HVAC System

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Group - 14

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Overview

This report is regarding our project HVAC System. In this project we have made a java program which would adjust the current atmosphere of the surroundings based on the given set of inputs. This project would also give the projections about the devices what their configurations should be in order to maintain optimum atmosphere in the surroundings.

Project Description

HVAC System stands for Heating, Ventilation and Cooling System. HVAC System helps to maintain optimum atmosphere which would increase the productivity in the environment. It mainly controls the temperature, humidity and air quality level through various devices like AC, Heater, etc. HVAC System is used in many domestic and commercial environments. HVAC System achieves optimum atmosphere by controlling the temperature of a room through heating and cooling. It also controls the humidity level in that environment by controlling the movement and distribution of air inside the room.

HVAC System also ensure the cleanliness of the environment through various purification and ventilation methods.

Goals

1. **Maintains Optimum Temperature:** Maintains temperature according to the conditions given.
2. **Controls Humidity:** Dehumidify or Humidify the surroundings according to given conditions.
3. **Check air quality:** Check if the air quality is safe or not and sets the exhaust speed accordingly according to the air quality level.

Technologies Used

1. **Java -** Used to design our software using object oriented principles and methodologies
2. **Swing -** An API which enables developer to develop GUI components in Java easily
3. **JavaMail API -** API used to send emails from the java Program. The **javax.mail** and **javax.mail.activation** packages contain the core classes of JavaMail API.
4. **Eclipse -** Eclipse is an open source IDE supported by IBM. Popularly used for the development of Java applications and Android apps.
5. **Netbeans -** Netbeans is an IDE launched by Apache for development of Java Applications. NetBeans provides a more user friendly interface which provides users with a drag and drop option which is much easier to use.

