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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MAJOR PROJECT

ON

Wireless Sensor Network Dependable Monitoring for Urban Air Quality.

UNDER THE GUIDANCE OF

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INTRODUCTION:

A recent projection by the United Nations (UN) foresees that by 2050 nearly 70% of global population will be living in the cities. This urbanization trend leads to considerable demands for transportation, industrial production, infrastructure and energy. This would raise concerns on sustainable development and require the need for effective measures for environmental monitoring in urban areas. Interdisciplinary and trans disciplinary efforts embracing advances in information and communication technology (ICT), autonomous systems, data science, computer science, systems theory, the Internet-of-Things (IoT) and artificial intelligence (AI) have formed the basis for smart sustainable city development. Towards environmental sustainability and social resilience in metropolitan areas, it is essential for residents to have clean air. In this regard, technical measures are needed for monitoring and improving air quality, whereby IOT-enabled wireless sensors networks are promising among available monitoring systems for healthy built environment and air quality management.

ABSTRACT:

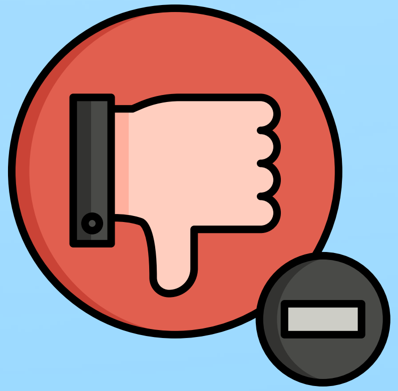
This project is an Internet of Things-enabled low-cost wireless sensor network with newly-developed dependable schemes to improve reliability for monitoring air quality in suburban areas. The system features sensing units for router communications with energy savings from dynamic conservation. Based on the reliability function and mean time to failure, a continuous time Markov chain model is used to analyze the monitoring performance. The proposed dependable monitoring network is shown to achieve high availability with regards to energy consumption and data assurance with the survival probability of over 80% during a minimum period of 72-hour operation for monitoring air quality in a suburb. Distributions of fine particle concentrations studied over a 6-month period demonstrate feasibility of the developed system in its high correlations to benchmark monitoring stations with the Pearson's coefficients obtained at 0.903 and 0.817 respectively for PM2.5 and PM10.

EXISTING SYSTEM:

- In Australia, along with recent big projects for infrastructure development to meet the urbanization needs, the problem of air quality modelling and control is also of top priority.
- A network of KOALA (Knowing Our Ambient Local Air Quality) low-cost sensors has been implemented for high spatial resolution air quality monitoring to successfully observe the emissions of fine particles and carbon monoxide during six months before and after a big sports event.
- These initiatives show benefits and feasibility of a low-cost solution using wireless sensor networks for monitoring air pollution and improving air quality in cities. Therefore, the needs and preferences of citizens should be considered in public-involved programs to implement of LWSN for environment monitoring.

DISADVANTAGES:

1. This would raise concerns on sustainable development and require the need for effective measures for environmental monitoring in urban areas.
2. Less monitoring quality in terms of availability, reliability.



PROPOSED SYSTEM:

- This project aims to develop a framework of dependable low-cost wireless sensor network (DLWSN) for air quality monitoring, which addresses the affordable deployment of a collocated monitoring system for reliable data aggregation and accurate assessment of urban air quality using the IoT-enabled system with enhanced availability.
- Here, the reliability analysis for the proposed system is conducted via the mean time to failure (MTTF) derived from the reliability function of the monitoring system, whereby the survival and failing probabilities of its sensor modules are calculated by a Markov chain model (MCM).
- The availability, reliability and resilience of the proposed DLWSN against environmental volatility are verified in extreme events such as bushfires and pandemic lockdown conditions.

ADVANTAGES:

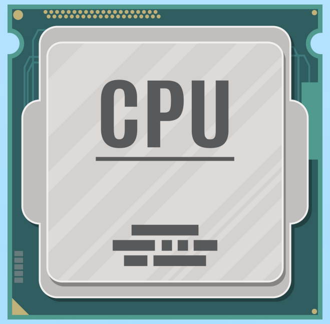
1. The proposed dependable monitoring network is shown to achieve high availability with regards to energy consumption and data assurance with the survival probability.
2. Enhancements in reliability and accuracy of the collocated dependable low-cost sensors network proposed for wireless monitoring of air quality in urban conditions.

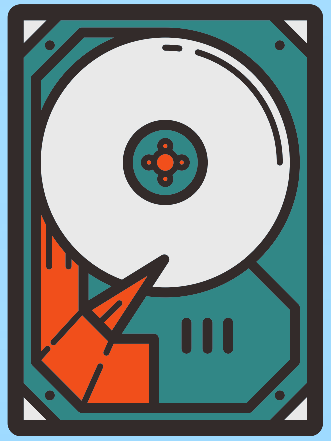
SOFTWARE REQUIREMENTS:

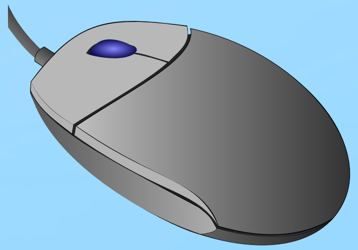
- Operating System: Windows
- Coding Language: Python 3.7

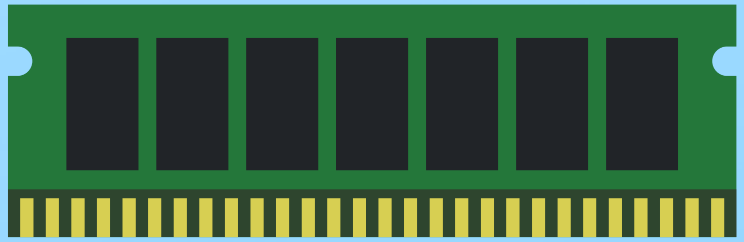
HARDWARE REQUIREMENTS:

- System : Pentium IV 2.4 GHz.
- Hard Disk : 40 GB.
- Floppy Drive : 1.44 Mb.
- Monitor : 15 VGA Color.
- Mouse : Logitech.
- Ram : 512 Mb.









