Introduction:

Smart homes have become a significant aspect of modern-day living. The integration of technology with homes has enabled people to control various aspects of their homes, including temperature, lighting, and appliances, from a single device. The temperature of a home is a critical aspect that affects the comfort of the residents, and it is essential to maintain an optimal temperature range.

In this project, we aim to develop a smart home temperature prediction system using machine learning algorithms. The system will use historical temperature data collected from a smart home and use it to predict the future temperature. This prediction will enable residents to plan their energy consumption and take necessary measures to ensure a comfortable environment.

Machine learning algorithms are widely used in various applications, and the accuracy of these algorithms has improved significantly over the years. The use of machine learning algorithms in this project will help to make more accurate predictions, compared to traditional statistical methods.

1.2 Purpose

This thesis presents a solution to improve the way devices interact within a smart home system to fit the users' needs and behaviour. The solution is presented as a smart home system using a few devices. The purpose of creating the system is to discuss whether the developed solution would be applicable on a larger scale. This thesis also covers what could be done differently with the purpose of presenting possible improvements for future systems.

2. LITERATURE SURVEY

2.1 Existing Problem

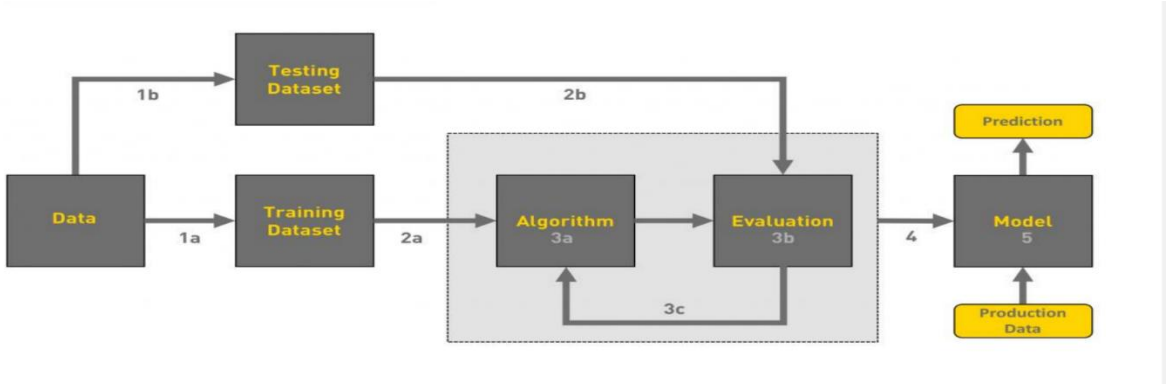
Most interactions between devices and sensors are currently dependent on mobile applications and rule-based systems to make them automated. The consumer decides the rules and the system works accordingly. Letting the user be in control can be negative in the sense that it can cause a lot of setup to make a good smart home. The 2 consumer might lack time or will to set up such rules. Difficult setups might make the consumer consider other alternatives or even avoid smart home systems altogether. Another approach on creating a smart home is to let the system monitor the environment and set up the rules itself. Giving the system full control of its learning process and the devices in the environment. How can Machine Learning be used in such a smart home system for it to learn and make decisions in its environment?

2.2 Proposed Solution

The goal of the project is to build a small smart home system. The system should be able to collect and interpret the data received from the connected components in the system. The collected data should be used by the system to learn and be able to make predictions based on newly gathered information. The predictions should then be used to control the smart home environment.

3. THEORITICAL ANALYSIS

3.1 Block Diagram



3.2 Hardware/Software Designing

Software Requirements:

Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. It was created by Guido van Rossum , and first released on February 20, 1991. Its high-level built in data structures, combined with dynamic typing and dynamic binding , make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Anaconda Navigator

Anaconda Navigator is a desktop graphical user interface (GUI) included in Anaconda distribution.Navigator allows you to launch common Python programs and easily manage conda packages, environments, and channels without using command-line commands. Navigator can search for packages on Anaconda Cloud or in a local Anaconda Repository.Conda is an open-source, crossplatform, package management system. For this project, we will be using Jupyter notebook and Spyder.

Jupyter Notebook

The Jupyter Notebook App is a server-client application that allows editing and running notebook documents via a web browser. The Jupyter Notebook App can be executed on a local desktop requiring no internet access or can be installed on a remote server and accessed through the internet.