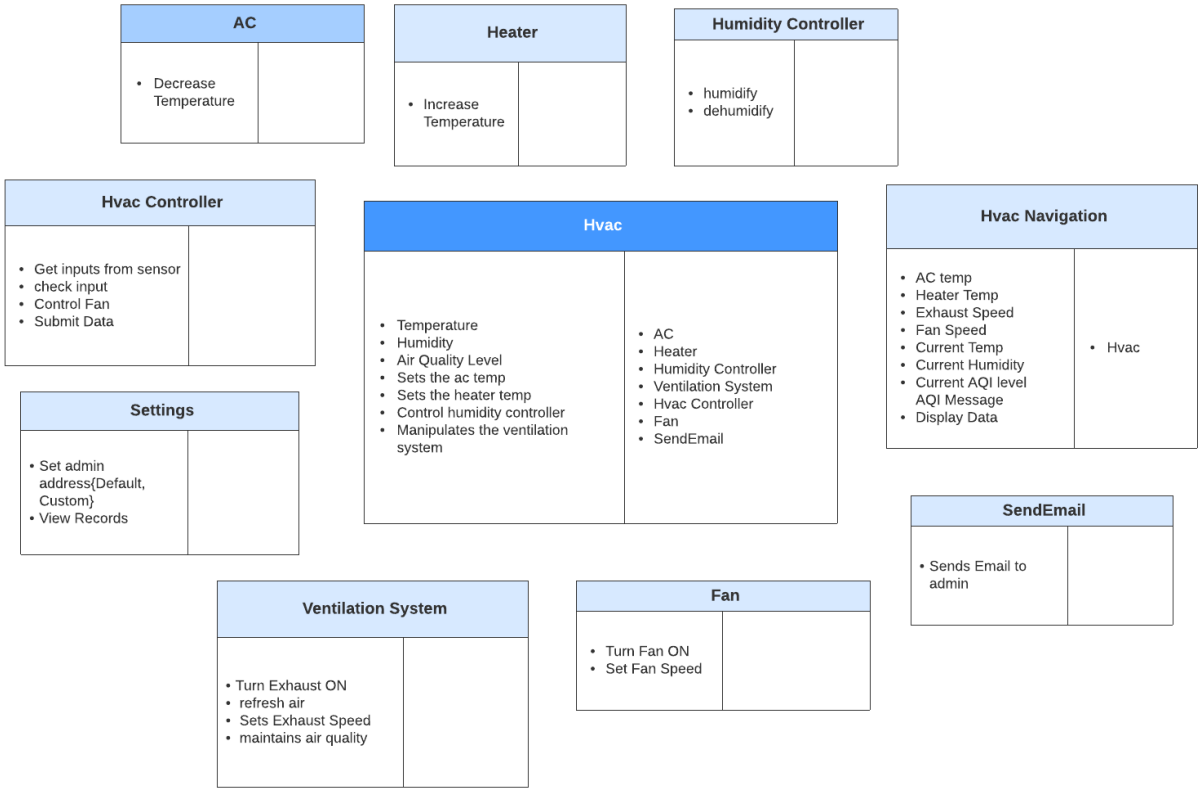
Specifications

Our HVAC System is based on devices which are

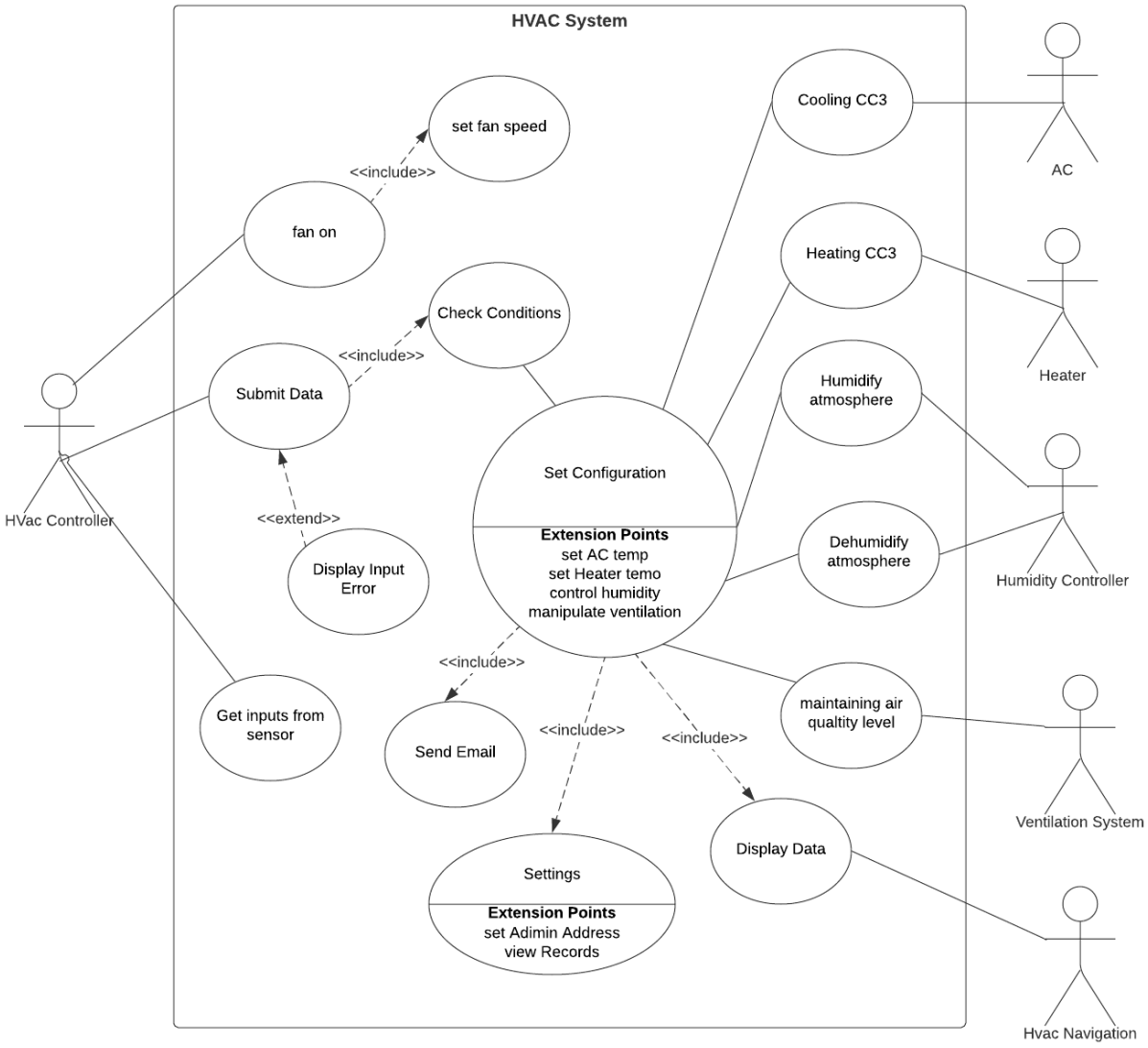
1. AC
2. Heater
3. Humidity Controller
4. Exhaust
5. Fan