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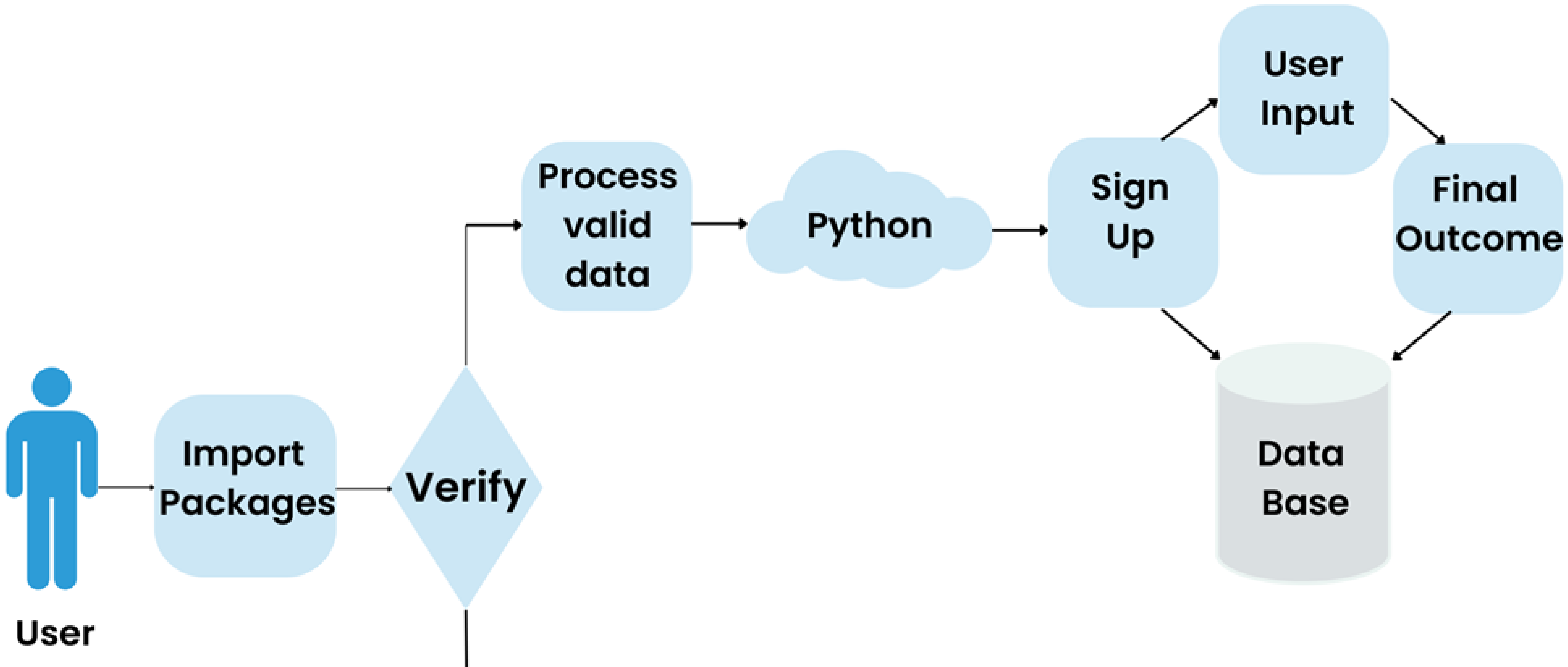
ARCHITECTURE:



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MODULES:

›Tensorflow:

TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google. TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open-source license on November 9, 2015.

›Numpy:

Numpy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code
- Useful linear algebra, Fourier transform, and random number capabilities

MODULES:

› Pandas:

Pandas is an open-source Python Library providing high-performance data manipulation and analysis tool using its powerful data structures. Python was majorly used for data munging and preparation. It had very little contribution towards data analysis. Pandas solved this problem. Using Pandas, we can accomplish five typical steps in the processing and analysis of data, regardless of the origin of data load, prepare, manipulate, model, and analyze. Python with Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc.

›Matplotlib:

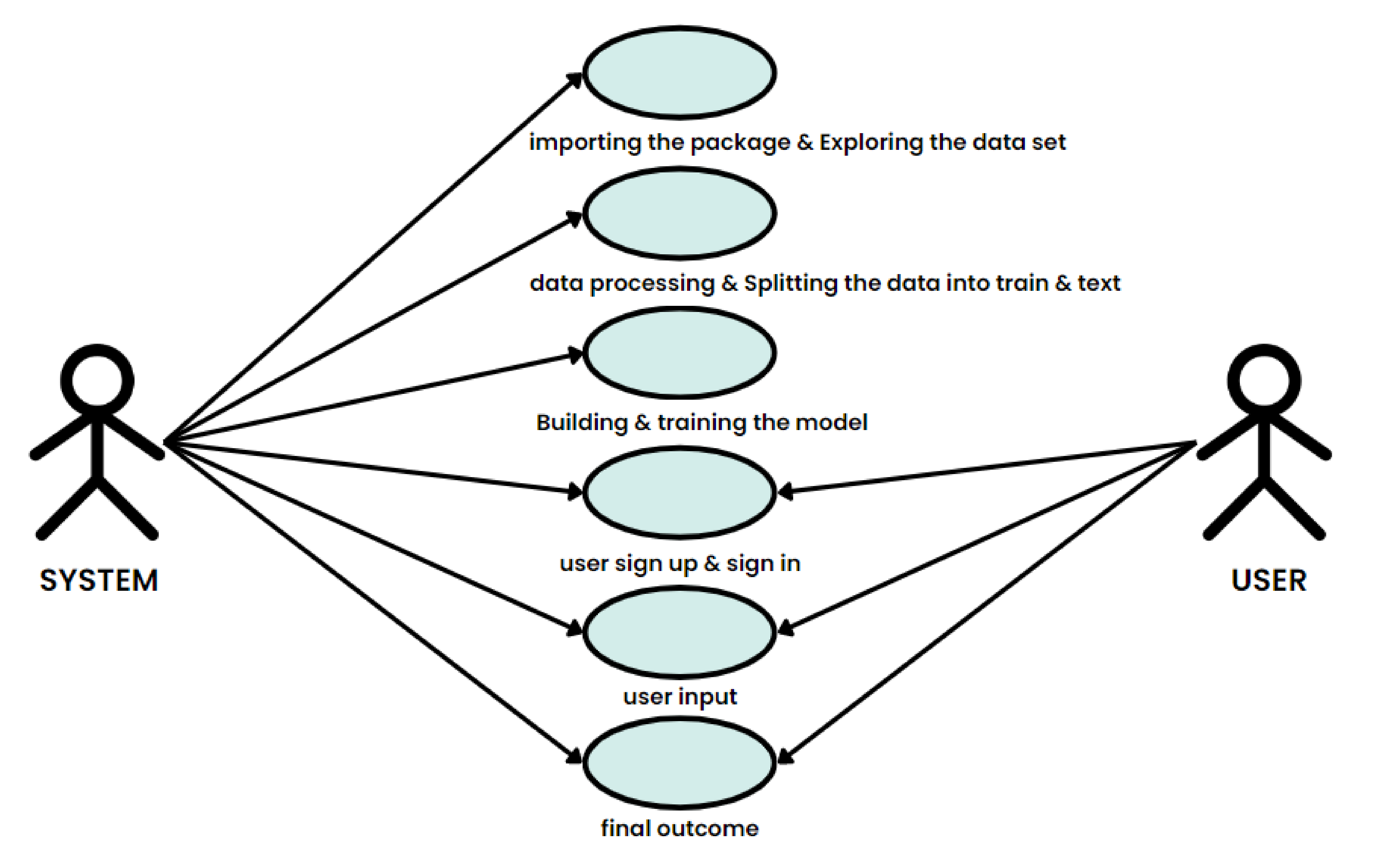
Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms. Matplotlib can be used in Python scripts, the Python and IPython shells, the Jupyter Notebook, web application servers, and four graphical user interface toolkits. Matplotlib tries to make easy things easy and hard things possible. You can generate plots, histograms, power spectra, bar charts, error charts, scatter plots, etc., with just a few lines of code.

MODULES:

›Scikit – learn:

Scikit-learn provides a range of supervised and unsupervised learning algorithms via a consistent interface in Python. It is licensed under a permissive simplified BSD license and is distributed under many Linux distributions, encouraging academic and commercial use.

USE CASE DIAGRAM:



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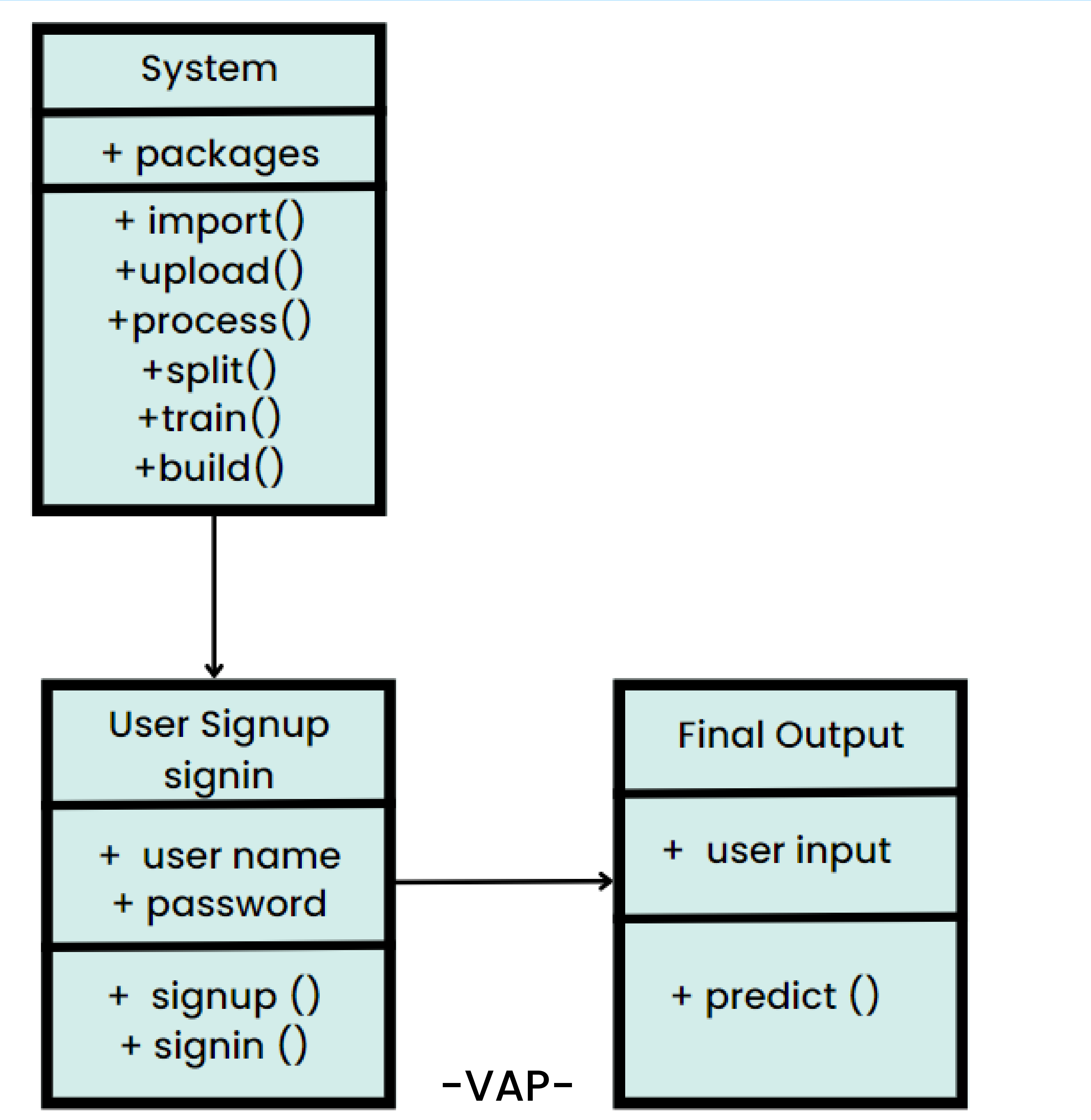
