OOM MINI-PROJECT
ATMOSPHERIC MANAGEMENT SYSTEM

Group Number: **7**

Group Members:

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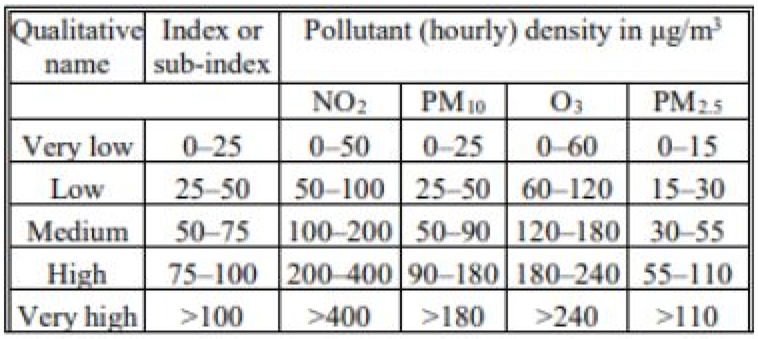
Problem Statement

To develop a GUI enabled air quality management system for IIITA campus. The system should be able to monitor the level of hazardous gases present in the environment (via means of random number generation). In an alarming situation the system must be able to generate alarm (also add auto generated message and mail system). Meanwhile, the system must also be capable of measuring the humidity and temperature present in the atmosphere. The code must also maintain the log record of previous days and a generate report button should be added to generate the report with the input given as range of timestamp or the whole record. Here is rough standard air quality measure:



Qualitative name	Index or sub-index	Pollutant (hourly) density in $\mu g/m^3$			
		NO_2	PM_{10}	O_3	$PM_{2.5}$
Very low	0–25	0–50	0–25	0–60	0–15
Low	25–50	50–100	25–50	60–120	15–30
Medium	50–75	100–200	50–90	120–180	30–55
High	75–100	200–400	90–180	180–240	55–110
Very high	>100	>400	>180	>240	>110

Air Quality Measures

Technologies Used:

Java, Java Swing/AWT

Required Functionality:

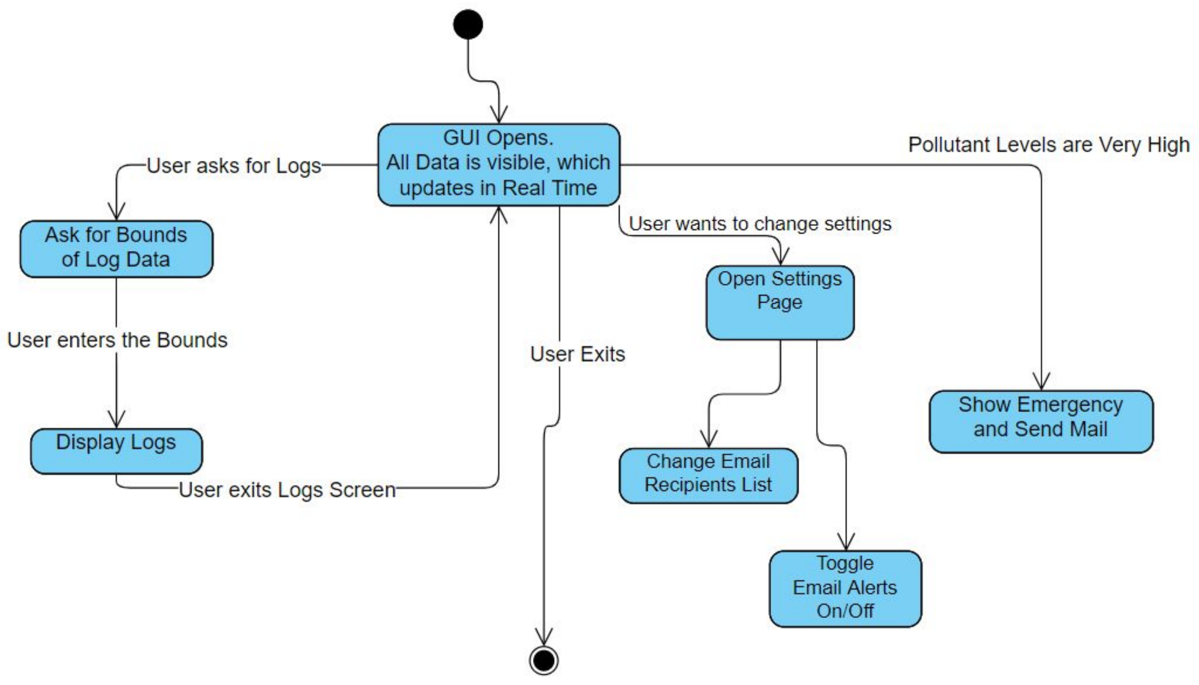
1. Main Screen: All air quality measures, pollutant levels, temperature and humidity is displayed and updated in real time.
2. Logs Screen: Generate log records of pollutant levels of previous days
3. Automatic Alerts: Email Alert when pollutant level is high.