UML Diagrams

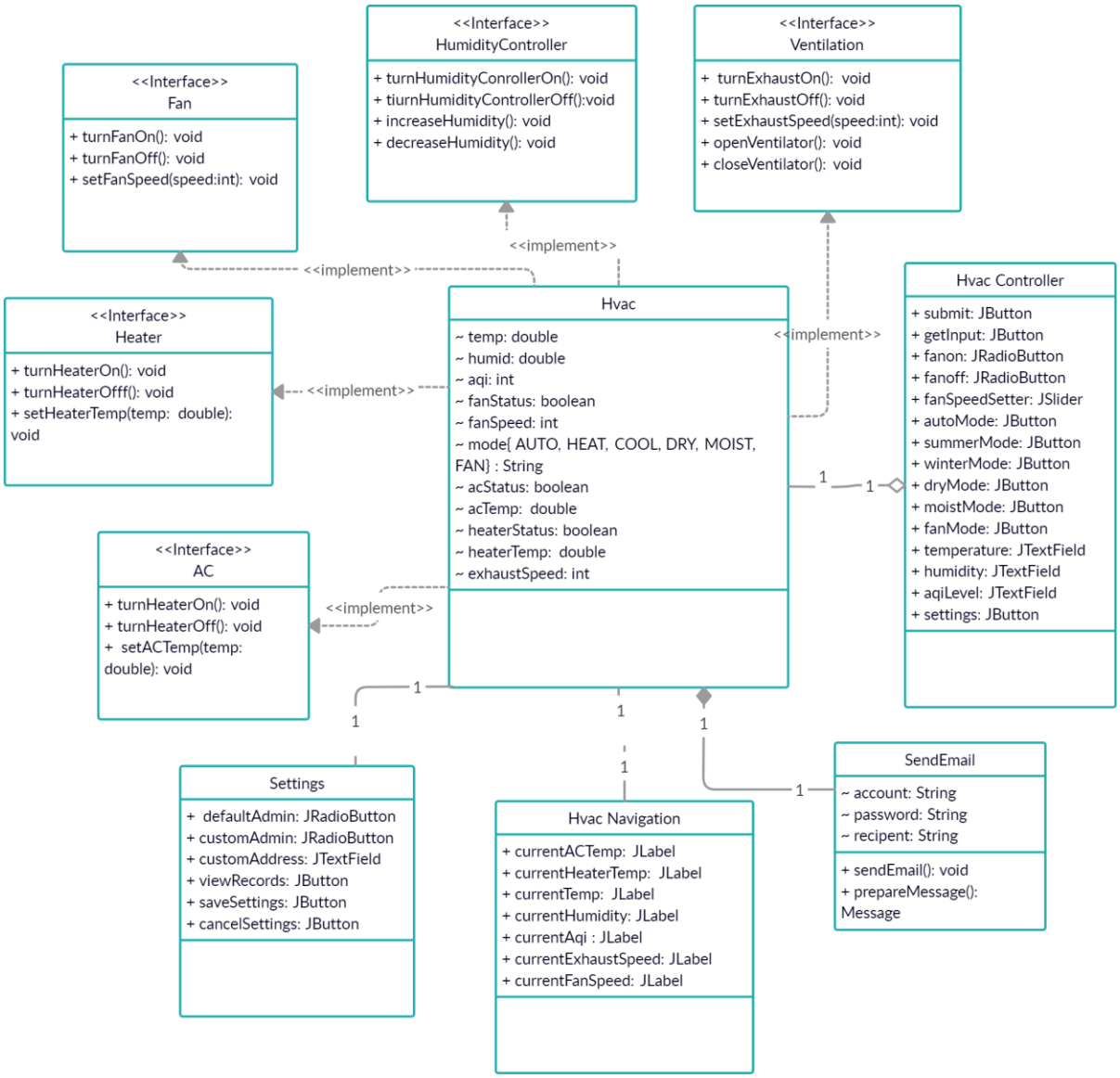
CRC Diagram


AC
• Decrease Temperature
Heater
• Increase Temperature
Humidity Controller
• humidify
• dehumidify
Hvac Controller
• Get inputs from sensor
• check input
• Control Fan
• Submit Data
Hvac
• Temperature
• Humidity
• Air Quality Level
• Sets the ac temp
• Sets the heater temp
• Control humidity controller
• Manipulates the ventilation system
• AC
• Heater
• Humidity Controller
• Ventilation System
• Hvac Controller
• Fan
• SendEmail
Hvac Navigation
• AC temp
• Heater Temp
• Exhaust Speed
• Fan Speed
• Current Temp
• Current Humidity
• Current AQI level
AQI Message
• Display Data
• Hvac
Settings
• Set admin address{Default, Custom}
• View Records
SendEmail
• Sends Email to admin
Ventilation System
• Turn Exhaust ON
• refresh air
• Sets Exhaust Speed
• maintains air quality
Fan
• Turn Fan ON
• Set Fan Speed

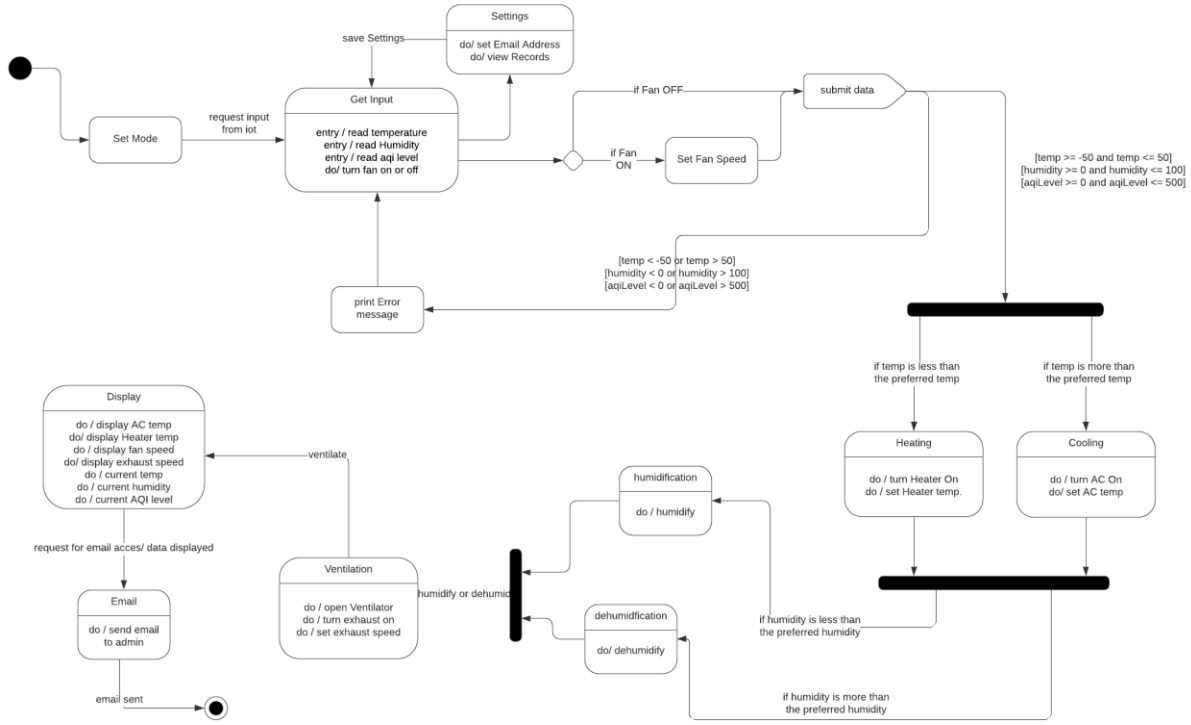
Use Case Diagram



Class Diagram



State Diagram

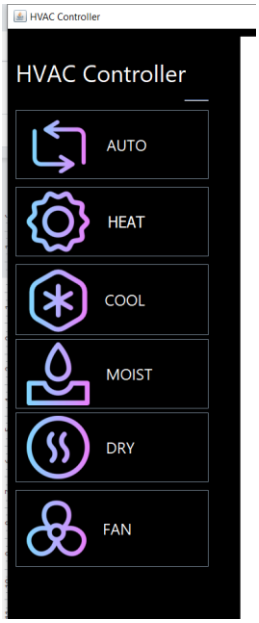


User Guide

The HVAC System program would open 2 tabs one for controlling and getting input and other is for displaying the required configurations which have been set to maintain optimum atmosphere.

