AIR QUALITY ANALYSIS AND PREDICTION OF LOCAL AREA
BY

MD. SAZZAD HOSSAIN RUME
ID: 162-15-7678

MD. RAKIB HASAN
ID: 161-15-6947

This Report Dedicated in Deteriorative Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By
Md.Sazzadur Ahamed
Senior Lecturer
Department of CSE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

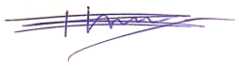
DHAKA, BANGLADESH

January-2021

APPROVAL

This Project/internship titled **"AIR QUALITY ANALYSIS AND PREDICTION OF LOCAL AREA"** submitted by Md. Rakib Hasan, Md. Sazzad Hosain Rume ID No: 161-15-6947, 162-15-7678 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 31 January 2021.

BOARD OF EXAMINERS



Dr. Touhid Bhuiyan — **Chairman**
Professor and Head
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Md. Sadekur Rahman — **Internal Examiner**
Assistant Professor
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Rubaiya Hafiz — **Internal Examiner**
Senior Lecturer
Department of Computer Science and Engineering
Faculty of Science & Information Technology
Daffodil International University

Dr. Shamim H Ripon — **External Examiner**
Professor
Department of Computer Science and Engineering
East West University

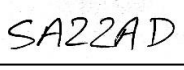
DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Md. Sazzadur Ahamed, Senior Lecturer Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

Md. Sazzadur Ahamed
Senior Lecturer Department of CSE
Daffodil International University

Submitted by:



Md. Sazzad Hossain Rume
ID: 162-15-7678
Department of CSE
Daffodil International University

Md. Rakib Hasan
ID: 161-15-6947
Department of CSE
Daffodil International University

ACKNOWLEDGEMENT

Alhumdulillah for everything, first we want to express my heartiest thanks and gratefulness to almighty Allah for His holy blessing makes me possible to complete the final year project successfully.

We really grateful and wish my profound my compulsion to **Md. Sazzadur Ahamed, Senior Lecturer**, Department of CSE Daffodil International University, Dhaka. Profound Knowledge and sharp fascination of my supervisor in the active learning model plan impacted to do this task. His infinite tolerance, chivalrous direction, persistent consolation, significant guidance, consistent and lively management, productive analysis, perusing numerous mediocre draft and amending them at all stage have made it conceivable to finish this project.

We might want to express our heartiest thanks to Professor Dr. Yousuf Mahbubul Islam, Honorable Vice Chancellor and to Dr. Sayed Akhter Hossain, Professor and Head, Department of CSE, for their benevolent assistance to complete our project and furthermore to other faculty members and the staffs of CSE department of Daffodil International University.

We might want to thank our exhausted course mate in Daffodil International University, who partook in this discuss while finishing the course work. At long last we should recognize with due regard the constant help and patients of our parents.

ABSTRACT

Currently, in many industrial and urban area of Bangladesh, analyzing and predicting air quality has become one of the most essential activities. The nature of air is favorably influenced due to Different types of pollution caused by transportation, power, fuel utilizes and so on. The testimony of hurtful gases is making a genuine danger for the quality of life in smart cities. With expanding air pollution, we need to implement proficient air quality analyzing and predicting models which gather data about the convergence of air poisons and give evaluation of air pollution in every zone. In this paper, we utilize a famous machine learning technique, to figure pollutant and particulate levels and to predict and analysis the air quality. The quality of air is influenced by multi-dimensional components including area, time, and uncertain factors. The aim of this paper is to investigate various machine learning based techniques for air quality analyzing and prediction.

Air quality is surveyed dependent on a banding framework which gauges the degrees of poisons, specifically Ozone (O3), Nitrogen dioxide (NO2) and Particulate issue - PM10 and PM2.5. The general air quality list at a specific time is given as the greatest band for any poison. PM2.5 is fine particulate matter of size under 2.5 micrometers and is considered to impact sly affect wellbeing going from cellular breakdown in the lungs to cardiovascular illnesses.

This project intends to predict the air quality band for PM2.5 utilizing present and authentic contamination information in blend with predicted air information which is promptly accessible. To tackle this issue, initially, exploratory information investigation will be directed on accessible air and pollution datasets to find the relationship between various highlights. Subsequent to utilizing appropriate information cleaning and highlight designing strategies dependent on the perceptions made, the practicality of utilizing different Machine Learning procedures, for example, LSTM will be investigated.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1
INTRODUCTION

1.1 Introduction

Air is quite possibly the most basic common assets for the presence and survival of the whole life on this planet. All types of life including plants and creatures rely upon air for their fundamental endurance. In this way, all living creatures require great quality of air which is free of harmful gases to proceed with their life. The increasing population, its automobiles and industries are polluting all the air at a disturbing rate. Air pollution can cause long-term and short-term wellbeing impacts. We are going to be able to collect real time data to analysis the current air quality and related information about it. We are also going to apply LSTM on an existing dataset to understand the overall air quality condition of the city and we will be able to predict or compare data between different times.