Improvised Functionality Added:

1. Settings Screen: Change the mailing list for email alerts and also ability to toggle on/off the emails.

State Diagram

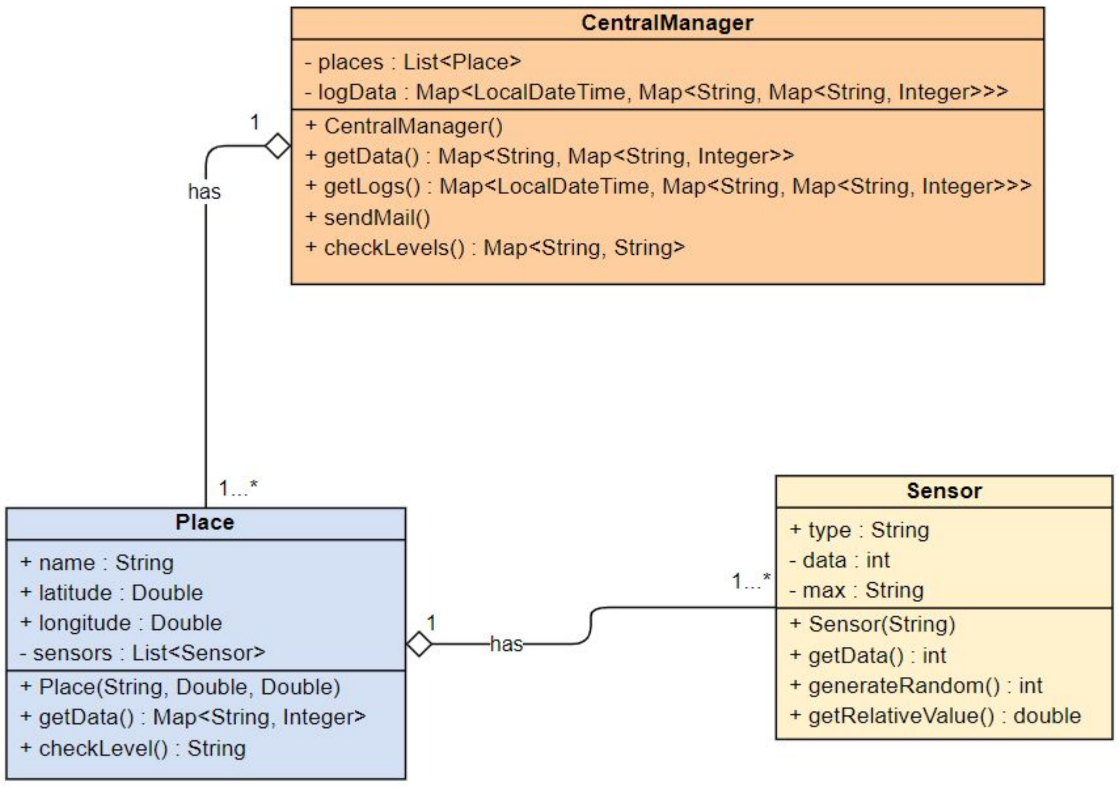
A State Diagram is a **behavioral** diagram which represents the behavior of a system or a part of a system using finite state transitions. The first state shows that the app opens and shows the levels of pollutants updating in real time. Now if the pollutants levels in the atmosphere are high, then the app shows an emergency and sends an Email to the admin. The user can also ask for logs details, where he is asked for bounds of the Log data required and once the user enters the Bounds then the app will display logs. The user can also open the settings page and change email recipients for emergency mails and can also toggle the emails off entirely.


GUI Opens.
All Data is visible, which updates in Real Time
User asks for Logs
Ask for Bounds of Log Data
User enters the Bounds
Display Logs
User exits Logs Screen
User Exits
User wants to change settings
Open Settings Page
Change Email Recipients List
Toggle Email Alerts On/Off
Pollutant Levels are Very High
Show Emergency and Send Mail

State Diagram

Class Diagram

The class diagram has appropriate structure to represent the classes, inheritance, relationships, and everything that OOPs have in its context. So here we have a class named CentralManager with attributes places and logData to store a list of places and log data. It has a default constructor for initializing the Places, checkLevels() to check the pollutants level in air and getData() and getLogs() that return data and logs , sendMail() to send a mail to admin on an emergency. CentralManager can manage one or more Place at a time. A Place class will have name, latitude, longitude and a list of sensors as its attributes. It has a constructor for initializing the Sensors. It also has the following functions: checkLevel() to check if pollutant level at the place is high or not,