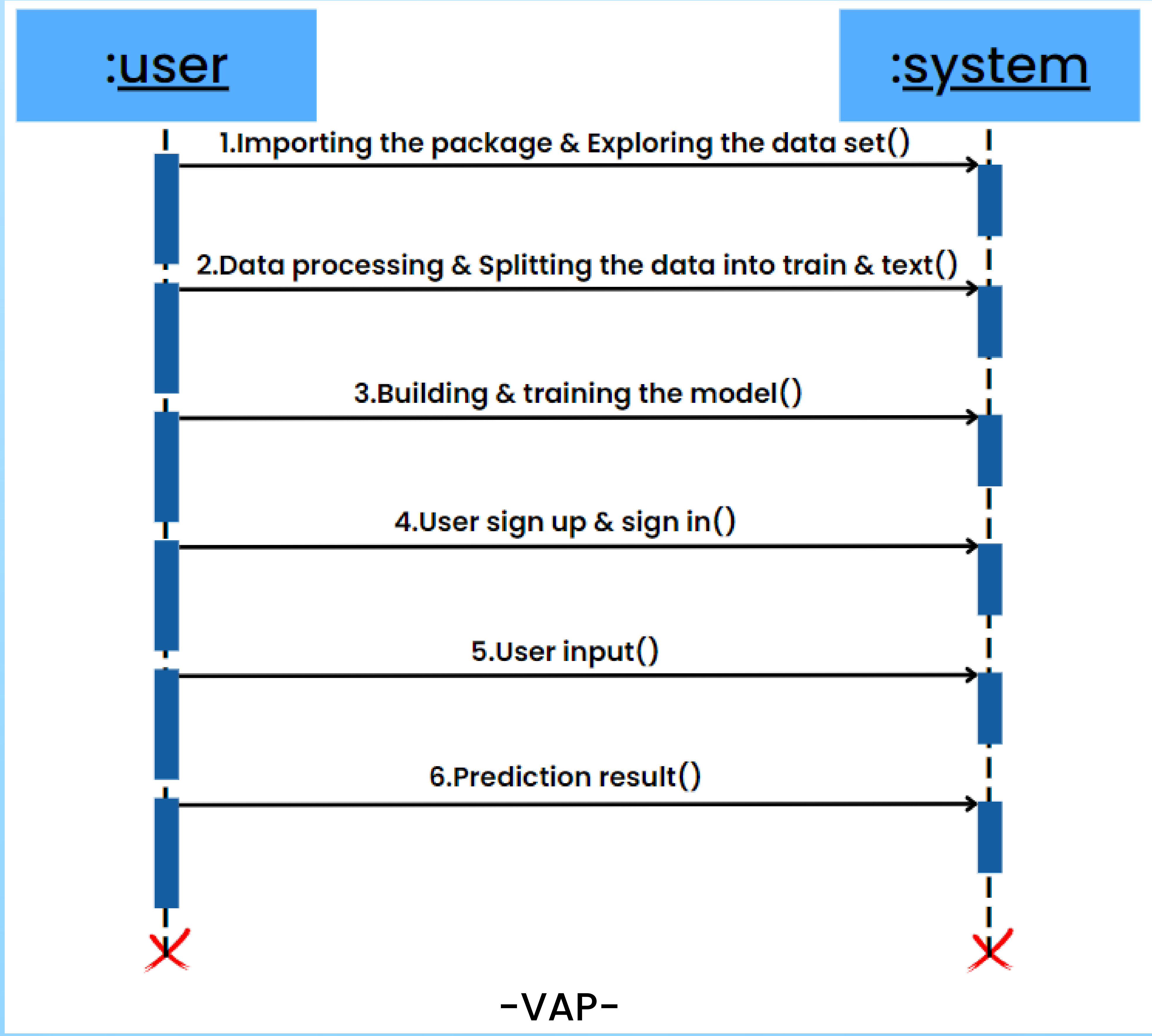
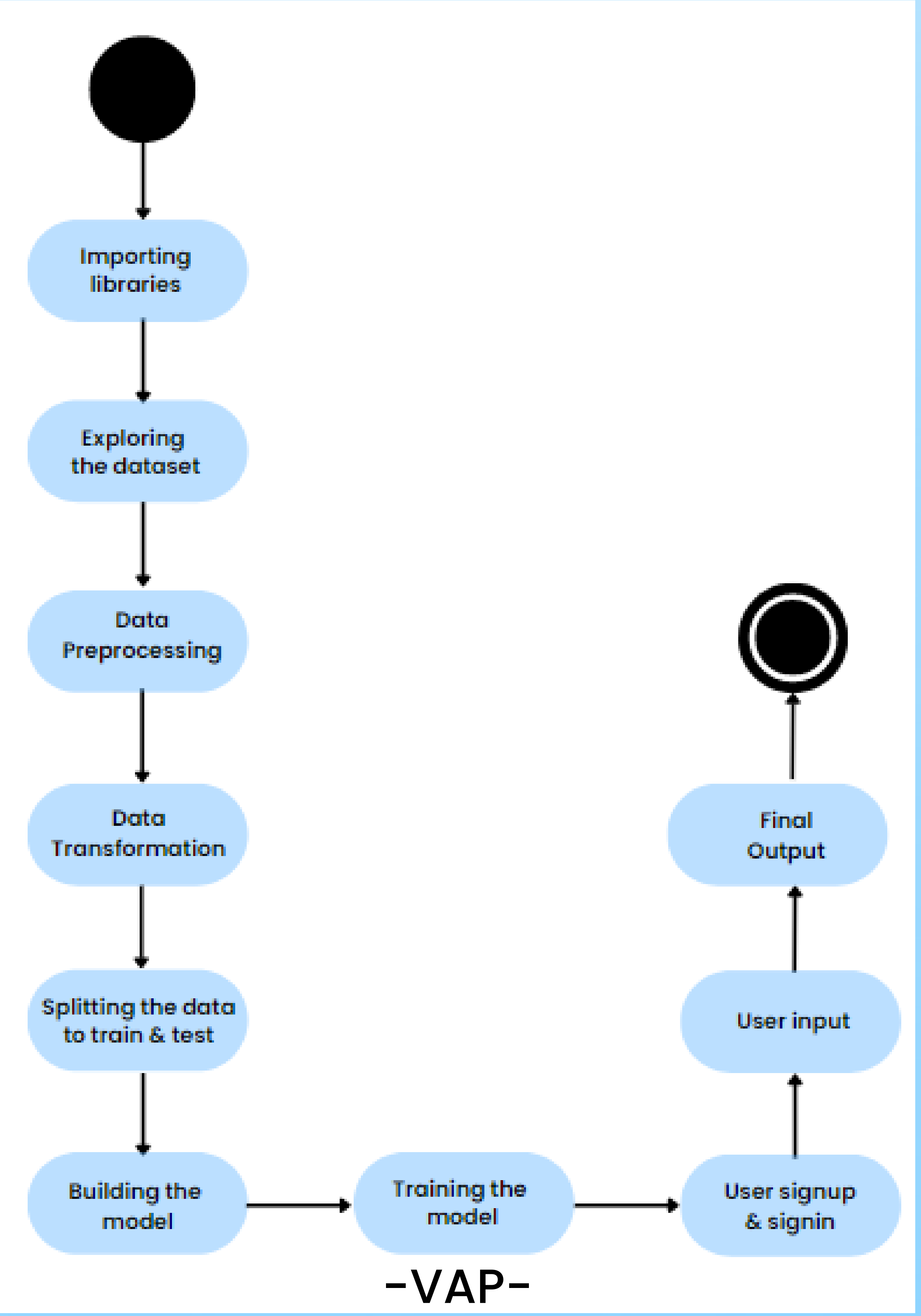
CLASS DIAGRAM:



SEQUENCE DIAGRAM:



ACTIVITY DIAGRAM:



SAMPLE CODE:

app.py

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```python
from flask import Flask, render_template, request
import joblib
import numpy as np
import pickle
import sqlite3

app = Flask(__name__)

lr = joblib.load("Models/model.pkl")

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

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

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

@app.route("/signup")
def signup():

    username = request.args.get('user','')
    name = request.args.get('name','')
    email = request.args.get('email','')
    number = request.args.get('mobile','')
    password = request.args.get('password','')
    con = sqlite3.connect('signup.db')
    cur = con.cursor()
    cur.execute("insert into `info` (`user`,`email`, `password`,`mobile`,`name`) VALUES (?, ?, ?, ?, ?)",(username,email,password,number,name))
    con.commit()
    con.close()
    return render_template("signin.html")
```

index.html

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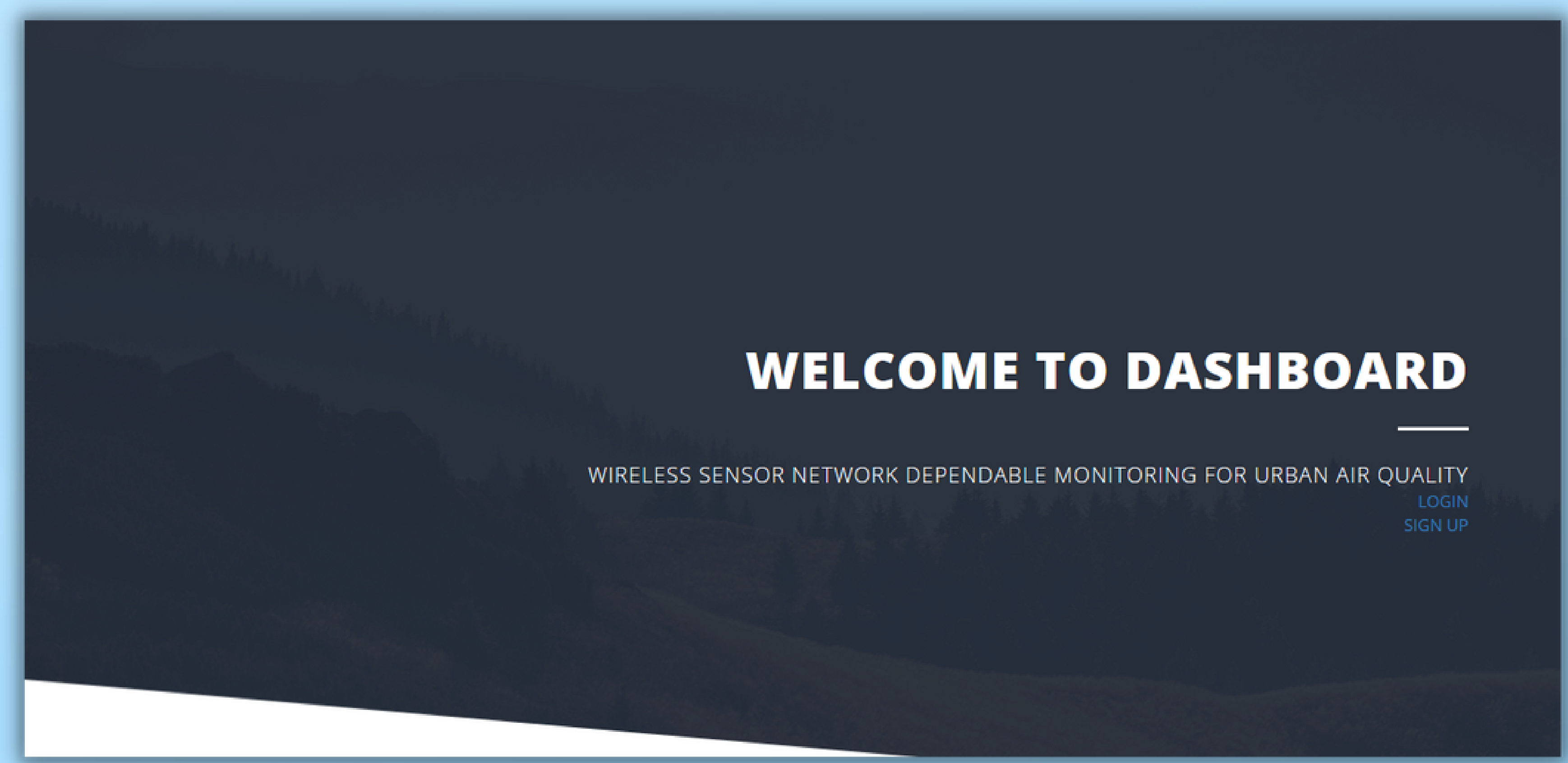
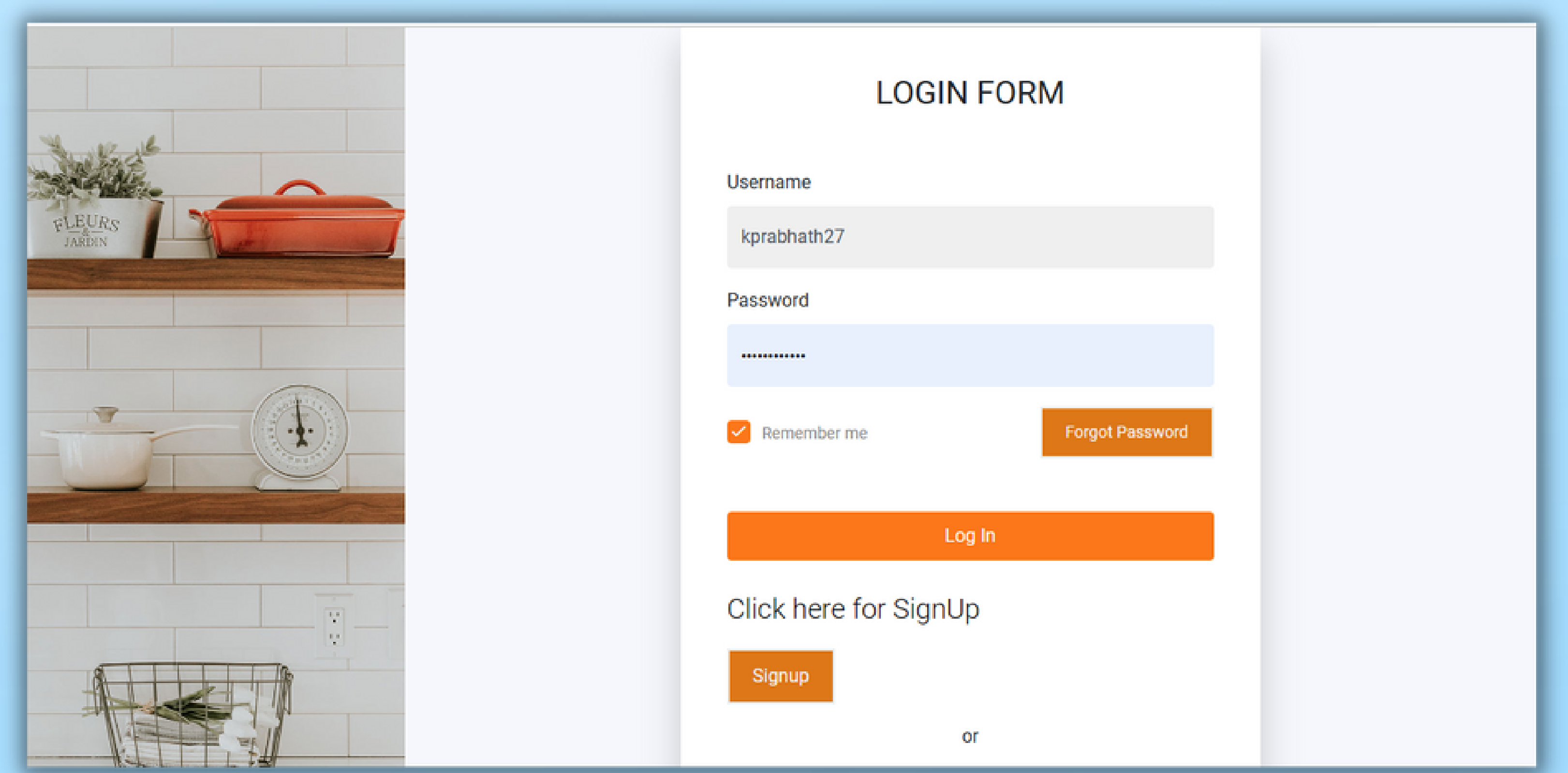
```html
<!doctype html>
<html class="no-js" lang="">
    <head>
        <meta charset="utf-8">
        <meta http-equiv="X-UA-Compatible" content="IE=edge,chrome=1">
        <title>HOme</title>
        <meta name="description" content="">
        <meta name="viewport" content="width=device-width, initial-scale=1">