HVAC Controller

In our HVAC Controller screen,



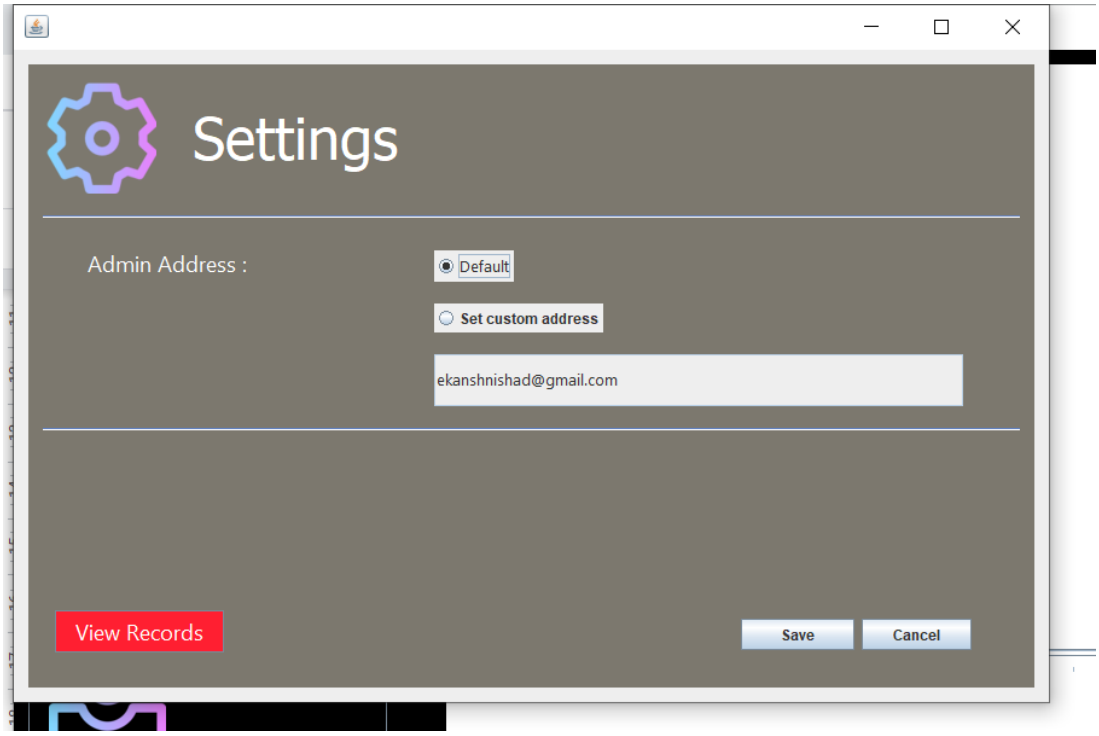
MODE -

There are 6 modes in our HVAC System i.e. auto, heat, cool, moist, dry and fan. These 6 modes will decide how the HVAC System would be working for a given set of inputs. The *Get Input* which is basically a random number generator which would generate random input based on the mode of the HVAC System. It would generate all the random input for temperature, humidity and air quality level.

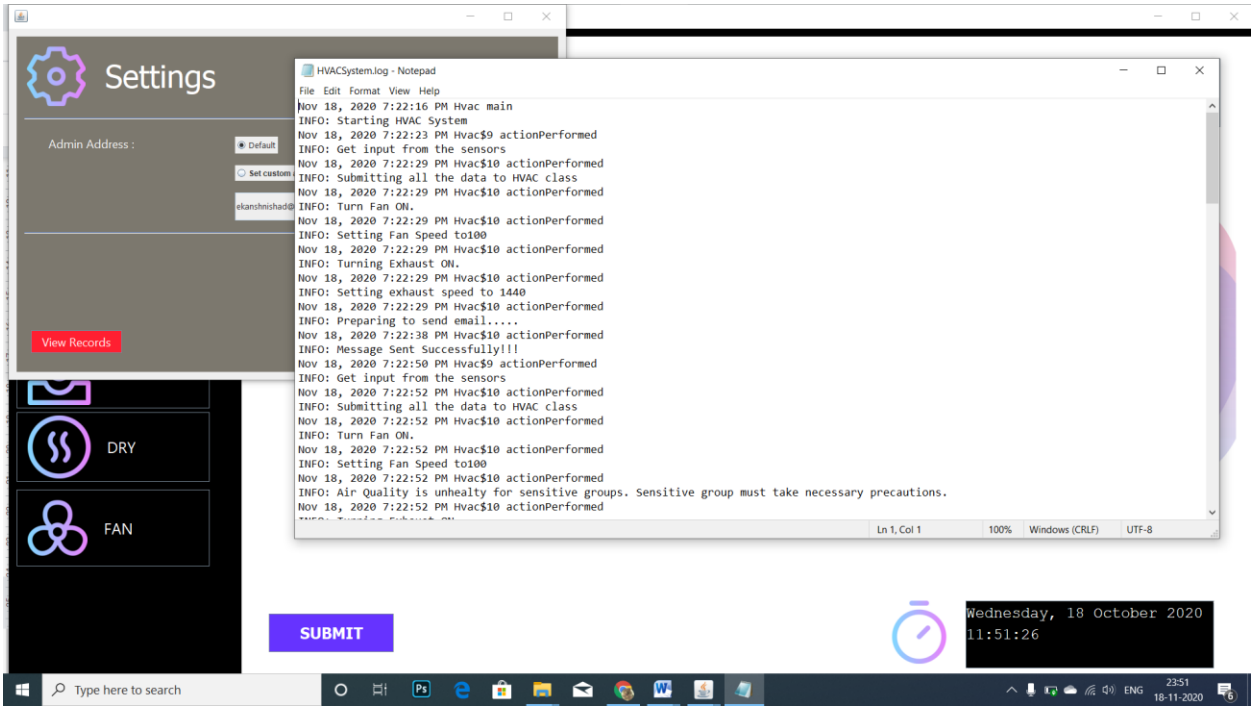
Settings Button-

9

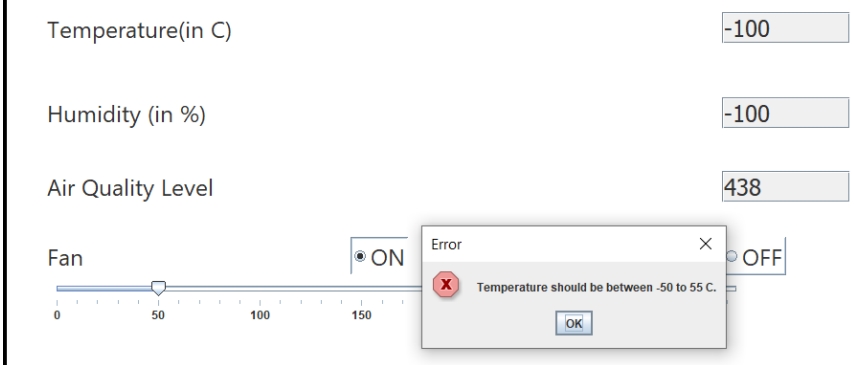
Settings button also which is basically to set the Admin Address whether it should be default or should be any custom address.