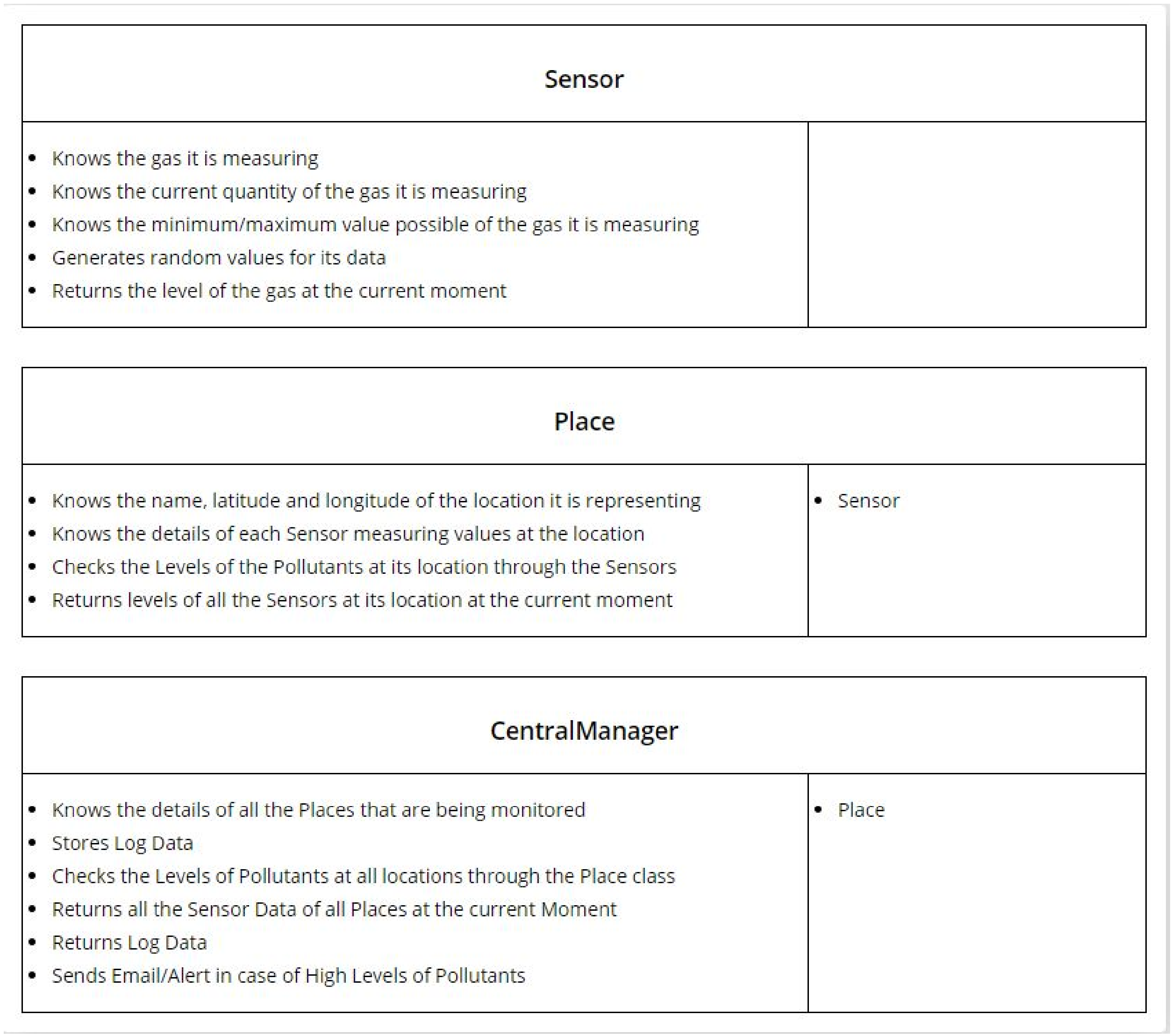

CentralManager
- places : List<Place>
- logData : Map<LocalDateTime, Map<String, Map<String, Integer>>>
+ CentralManager()
+ getData() : Map<String, Map<String, Integer>>
+ getLogs() : Map<LocalDateTime, Map<String, Map<String, Integer>>>
+ sendMail()
+ checkLevels() : Map<String, String>
1
has
1...*
Place
+ name : String
+ latitude : Double
+ longitude : Double
- sensors : List<Sensor>
+ Place(String, Double, Double)
+ getData() : Map<String, Integer>
+ checkLevel() : String
1
has
1...*
Sensor
+ type : String
- data : int
- max : String
+ Sensor(String)
+ getData() : int
+ generateRandom() : int
+ getRelativeValue() : double

Class Diagram

getData() to get pollutant levels at the place. Again a place can have one or more sensors to check different pollutant levels. The Sensor class has its type(what type of pollutant it will measure), data, min and max as its attributes. The constructor initializes the sensor type and min-max values, generateRandom() which will generate a random value of pollutant level and a getData() function that will return the data collected by the particular sensor.

CRC Diagram

CRC Diagram consists of some standard cards which represent the responsibilities and collaborators of each class. So, the first card shows the Sensor Class and all its responsibilities are listed in the left column of the card and the right column is empty which means the Sensor Class doesn’t require any other to fulfill its mentioned responsibilities. Then the next card shows the Place Class with its responsibilities mentioned in the left column and it needs to collaborate with the Sensor Class to get all of its responsibilities done and the last card shows the CentralManager Class with its responsibilities mentioned in the left column and CentralManager needs to collaborate with the Place class as it manages and stores details of all the Place instances.



