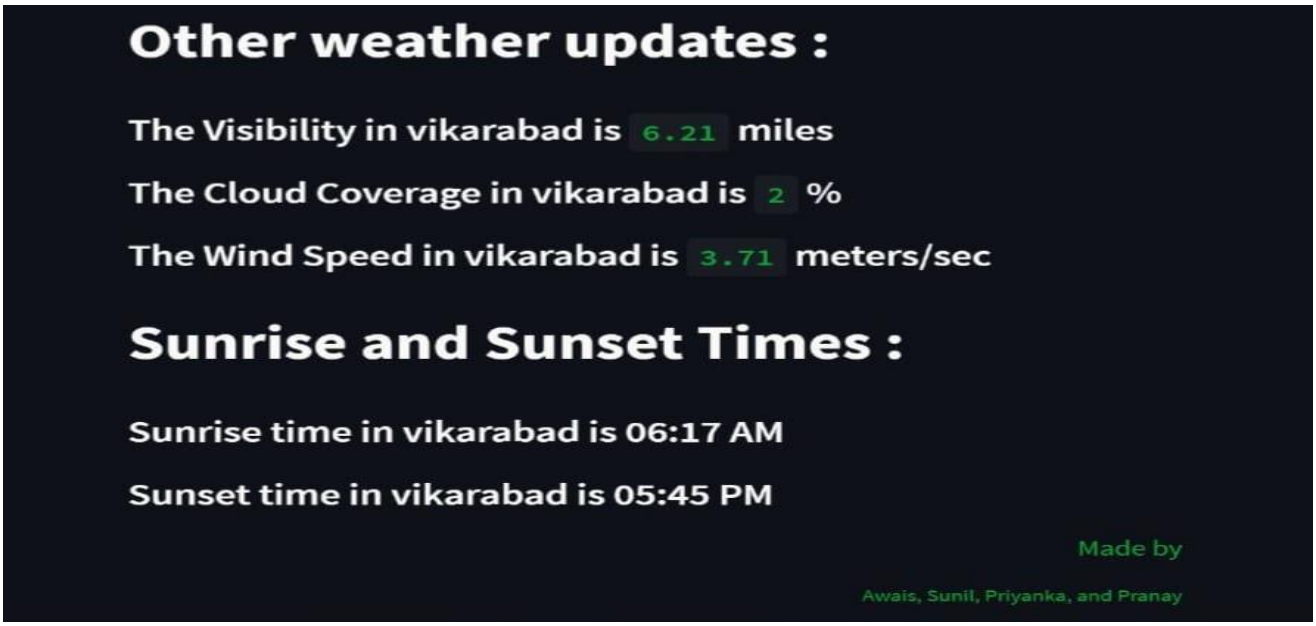


Fig.4 Other weather updates and Sunrise, Sunset times.

Fig.5 Current status and impending weather changes

5.2 Discussion:

Weather forecasting is an important science. Accurate forecasting can help to save lives and minimise property damage. It's also crucial for agriculture, allowing farmers to track when it's best to plant or helping them protect their crops.

And it will only become more vital in the coming years. Severe weather events are becoming more frequent and more intense because of climate change and variability.

I am a meteorologist with specialities in forecasting weather and climate change – who wants to improve the quality of weather products and their applications to spur socioeconomic development across Africa. Doing so matters: the World Bank has pointed out that better weather forecasts can bolster the continent's development.

So, how does forecasting work? What does it take to produce accurate, reliable and timely forecasts? And how can African countries do better on this front?

A complex process:

Weather forecasting is complex and challenging. The process entails three steps: observation, analysis and communication.

For observation, forecasters work with atmospheric models. These are sets of equations that depict the state of the atmosphere. The models use information on the initial state (observations) of the atmosphere, land and ocean to forecast weather. Data from the models is combined with information drawn from weather stations which are set up at key points across a region or country to give the actual state of the atmosphere. This data assimilation produces a better forecast since it optimises forecasters' understanding of the evolving weather system.

It's easier to be accurate when giving a short-range forecast – one that covers hours to days – than it is when interpreting long-range (months or seasons) data. The atmospheric system is dynamic; the more time that passes, the less certain forecasters can be of its state.

Technological advances have greatly improved the general quality of weather forecasting. For instance, more observations are possible because of automated weather stations. There's also been an increase in the use of high performance computing. This allows for more data storage, faster processing, analysis, and visualisation of incoming data.

These datasets are key in diagnosing past and current weather to create a forecast. Unfortunately, the data observation network (both manual and automated stations) is still poor, especially in developing countries. That's the result of limited investment into the sector. Forecasters in these countries are forced to use alternative datasets that are not very accurate.

One such alternative dataset is Numerical Weather Prediction. It uses global deterministic models that are normally not detailed enough to realistically represent convection at a local or regional level; forecasters using this data often can't accurately predict rainfall, especially heavy rain. A lack of access to better historical data also means forecasters struggle to identify when an area's seasonal rainfall will start and end because they can't examine trends over years or decades.

It's these variations in access to data and technology that mean some forecasts are more accurate than others.

Once forecasts have been collated, they are released in various forms. The way that weather products – apps, TV and radio bulletins or website updates – are packaged will differ depending on end users' needs. Some people, like farmers, may be especially interested in seasonal forecasts and will seek these out. Athletes, for example, are more likely to use portals or services that focus on hourly and daily forecasts.

I would recommend that, whoever you are, you consider seasonal forecasts general information for broad planning purposes. But this should be interpreted together with monthly, weekly and daily forecasts for accuracy's sake.

CHAPTER 6
CONCLUSION AND FUTURE WORK

6.1 Conclusion:

This research suggests and proposes an efficient and accurate weather prediction and forecasting model using linear regression concept. This concept is a part of machine learning. It is a very efficient weather prediction model and using the entities temperature, humidity and pressure, it can be used to make reliable weather predictions. This model also facilitates decision making in day-to-day life. It can yield even better results when applied to cleaner and larger datasets. Pre-processing of the datasets is effective in the prediction as unprocessed data can also affect the efficiency of the model.

6.2 Future Work:

- Weather forecasts are made by collecting as much data as possible about the current state of the atmosphere (particularly the temperature, humidity and wind) to determine how the atmosphere evolves in the future.
- However, th+e chaotic nature of the atmosphere makes the forecasts less accurate as the range of the forecast increases.
- Traditional observations made at the surface of atmospheric pressure, temperature, wind speed, wind direction, humidity, precipitation are collected routinely from trained observers, automatic weather stations or buoys.During the data assimilation process, information gained from the observations is used In conjunction with a numerical model's most recent forecast for the time that observations were made to produce the meteorological analysis. The complicated equations which govern how the state of a fluid changes with time require supercomputers to solve them.
- The output from this model can be used the weather forecast as alternative.

CHAPTER 7
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