Spyder

Spyder is an open-source cross-platform integrated development environment (IDE) for scientific programming in the Python language. Spyder integrates with a number of prominent packages in the scientific Python stack, including NumPy, SciPy, Matplotlib, pandas, IPython, SymPy and Cython, as well as other open-source software. It is released under the MIT license.

Flask

Flask is a micro web framework written in Python. It is classified as a microframework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions. However, Flask supports extensions that can add application features as if they were implemented in Flask itself.

Hardware Requirements:

Operating System: Windows 7 or above

Processor:Intel Core i5 and above

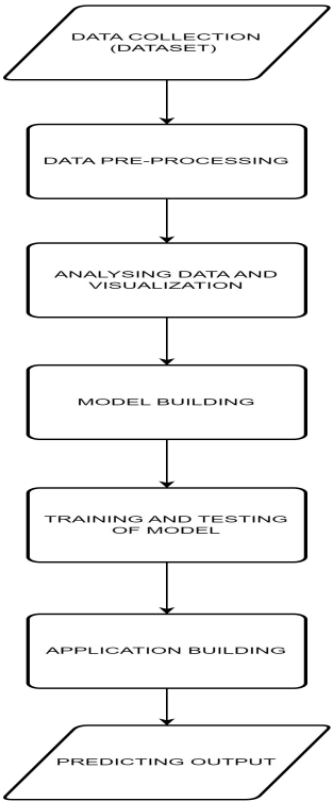
RAM: 4Gb and above

Storage Space Required: 10gb and above

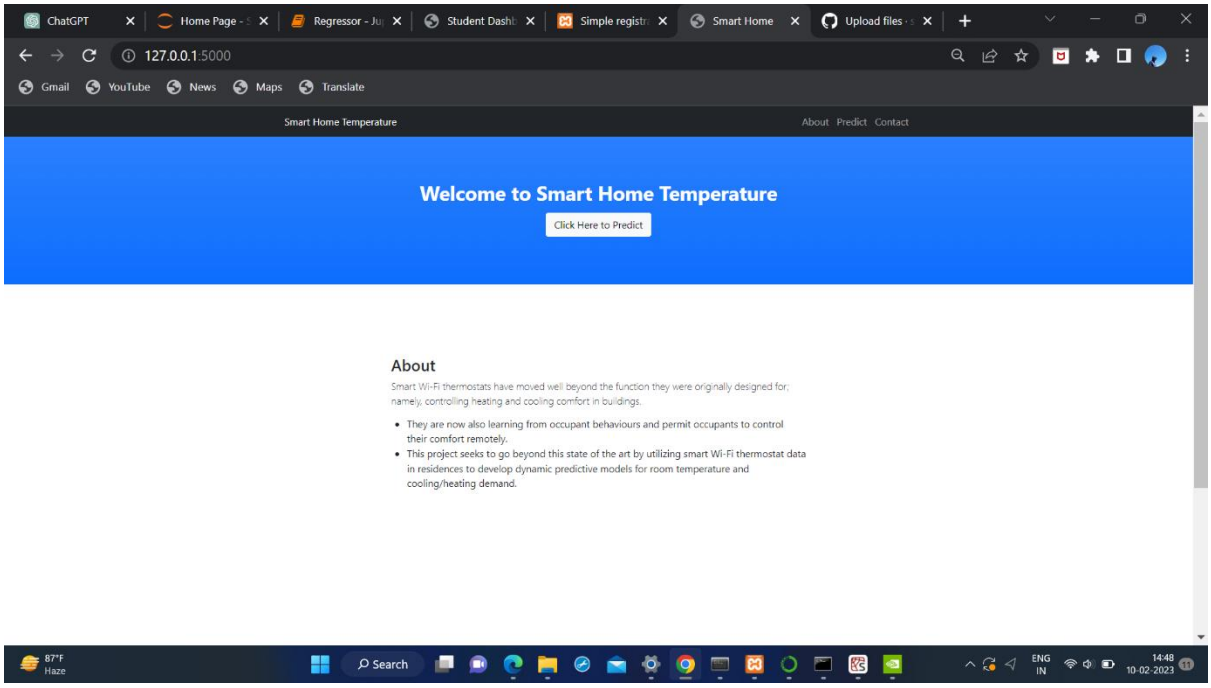
4. EXPERIMENTAL INVESTIGATIONS

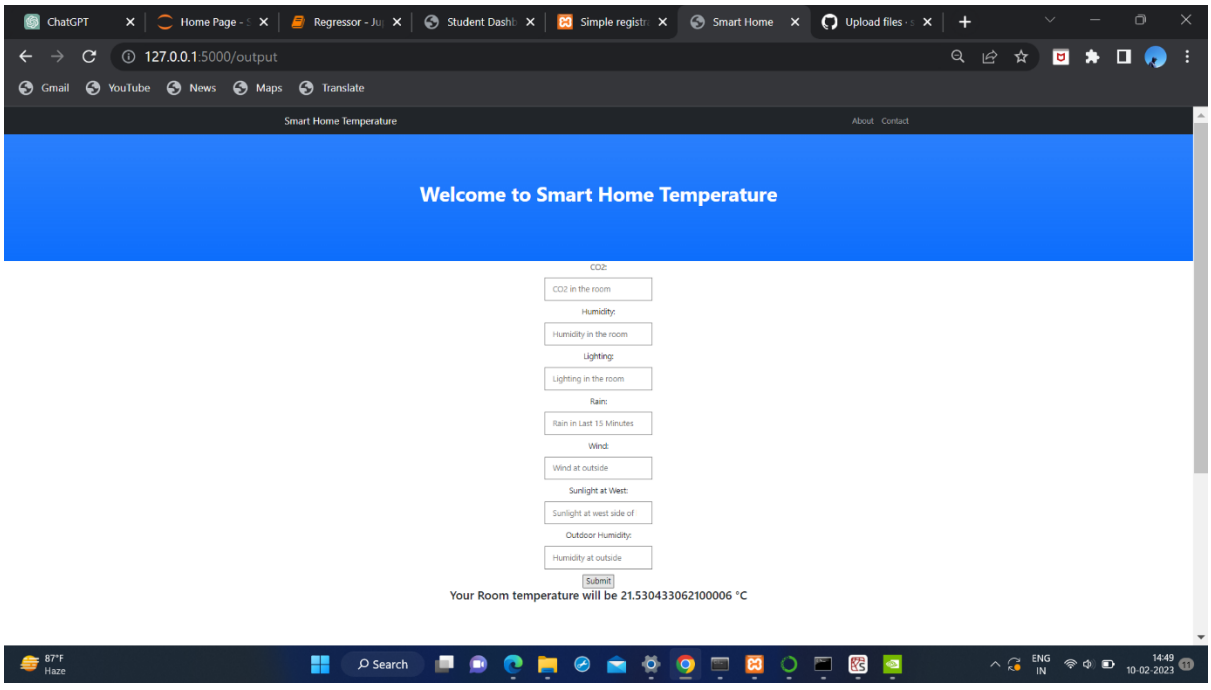
The text data need to be organized before proceeding with the project. We will be using PS_20174392719_1491204439457_logs.csv dataset file to fetch the text data of training data. The datas are to be preprocessed in a way such that there is no empty field or outliers.We will create a function that uses the pre-trained model for predicting custom outputs. Then we have to test and train the model. After the model is build, we will be integrating it to a web application build in flask.

5. FLOWCHART



6. RESULT


127.0.0.1:5000
Smart Home Temperature
About Predict Contact
Welcome to Smart Home Temperature
Click Here to Predict
About
Smart Wi-Fi thermostats have moved well beyond the function they were originally designed for, namely, controlling heating and cooling comfort in buildings.
They are now also learning from occupant behaviours and permit occupants to control their comfort remotely.
This project seeks to go beyond this state of the art by utilizing smart Wi-Fi thermostat data in residences to develop dynamic predictive models for room temperature and cooling/heating demand.


127.0.0.1:5000/output
Smart Home Temperature
About Contact
Welcome to Smart Home Temperature
CO2:
CO2 in the room
Humidity:
Humidity in the room
Lighting:
Lighting in the room
Rain:
Rain in Last 15 Minutes
Wind:
Wind at outside
Sunlight at West:
Sunlight at west side of
Outdoor Humidity:
Humidity at outside
Submit
Your Room temperature will be 21.530433062100006 °C

7. ADVANTAGES

Improved Comfort: With smart home room temperature prediction, the temperature of a room can be automatically adjusted based on past temperature readings and individual preferences, leading to improved comfort levels.