        <link href="https://fonts.googleapis.com/css?family=Open+Sans:300,400,600,700,800" rel="stylesheet">
        <link rel="apple-touch-icon" href="apple-touch-icon.png">

        <link rel="stylesheet" href="static/css/bootstrap.min.css">
        <link rel="stylesheet" href="static/css/bootstrap-theme.min.css">
        <link rel="stylesheet" href="static/css/fontAwesome.css">
        <link rel="stylesheet" href="static/css/tooplate-style.css">

        <script src="static/js/vendor/modernizr-2.8.3-respond-1.4.2.min.js"></script>
    </head>
    <body>


        <section class="first-section">
          <div class="container">
            <div class="row">
              <div class="col-md-12">
                <div class="text-content">
                  <h2>Welcome To Dashboard</h2>
                  <div class="line-dec"></div>
                  <span>Wireless Sensor Network Dependable Monitoring for Urban Air Quality</span>
                  <br>
                  <a href="/index">HOME</a><br>
                  <a href="/about">ABOUT</a><br>
                  <a href="/notebook">NOTEBOOK</a><br>
                  <a href="/login">SIGNOUT</a>
                </div>
              </div>
```

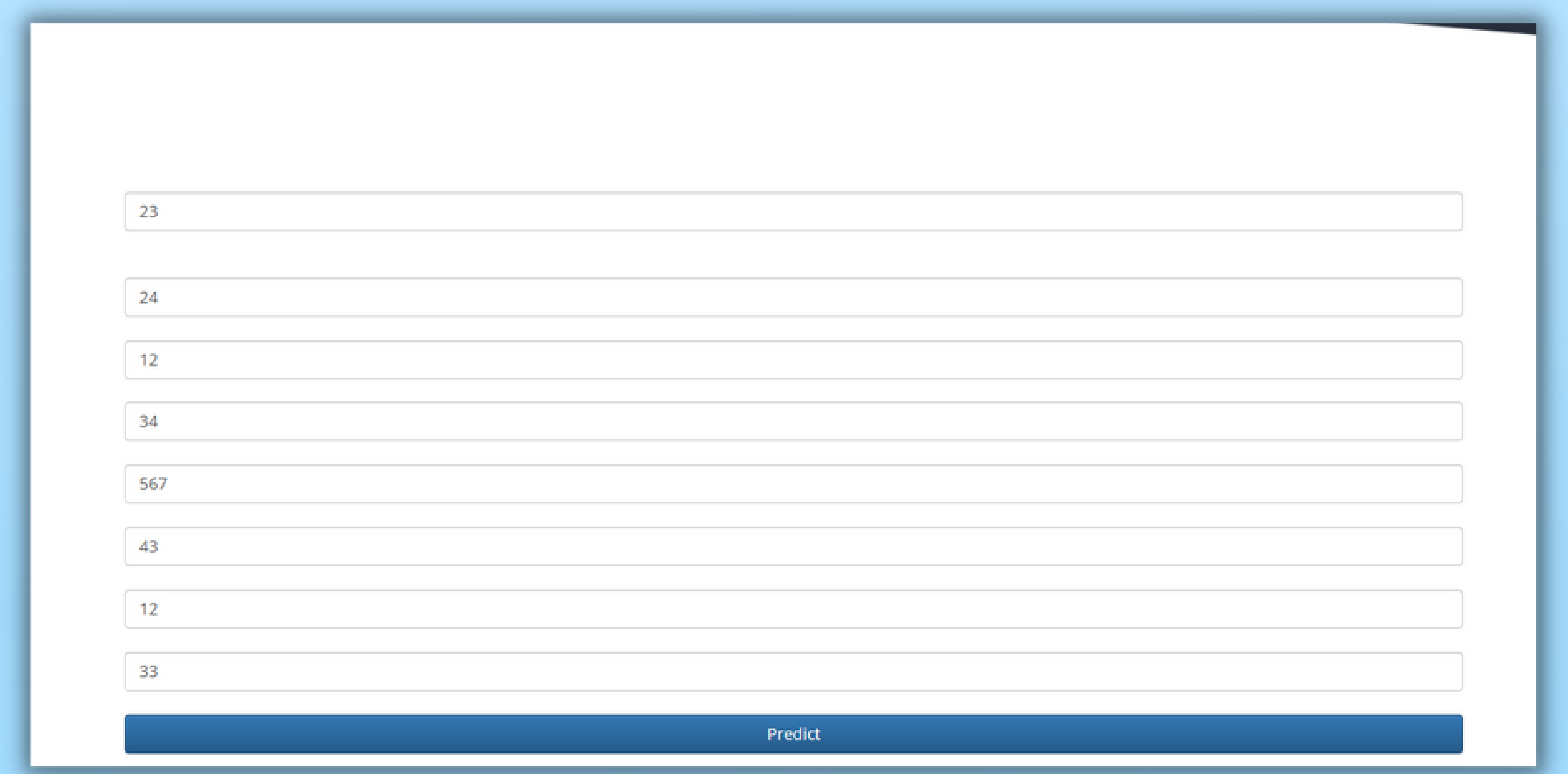
RESULT:


WELCOME TO DASHBOARD
WIRELESS SENSOR NETWORK DEPENDABLE MONITORING FOR URBAN AIR QUALITY
LOGIN
SIGN UP


jupyter NOtebook Last Checkpoint: 11/16/2022 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Not Connected
Not Trusted
Python 3
Run
Code
In [16]:
cols = list(df.columns)
plt.figure(figsize=(20, 20))
for i in range(1, 9):
plt.subplot(3, 4, i)
sns.scatterplot(x = cols[i - 1], y = df['PM 2.5'],data = df, hue = "Acceptable", palette = "husl")
Acceptable
PM 2.5
T
TM
Tm
SLP

RESULT:


LOGIN FORM
Username
kprabhath27
Password
Remember me
Forgot Password
Log In
Click here for SignUp
Signup
or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12
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567
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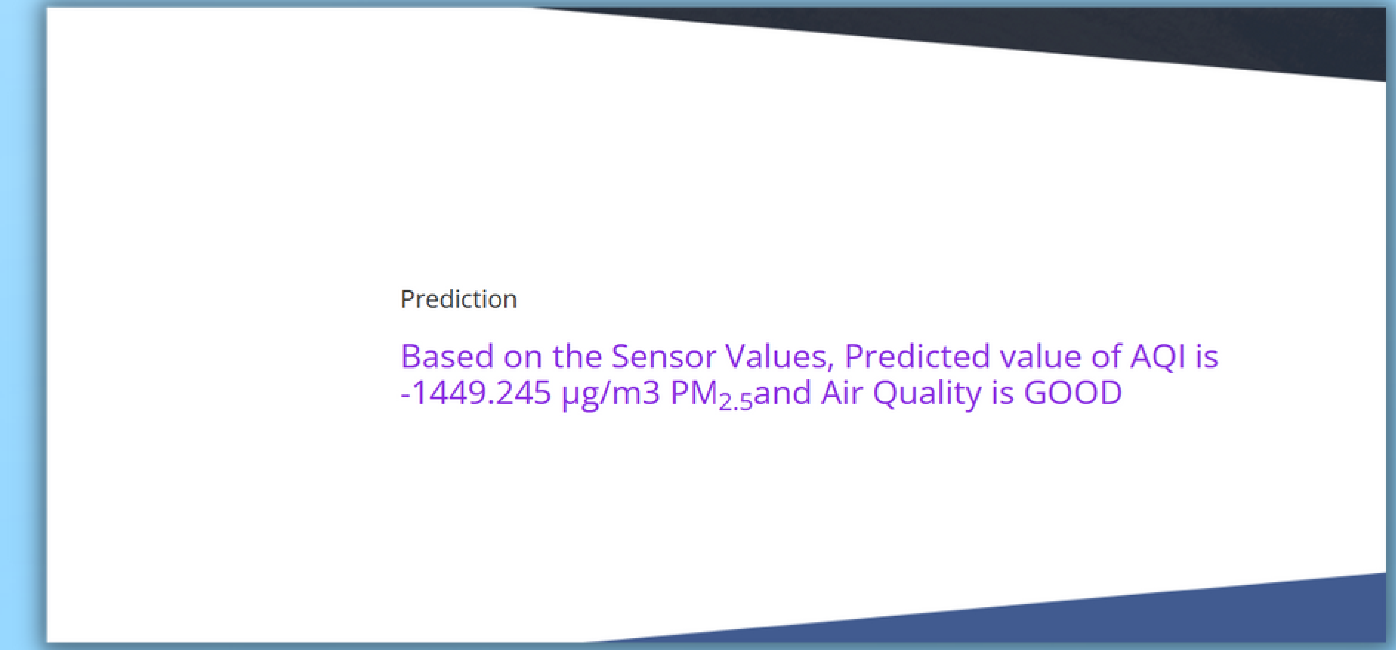
33
Predict


Prediction
Based on the Sensor Values, Predicted value of AQI is -1449.245 μg/m3 PM2.5and Air Quality is GOOD

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CONCLUSION:

This project presents a new development for a reliable environmental monitoring system built on the combination of physical and communication redundancies. By collocation of similar sensor motes to monitor the same parameters, increasing the time to failure for each module via energy management, and incorporating an effective IoT-enabled dependable control algorithm, the proposed low-cost wireless sensor network can significantly improve the monitoring quality in terms of availability, reliability with high correlations (0.903 for PM2.5, 0.817 for PM10) and fault tolerance with a high survival probability above 80%. The continuous-time Markov model and statistical tools are utilized in the design and performance verification. The system architecture is described along with hardware implementation. The developed system has been successfully tested in laboratory conditions as well as applied to real-world monitoring of air quality profiles of a construction site in a suburb, considering the impact of construction activities as well as different weather events such as bushfires, COVID-19 lockdown and heavy rain.

GITHUB LINK:

https://github.com/kph27/major-project.git

NOVELTY:

Towards environmental sustainability and social resilience in metropolitan areas, it is essential for residents to have clean air. In this regard, technical measures are needed for monitoring and improving air quality, whereby IOT-enabled wireless sensors networks are promising among available monitoring systems for healthy built environment and air quality management. An integrated monitoring system is proposed for a smart building, where real-time indoor air quality data are monitored round the clock using IOT-enabled multisensory fusion. For outdoor air quality, a simulation model is used to monitor the traffic conditions of urban road networks that have a direct effect on vehicle emissions. An open online database and measured data from urban sensor networks has been used to address individual incidents related to air pollutants. This paper presents an Internet of Things-enabled low-cost wireless sensor network with newly-developed dependable schemes to improve reliability for monitoring air quality in suburban areas. The System features sensing units for router communications with energy savings from dynamic conservation.

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THANK YOU

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