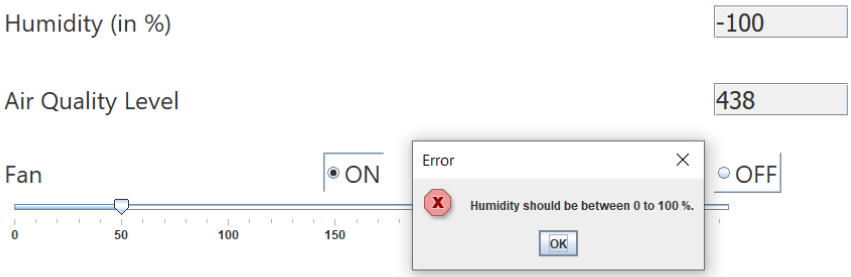


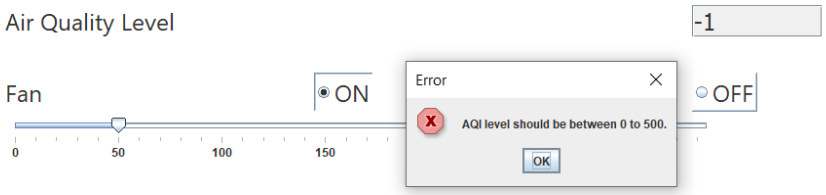
This settings button also contains a button view records which would be useful to view the records which are stored in the log file.



There are 3 text fields for input of temperature , humidity and air quality level which would be either directly taken input or randomly generated using the *Get Input* button. These 3 text fields should have values in the given range otherwise it would give error like







FAN -

The 2 radio buttons are for Fan Status - ON and OFF which would set whether the Fan should be ON or OFF. The slider is used to control fan speed.

Submit Button -

Submit button would set all the values of attributes in the HVAC class. This submit button on clicking would automatically set the input in the HVAC System. And when the configuration is sent an email would be sent to the admin regarding the actions taken in the HVAC System.

Working

If the mode set is set in auto mode

Then if the temperature < 21 C

Then set the heater on and turn off the ac

Set the temperature of the heater as 24 C.

Else if the temperature is > 29 C

THEN set the heater off and turn on the ac

Set the temperature of ac as 24 C

Else

Turn both off

If the humidity is < 37.5 %

Humidify atmosphere using humidity controller

Else if the humidity > 56.25 %

Dehumidify atmosphere using humidity controller

If the mode set is set in heat mode

Then if the temperature < 18 C

Then set the heater on and turn off the ac

Set the temperature of the heater as 22C.

Else

Turn both off

If the humidity is < 25 %

Humidify atmosphere using humidity controller

Else if the humidity > 42 %

Dehumidify atmosphere using humidity controller

If the mode set is set in cool mode

then if the temperature is > 29 C
THEN set the heater off and turn on the ac
Set the temperature of heater as 25 C

Else
Turn both off

If the humidity is < 40%
Humidify atmosphere using humidity controller
Else if the humidity > 60%
Dehumidify atmosphere using humidity controller

If the set mode is moist
If the temp < 10
Then turn heater on
Set heater temp to 25
Else if temp > 42
Then turn ac on
Set ac temp to 25

If the humidity < 60
Then humidify

If the set mode is dry
If the temp < 10
Then turn heater on
Set heater temp to 25
Else if temp > 42
Then turn ac on
Set ac temp to 25

If the humidity > 25
Then dehumidify

If the set mode is fan
Then only ventilation would work and the heating and cooling system would be off.