Sensor	
• Knows the gas it is measuring • Knows the current quantity of the gas it is measuring • Knows the minimum/maximum value possible of the gas it is measuring • Generates random values for its data • Returns the level of the gas at the current moment	

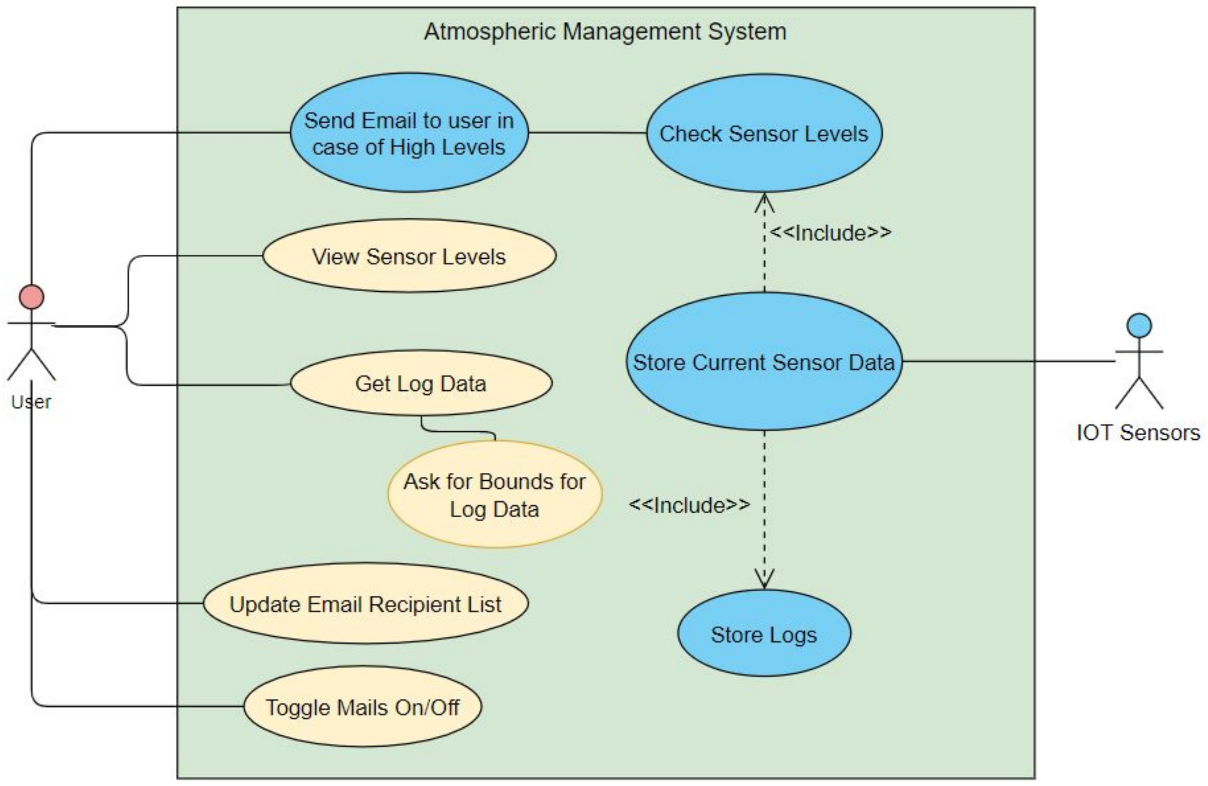
Place	
• Knows the name, latitude and longitude of the location it is representing • Knows the details of each Sensor measuring values at the location • Checks the Levels of the Pollutants at its location through the Sensors • Returns levels of all the Sensors at its location at the current moment	• Sensor

CentralManager	
• Knows the details of all the Places that are being monitored • Stores Log Data • Checks the Levels of Pollutants at all locations through the Place class • Returns all the Sensor Data of all Places at the current Moment • Returns Log Data • Sends Email/Alert in case of High Levels of Pollutants	• Place