Energy Efficiency: By accurately predicting the temperature of a room, a smart home system can reduce energy waste by only heating or cooling the room when necessary. This can result in lower energy bills and a more environmentally friendly home.

Increased Convenience: With smart home room temperature prediction, there is no need to manually adjust the temperature of a room. This can be especially convenient for people with mobility issues or those who are always on the go.

Enhanced Security: Some smart home systems can be set to automatically turn on the heating or cooling when the room is unoccupied, which can help to prevent damage to the home and increase security by deterring intruders.

Improved Air Quality: By accurately predicting the temperature of a room, a smart home system can help to maintain optimal indoor air quality by preventing over-heating or over-cooling, which can cause indoor air pollution.

DISADVANTAGES

Cost: The initial cost of setting up a smart home room temperature prediction system can be high, especially if you need to purchase new equipment or upgrade your existing heating and cooling system.

Complexity: Some smart home room temperature prediction systems can be complex to set up and operate, requiring technical knowledge and skills that many people may not possess.

Reliance on technology: A smart home room temperature prediction system relies on technology and requires a reliable power source and internet connection to work effectively. If there is a power outage or internet connectivity issue, the system may not work properly.

Data privacy concerns: Some smart home room temperature prediction systems collect and store large amounts of data, which can raise privacy concerns for some people.

Limited customization: While some smart home room temperature prediction systems allow for some customization, they may not offer the same level of control and customization as manual temperature control systems.

8. APPLICATIONS

Climate control: A smart home room temperature prediction system can automatically adjust the temperature of a room based on past readings, individual preferences, and real-time weather conditions to provide a comfortable living environment.

Energy management: By accurately predicting the temperature of a room, a smart home system can reduce energy waste by only heating or cooling the room when necessary. This can help to lower energy bills and reduce a home's carbon footprint.

Health and wellness: A smart home room temperature prediction system can help to maintain optimal indoor air quality by preventing over-heating or over-cooling, which can help to improve the health and well-being of the occupants.

Remote control: With a smart home room temperature prediction system, it is possible to control the temperature of a room remotely using a smartphone, tablet, or other connected device, which can be especially convenient for people who are always on the go.

Home automation: A smart home room temperature prediction system can be integrated with other smart home devices, such as smart lighting, security systems, and entertainment systems, to provide a comprehensive home automation solution.

9. CONCLUSION

In conclusion, smart home room temperature prediction is a rapidly growing technology that offers many benefits to homeowners and building occupants. By accurately predicting the temperature of a room, these systems can reduce energy waste, improve comfort, and provide greater convenience and control. Additionally, with advancements in artificial intelligence and machine learning, the accuracy and functionality of these systems is likely to continue to improve in the future.

10. FUTURE SCOPE

Improved accuracy: With advancements in artificial intelligence and machine learning, the accuracy of smart home room temperature prediction systems is likely to improve, leading to more precise temperature control and increased energy efficiency.

Increased integration with other devices: Smart home room temperature prediction systems are likely to become increasingly integrated with other smart home devices, such as smart lights, security

systems, and entertainment systems, providing a more seamless and integrated home automation experience.

Greater customization: In the future, smart home room temperature prediction systems may offer greater customization options, allowing users to tailor the system to their individual needs and preferences.

Expansion into commercial buildings: Smart home room temperature prediction systems are currently mostly used in homes, but in the future, they may become more widely adopted in commercial buildings, such as office buildings, hotels, and hospitals, leading to increased energy efficiency and cost savings.

Increased adoption of renewable energy: As the use of renewable energy sources, such as solar and wind power, continues to grow, smart home room temperature prediction systems may be designed to work seamlessly with these energy sources, leading to even greater energy efficiency and sustainability.

11. BIBLOGRAPHY

https://www.researchgate.net/publication/354937786_Online_Transaction_Fraud_Detection_System_Based_on_Machine_Learning

https://thecleverprogrammer.com/2022/02/22/online-payments-fraud- detection-with-machine-learning/