Exhaust speed is determined on the basis of aqi level

If aqi level > 100

Set Exhaust Speed to (aqi level - 100)*2.88 + 1440 rpm

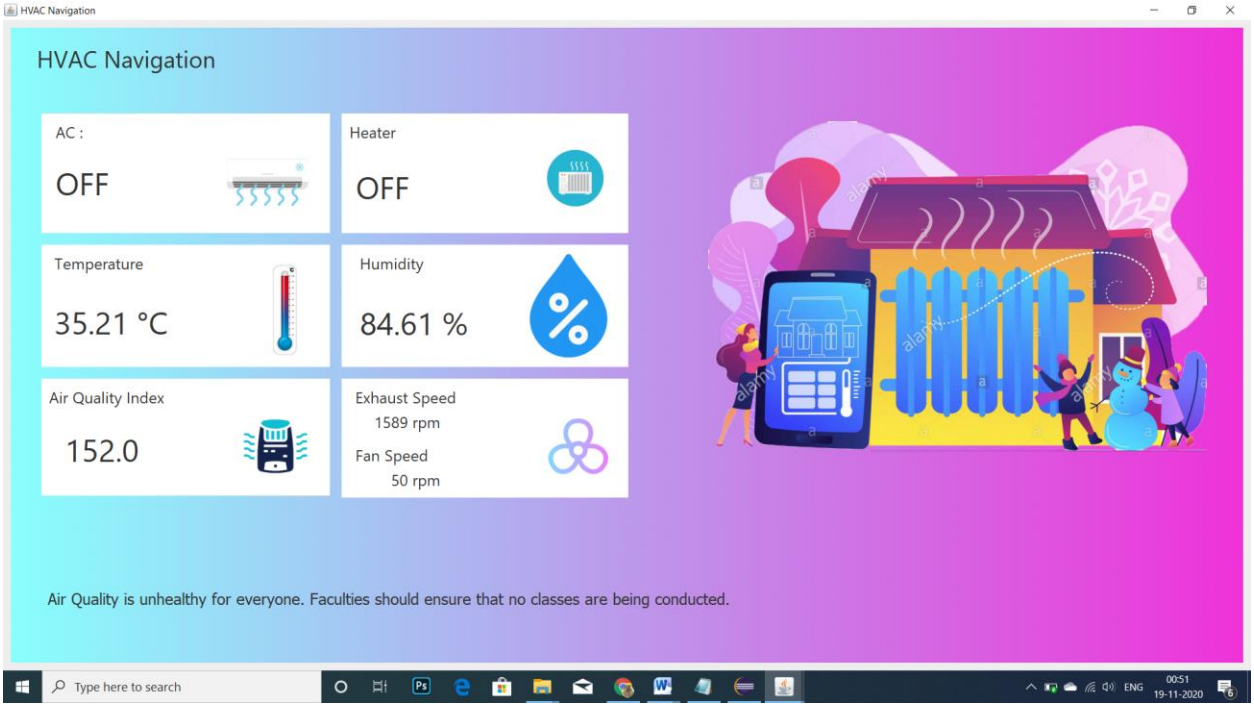
else

Set Exhaust Speed to 1440 rpm

A timer is made to change the values of the HVAC System accordingly due to these devices the surroundings would get affected by it. We have hard coded things so that it might appear that the temperature, humidity and air quality level is really changing due to AC, Heater, etc.
<< See from line no 704-976 in Hvac class>>

A warning message is assigned in the Hvac class which is later used to display a message on the HVAC Navigation Screen.
At last all the configuration would be set in the Hvac Navigation screen update periodically.
An email would also be sent to the admin if any new action would be taken.

HVAC Navigation

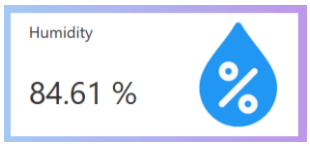


This is the HVAC Navigation Tab. This tab would show the current configuration of the HVAC System. It would also show the current conditions as it keeps changing every second.

This Panel would show the current status of AC whether it is ON or OFF. If ON , AC temp would be shown in the Panel.

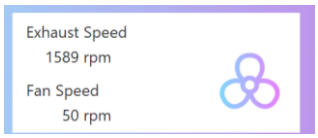
This Panel would show the current status of Heater whether it is ON or OFF. If ON , Heater temp would be shown in the Panel.

Current Temperature would be shown in this Panel. If AC or Heater would be ON then the current temperature would keep fluctuating every second. Thus this Panel is updated every second when the AC or Heater is ON.



Current Humidity would be shown in this Panel. If the Humidity Controller would be ON and the humidity is not in the preferred range then the Humidity Controller would humidify/dehumidify the humidity to bring it to the preferred range.

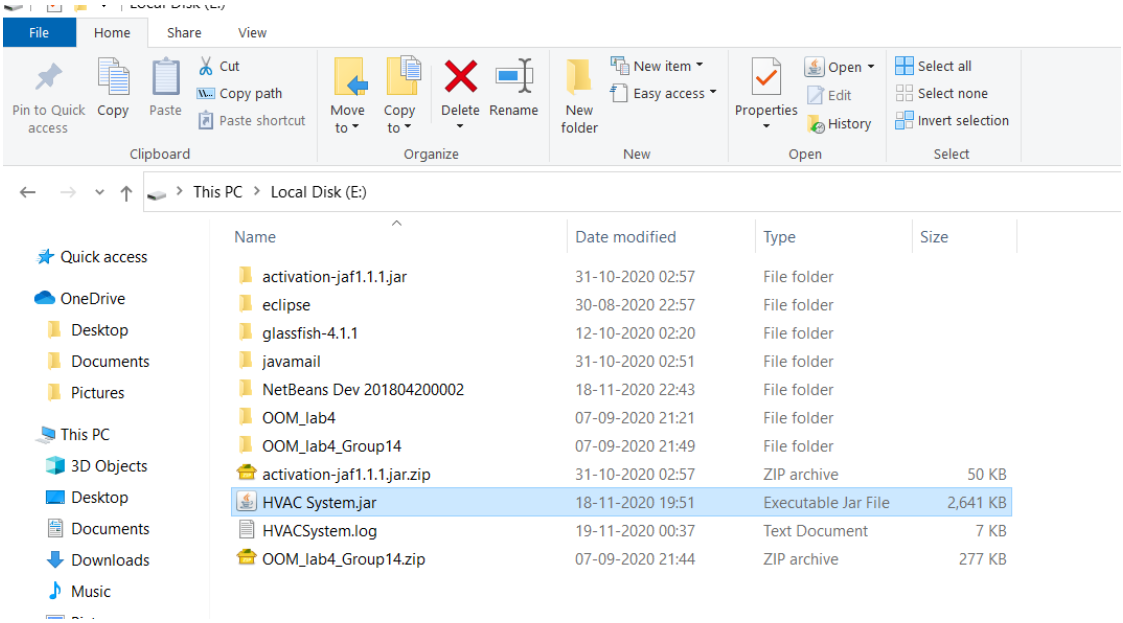
Current air quality index would be shown here in this panel. This air quality level would depend on the fan speed and exhaust speed as they are responsible for ventilating the room. It keeps changing periodically.