CRC Diagram

Use Case Diagram

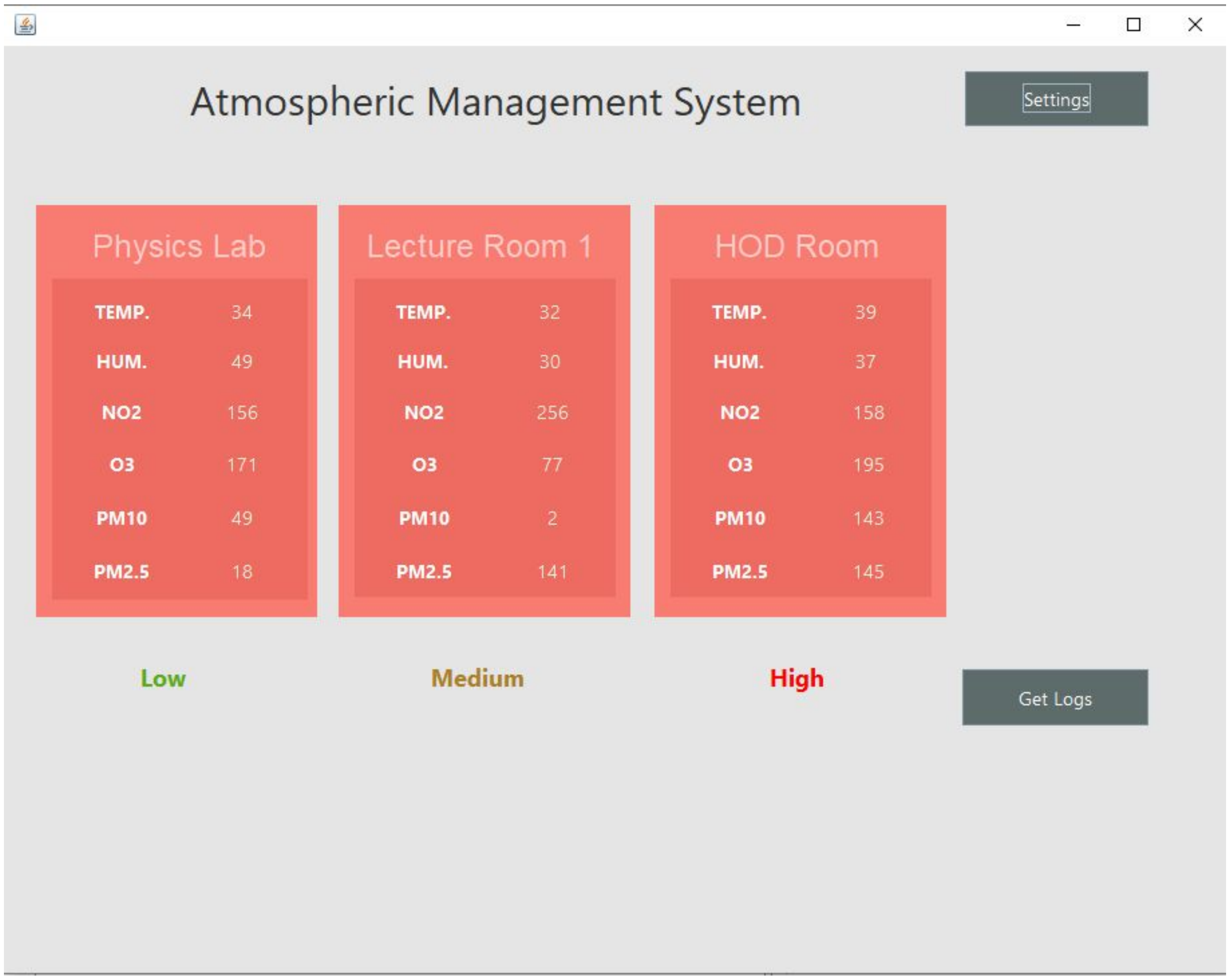
Use Case Diagram is used to represent the dynamic behavior of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. The user can view the sensor levels, get log data, update email recipients list, or toggle mails on/off. In the backend, the IOT Sensors(random number generation here) will generate the data, and the included functionality is that it checks the sensors levels and stores them as logs, it will also send an email alert when the pollutant levels are high.


Atmospheric Management System
Send Email to user in case of High Levels
Check Sensor Levels
View Sensor Levels
<<Include>>
Store Current Sensor Data
Get Log Data
User
IOT Sensors
Ask for Bounds for Log Data
<<Include>>
Update Email Recipient List
Store Logs
Toggle Mails On/Off

Use Case Diagram

App Walkthrough

This is the homescreen of our system. On the homescreen we display the level of different gases present in three different places of CC3 (Physics Lab, Lecture Room 1, HOD Room). In each card we display the level of hazardous gases in the particular place and also the temperature and humidity.. These values that are generated randomly are updated every 4 seconds in each card and according to the level of gases.



	Physics Lab	Lecture Room 1	HOD Room
TEMP.	34	32	39
HUM.	49	30	37
NO2	156	256	158
O3	171	77	195
PM10	49	2	143
PM2.5	18	141	145
	Low	Medium	High