12. APPENDIX

A. SOURCE CODE

APP.PY

```
from flask import Flask, request, render_template

import pickle

import numpy as np

import pandas as pd


model = pickle.load(open(r'C:\Users\dell\Telegram Desktop\Smart Home - Temperature Prediction\Smart Home - Temperature Prediction\Flask\temperature.pkl','rb'))

app = Flask(__name__)


@app.route("/")

def home():
```

```
    return render_template("index.html")


@app.route("/predict")
def predict():
    return render_template("predict.html")


@app.route('/output', methods = ['post','get'])
def output():
    #  reading the inputs given by the user
    input_feature= [float(x) for x in request.form.values()]
    input_feature=[np.array(input_feature)]
    print(input_feature)
    names = ['CO2_room', 'Relative_humidity_room', 'Lighting_room', 'Meteo_Rain', 'Meteo_Wind',
'Meteo_Sun_light_in_west_facade',
       'Outdoor_relative_humidity_Sensor']
    print(names)
    data = pd.DataFrame(input_feature,columns=names)
    print(data)
    prediction=model.predict(data)
    print(prediction)
    return render_template('predict.html', prediction=prediction[0])



if __name__ == '__main__':
    app.run(debug = True)
```

INDEX.HTML

```
<!DOCTYPE html>
<html lang="en">
    <style>
        p{
            font-size:22px;
```

```
    }
    li{
        font-size:20px;
    }
</style>

<head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
    <meta name="description" content="" />
    <meta name="author" content="" />
    <title>Smart Home</title>
    <link rel="icon" type="image/x-icon" href="assets/favicon.ico" />
    <!-- Core theme CSS (includes Bootstrap)-->
    <link rel="stylesheet" href="{{ url_for('static', filename='css/styles.css') }}"/>
</head>
<body id="page-top">
    <!-- Navigation-->
    <nav class="navbar navbar-expand-lg navbar-dark bg-dark fixed-top" id="mainNav">
        <div class="container px-4">
            <a class="navbar-brand" href="#page-top">Smart Home Temperature</a>
            <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-
target="#navbarResponsive" aria-controls="navbarResponsive" aria-expanded="false" aria-
label="Toggle navigation"><span class="navbar-toggler-icon"></span></button>
            <div class="collapse navbar-collapse" id="navbarResponsive">
                <ul class="navbar-nav ms-auto">
                    <li class="nav-item"><a class="nav-link" href="#about">About</a></li>
                    <li class="nav-item"><a class="nav-link"
href="{{url_for('predict')}}">Predict</a></li>
                    <li class="nav-item"><a class="nav-link" href="#contact">Contact</a></li>
                </ul>
            </div>
        </div>
```

```
</nav>
<!-- Header-->
<header class="bg-primary bg-gradient text-white">
    <div class="container px-4 text-center">
        <h1 class="fw-bolder">Welcome to Smart Home Temperature</h1>
        <p class="lead"></p>
        <a class="btn btn-lg btn-light" href="{{url_for('predict')}}">Click Here to Predict</a>
    </div>
</header>
<!-- About section-->
<section id="about">
    <div class="container px-4">
        <div class="row gx-4 justify-content-center">
            <div class="col-lg-8">
                <h2>About</h2>
                <p class="lead">Smart Wi-Fi thermostats have moved well beyond the function they were originally designed for; namely, controlling heating and cooling comfort in buildings.</p>
                <ul>
                    <li>They are now also learning from occupant behaviours and permit occupants to control their comfort remotely. </li>
                    <li>This project seeks to go beyond this state of the art by utilizing smart Wi-Fi thermostat data in residences to develop dynamic predictive models for room temperature and cooling/heating demand. </li>

                </ul>
            </div>
        </div>
    </div>
</section>

<!-- Contact section-->
<section id="contact">
    <div class="container px-4">
        <div class="row gx-4 justify-content-center">
```

```
                <div class="col-lg-8">
                    <h2>Contact us</h2>
                    <h4 style="text-align:center">TheSmartBridge</h4>
                    <p class="lead">Bapuji Nagar Park, 2nd Floor, Plot No 132, Habsiguda Main Rd, above DCB bank, Nacharam, Hyderabad, Telangana 500076</p>
                </div>
            </div>
        </div>
    </section>
    <!-- Footer-->
    <footer class="py-5 bg-dark">
        <div class="container px-4"><p class="m-0 text-center text-white">Copyright &copy; www.sbsmarthomepred.com</p></div>
    </footer>
    <!-- Bootstrap core JS-->
    <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
    <!-- Core theme JS-->
    <script src="{{ url_for('static', filename = 'js/scripts.js')}}"></script>
  </body>
</html>
```