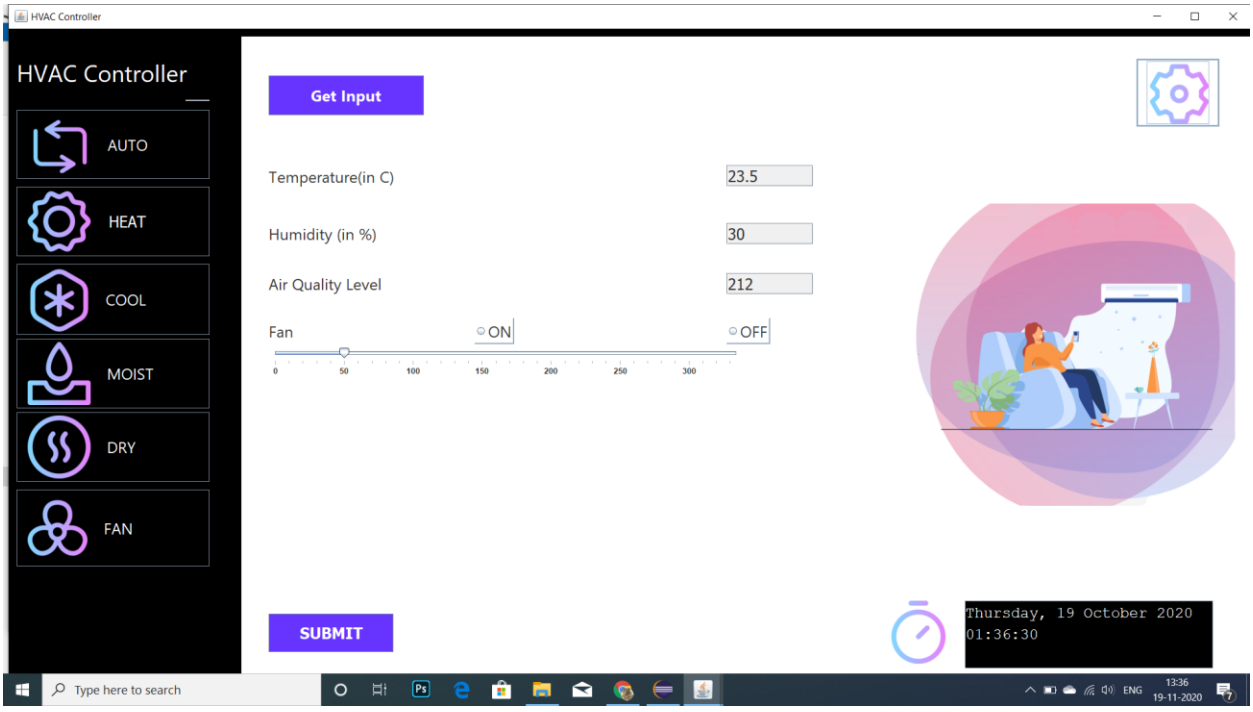
This panel would show the information about Ventilation System. It would show the information about exhaust speed and fan speed.