Home Screen

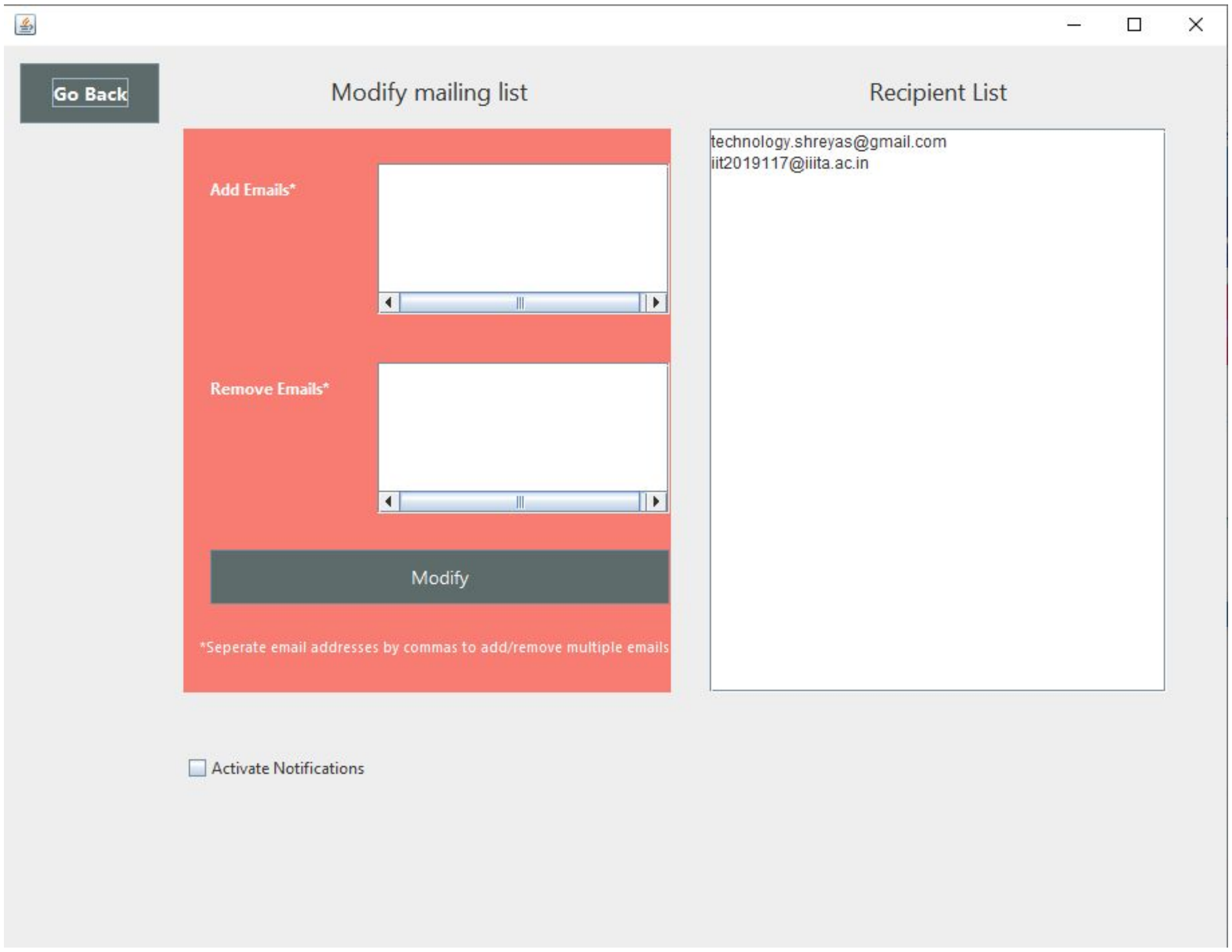
According to the relative levels of the pollutants, an AQI level is generated as Very Low, Low, Medium, High and Very High.

Accordingly, in the particular screenshot, it shows the pollutant level at the places as Low, Medium and High.

If the level is High or Very High an email is sent as an alert.

The home screen has buttons to get the logs, or to access the settings.

If we click the Settings button, the Settings screen is displayed.