PREDICT.HTML

```
<!DOCTYPE html>
<html lang="en">
  <style>
    form {
      text-align: center;
      }
      input[type = number] {
      width: auto;
      padding: 10px 15px;
      margin: 10px 0;
```

```
      box-sizing: border-box;
    }
    h4{
      text-align: center;
    }
  </style>
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no" />
    <meta name="description" content="" />
    <meta name="author" content="" />
    <title>Smart Home</title>
    <link rel="icon" type="image/x-icon" href="assets/favicon.ico" />
    <!-- Core theme CSS (includes Bootstrap)-->
    <link rel="stylesheet" href="{{ url_for('static', filename='css/styles.css') }}"/>
  </head>
  <body id="page-top">
    <!-- Navigation-->
    <nav class="navbar navbar-expand-lg navbar-dark bg-dark fixed-top" id="mainNav">
      <div class="container px-4">
        <a class="navbar-brand" href="#page-top">Smart Home Temperature</a>
        <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarResponsive" aria-controls="navbarResponsive" aria-expanded="false" aria-label="Toggle navigation"><span class="navbar-toggler-icon"></span></button>
        <div class="collapse navbar-collapse" id="navbarResponsive">
          <ul class="navbar-nav ms-auto">
            <li class="nav-item"><a class="nav-link" href="#about">About</a></li>

            <li class="nav-item"><a class="nav-link" href="#contact">Contact</a></li>
          </ul>
        </div>
      </div>
    </nav>
```

```
<!-- Header-->
<header class="bg-primary bg-gradient text-white">
    <div class="container px-4 text-center">
        <h1 class="fw-bolder">Welcome to Smart Home Temperature</h1>
        <p class="lead"></p>

    </div>
</header>

<div>
    <form action="{{url_for('output')}}" method="post">
        <label for="CO2_room">CO2:</label>
        <input type = 'number' label =  id = 'CO2_room' name = 'CO2_room', placeholder="CO2 in the room"><br>
        <label for="Relative_humidity_room">Humidity:</label>
        <input type = 'number' id = 'Relative_humidity_room' name = 'Relative_humidity_room', placeholder="Humidity in the room"><br>
        <label for="Lighting_room">Lighting:</label>
        <input type = 'number' id = 'Lighting_room' name = 'Lighting_room', placeholder="Lighting in the room"><br>
        <label for="Meteo_Rain">Rain:</label>
        <input type = 'number' id = 'Meteo_Rain' name = 'Meteo_Rain', placeholder="Rain in Last 15 Minutes"><br>
        <label for="Meteo_Wind">Wind:</label>
        <input type = 'number' id = 'Meteo_Wind' name = 'Meteo_Wind', placeholder="Wind at outside"><br>
        <label for="Meteo_Sun_light_in_west_facade">Sunlight at West:</label>
        <input type = 'number' id = 'Meteo_Sun_light_in_west_facade' name = 'Meteo_Sun_light_in_west_facade', placeholder="Sunlight at west side of home"><br>
        <label for="Outdoor_relative_humidity_Sensor">Outdoor Humidity:</label>
        <input type = 'number' id = 'Outdoor_relative_humidity_Sensor' name = 'Outdoor_relative_humidity_Sensor', placeholder="Humidity at outside"><br>
        <input type="submit" value="Submit">
    </form>
```

```
        <h4>Your Room temperature will be {{prediction}} °C</h4>


    </div>




    <!-- Contact section-->
    <section id="contact">
        <div class="container px-4">
            <div class="row gx-4 justify-content-center">
                <div class="col-lg-8">
                    <h2>Contact us</h2>
                    <h4 style="text-align:center">TheSmartBridge</h4>
                    <p class="lead">Bapuji Nagar Park, 2nd Floor, Plot No 132, Habsiguda Main Rd, above DCB bank, Nacharam, Hyderabad, Telangana 500076</p>
                </div>
            </div>
        </div>
    </section>
    <!-- Footer-->
    <footer class="py-5 bg-dark">
        <div class="container px-4"><p class="m-0 text-center text-white">Copyright &copy; www.sbsmarthomepred.com</p></div>
    </footer>
    <!-- Bootstrap core JS-->
    <script src="https://cdn.jsdelivr.net/npm/bootstrap@5.1.3/dist/js/bootstrap.bundle.min.js"></script>
    <!-- Core theme JS-->
    <script src="{{ url_for('static', filename = 'js/scripts.js')}}"></script>
  </body>
</html>
```