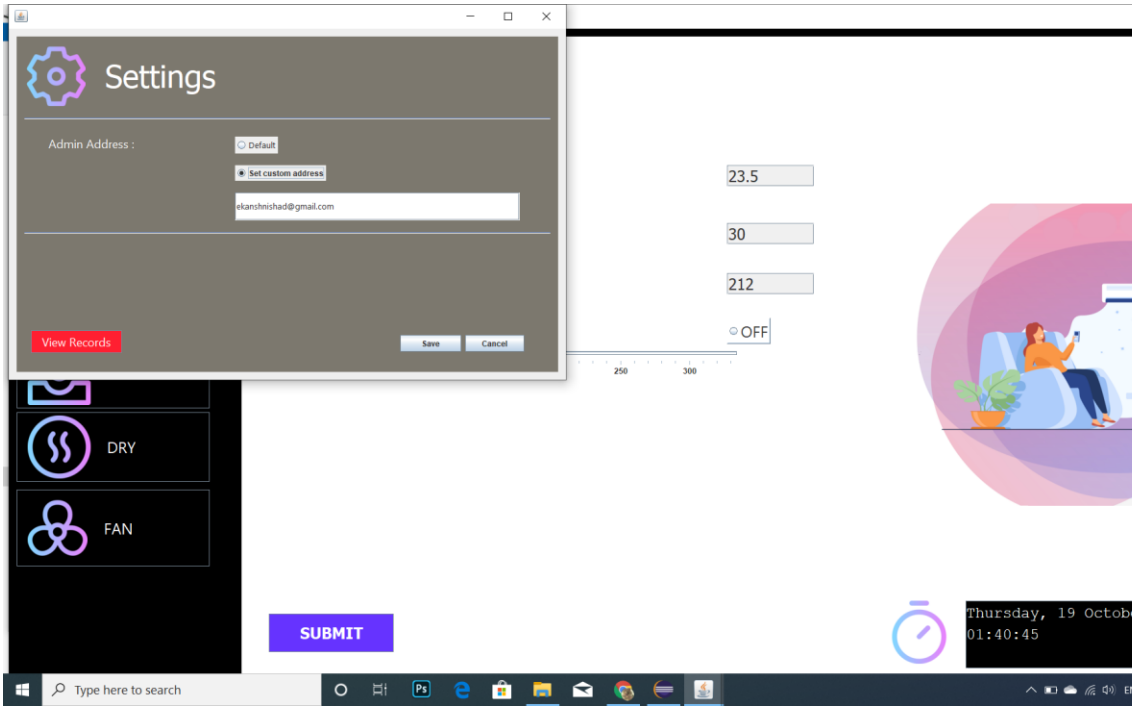
Instructions

1. First of all open the jar file by double clicking it. Make sure you have JRE 1.8 or above installed in your computer.

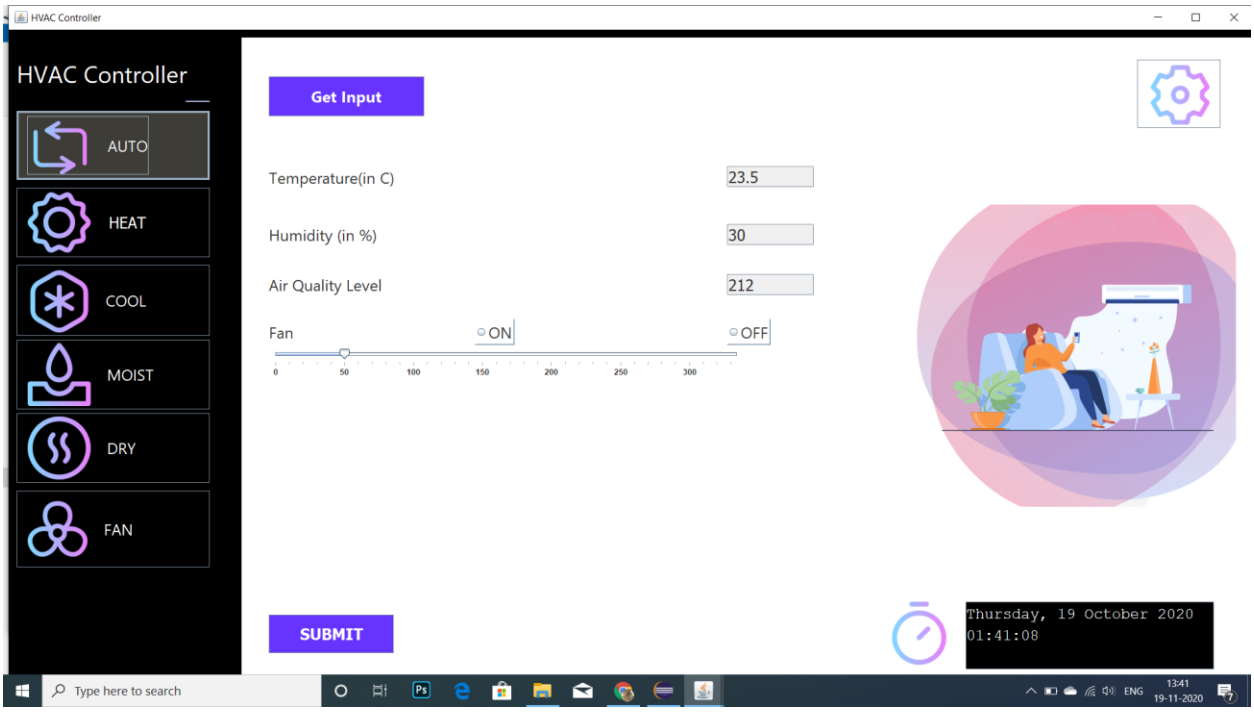


2. It would show 2 screens - Hvac Controller and Hvac Navigation.
3. In the Hvac Controller screen first select the settings button and set the custom admin address.



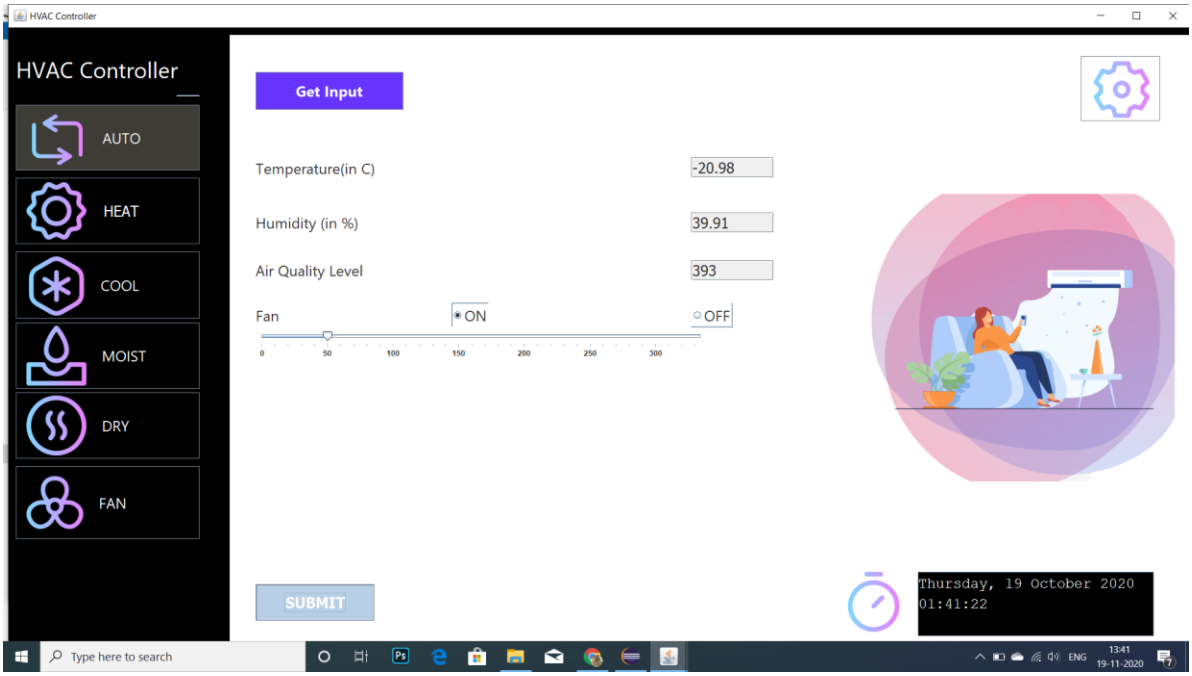


4. Now select the mode of the Hvac system in which you want to run.



5. Now you have 2 options you can either take input manually or use random no generator using Get Input Button. Note the mode should be selected before pressing Get Input Button.

6. Now set the Fan status and Fan speed and press the submit button. Note the submit button would work only if
    a. Temperature should be between -50 to 55 C
    b. Humidity should be between 0 to 100 %
    c. AQI level should be between 0 to 500.
    d. If any mode is selected
    e. Should have an active internet connection for sending email



7. Now move to the Hvac Navigation Screen here you would see all the configurations of the HVAC System based on the given set of Inputs.

References

- Derek Banas - UML 2.0
- Java Swing Tutorial - javatpoint
- How to send email using java
- Stack Overflow