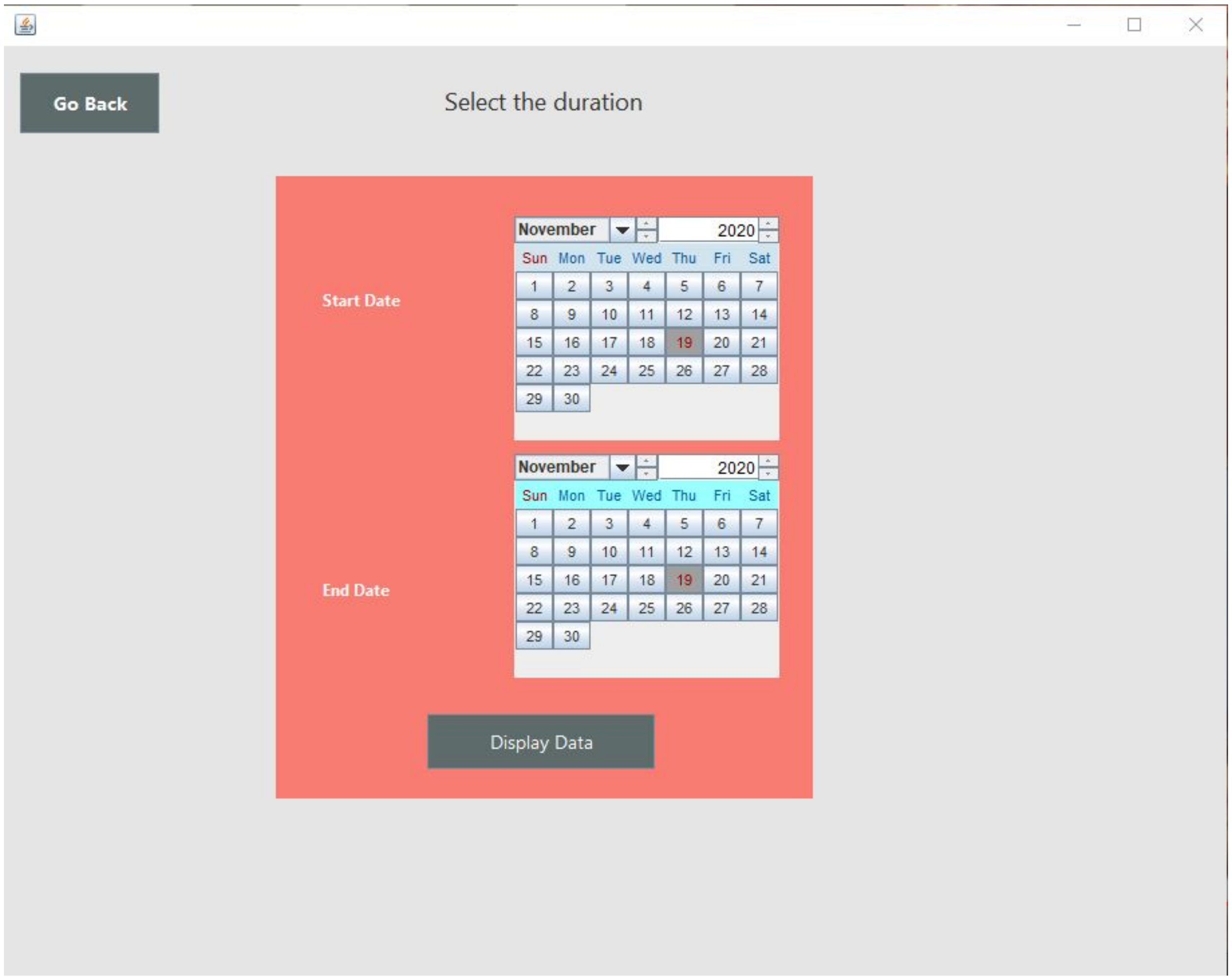


technology.shreyas@gmail.com
iit2019117@iiita.ac.in

Settings Screen

In the Settings Screen, the mailing list is displayed and emails from the list can be added or removed. This mailing list is used to determine who will get the email alerts in case of high pollutant level.
The active notifications checkbox is present to toggle the alert mails on or off. If the box is unchecked the high alert mail would not be sent. This is added to prevent spamming of inbox with alert mails.
We can always go back to our home screen by pressing the Go Back button.

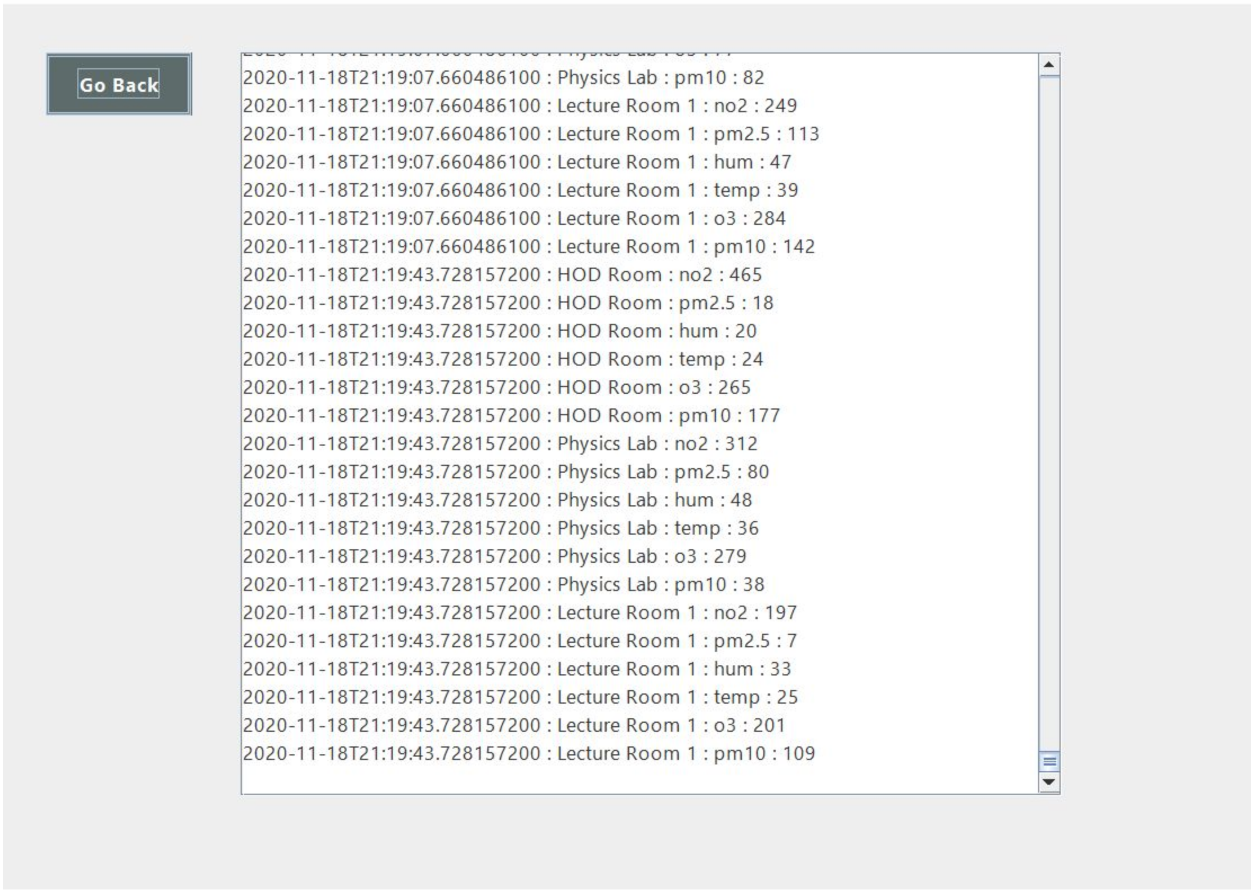
If we click on the Get Logs button from the homescreen, the Select Logs Duration Screen opens up.



Select Logs Duration Screen

Here we have to decide for what duration we want our logs to be shown. We have to select the start and the end date and click on the display data option. Also just to note, while testing, we need to mention the dates of 18 as start, and 20 as end to get the logs for 19. So, Start and End Date are not included in the Log Data, only dates in between. We can also always go back to the Home Screen by clicking the Go Back button.

When we click Display Data after selecting the bounds, the Logs screen is displayed.

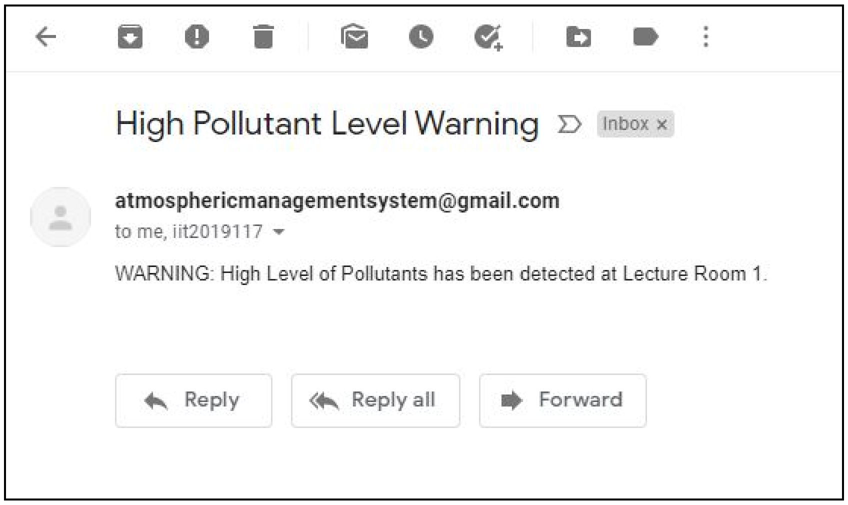


```
2020-11-18T21:19:07.660486100 : Physics Lab : pm10 : 82
2020-11-18T21:19:07.660486100 : Lecture Room 1 : no2 : 249
2020-11-18T21:19:07.660486100 : Lecture Room 1 : pm2.5 : 113
2020-11-18T21:19:07.660486100 : Lecture Room 1 : hum : 47
2020-11-18T21:19:07.660486100 : Lecture Room 1 : temp : 39
2020-11-18T21:19:07.660486100 : Lecture Room 1 : o3 : 284
2020-11-18T21:19:07.660486100 : Lecture Room 1 : pm10 : 142
2020-11-18T21:19:43.728157200 : HOD Room : no2 : 465
2020-11-18T21:19:43.728157200 : HOD Room : pm2.5 : 18
2020-11-18T21:19:43.728157200 : HOD Room : hum : 20
2020-11-18T21:19:43.728157200 : HOD Room : temp : 24
2020-11-18T21:19:43.728157200 : HOD Room : o3 : 265
2020-11-18T21:19:43.728157200 : HOD Room : pm10 : 177
2020-11-18T21:19:43.728157200 : Physics Lab : no2 : 312
2020-11-18T21:19:43.728157200 : Physics Lab : pm2.5 : 80
2020-11-18T21:19:43.728157200 : Physics Lab : hum : 48
2020-11-18T21:19:43.728157200 : Physics Lab : temp : 36
2020-11-18T21:19:43.728157200 : Physics Lab : o3 : 279
2020-11-18T21:19:43.728157200 : Physics Lab : pm10 : 38
2020-11-18T21:19:43.728157200 : Lecture Room 1 : no2 : 197
2020-11-18T21:19:43.728157200 : Lecture Room 1 : pm2.5 : 7
2020-11-18T21:19:43.728157200 : Lecture Room 1 : hum : 33
2020-11-18T21:19:43.728157200 : Lecture Room 1 : temp : 25
2020-11-18T21:19:43.728157200 : Lecture Room 1 : o3 : 201
2020-11-18T21:19:43.728157200 : Lecture Room 1 : pm10 : 109
```

Logs Screen

The logs will give the exact details, so what was the level of each pollutant at a place with an exact timestamp.

Also, here is a sample mail that is sent in case of emergency:



High Pollutant Level Warning

atmosphericmanagementsystem@gmail.com
to me, iit2019117

WARNING: High Level of Pollutants has been detected at Lecture Room 1.

Sample Mail