Air is one essence of our life. So ensuring the quality of air is greatly important. In recent years, global warming is pushing the air quality into hazard. Especially in the Asian region where most of the world population lives. Bangladesh is also a victim of this situation as well. Dhaka is the most affected by this situation. The air quality of the Dhaka is constantly beyond the normal or healthy air quality measuring values. So we wanted to help with our project to get a better understanding of our air quality and take preparation to avoid health hazard issues in future as much as possible.

1.2 Motivation:

- Our mission is to beware people about the dangerous effect of polluted air.
- User's will be able to monitor the real-time air quality of current location and will be able to compare data between different times.
- This system will be able to analysis the air quality of our local area and get better understanding of it now and for future.

1.3 Objectives of the system

- To create a whole easy to use service-based application and site whose essential need is to fulfill client's assumptions.
- The act of utilization of **air quality analysis and prediction of local area** by the most single user all over the Bangladesh.
- We want to learn about our local air quality so that we can take necessary steps to protect our health.

1.4 Expected Outcomes

- It will be conceivable to get services at a short time with low exertion.
- As, people can be able to monitor the current air quality, people will be able to take Necessary steps to visiting the location.
- Future air quality can be predicted.

1.5 Layout of Report

Chapter 1: Introduction

In this section we have referenced with respect to the motivation, objectives and furthermore the expected outcomes for this system.

Chapter 2: Background

We have spoken about our project foundation in this piece of our task report. We will in general conjointly raise the associated work, equilibrium to elective examinee technique, and the extent of the issue and difficulties of the project.

Chapter 3: Requirement Specification

This section of our project report we are going to with respect to all the necessities like information stream outline, prerequisites and analysis gather, use case model of our project and the statement of use case, the logical relational database model and hence the style needs for our project.

Chapter 4: Design Specification

That portion of our project report we discus all out style of our system as example Front-end design, cooperation plan and the epitome requested. Every one of that things are significant for our project.

Chapter 5: Conclusion and Future Scope

In the section of our project report we have viewed the completion and talk about our project future advancement much need about this system update.

CHAPTER 2
BACKGROUND

2.1 Introduction

The thought behind the proposed online application is to develop reliable, vigorous and user– friendly system that permits Users to monitor air quality from any area as his/her prerequisite, for required area and in any of the chose urban cities in Bangladesh. This service will accommodated each individual people who need to know about the current air quality.

Here we are getting access to the real time data of the air quality of Dhaka city. The pm2.5 and also other important particles in the air that show the quality of the air. We are trying to analyze the data and make it more refined and visualize it to the general user to understand it more graphically to grasp the overall understanding of the situation. We are also using some maps and graphs to locate the area in the globe to give the visual location.

2.2 Comparative Studies

Our python online application and site is disparate from the live any remaining website's. Each individual people will have the option to get a wide range of air data by utilizing our websites. The proposed air quality analysis and prediction system upkeep is simpler for clients. It isn't delay process; it is exceptionally quicker system and easy to use. Clients effectively enlistment and make her/his profile, login, and see the updates. This online system gives the amount of each component of air. Users will be able to understand the current quality of air by a notification.

2.3 Scope of this project

- It is an open spot where individuals can join and observe the air updates.
- In this system where all users can interact with us.
- Users will be able to get access easily.
- Users will be able to see the future’s probable air quality.
- Users can easily find deference between different times air quality.

2.4 Challenges

- Admin has to maintain a huge dataset.
- Collecting dataset is a big challenge for this project.
- Input will be taken from the environment and give the real-time update of the air quality.
- Need a huge dataset to predict accurately the future air quality.
- Google map API access is a significant challenge.

2.5 Schedule of Time

Table 2.1: Description of Time Period.

Description	**Time Length**
Requirement Analysis	1 Month
Collecting Requirements	2.5 Months
Implementation Period	3 Months
Testing Period	1 Month
Total Time	**7.5 Months**

CHAPTER 3
SPECIFICATION OF REQUIREMENTS

3.1 Air Quality Analysis and Prediction of Local Area's Action Method

A processing model was made by us for our project. By that we can be able to understand the entire method of our Air Quality Analysis and Prediction of Local Area System. Here two part, one is real time analysis and the another is existing data analysis. In the real time analysis part data will be get through API and then the data will exacting through different algorithm. Then the data will be separated into different important part to analysis the air quality. Then finally those data will be plotted into a map. In the existing data analysis part, data will be clean first and the useful columns will be remain for the analysis. Then we will apply LSTM algorithm and train the data, after training we will be able to compare the air quality in different times.

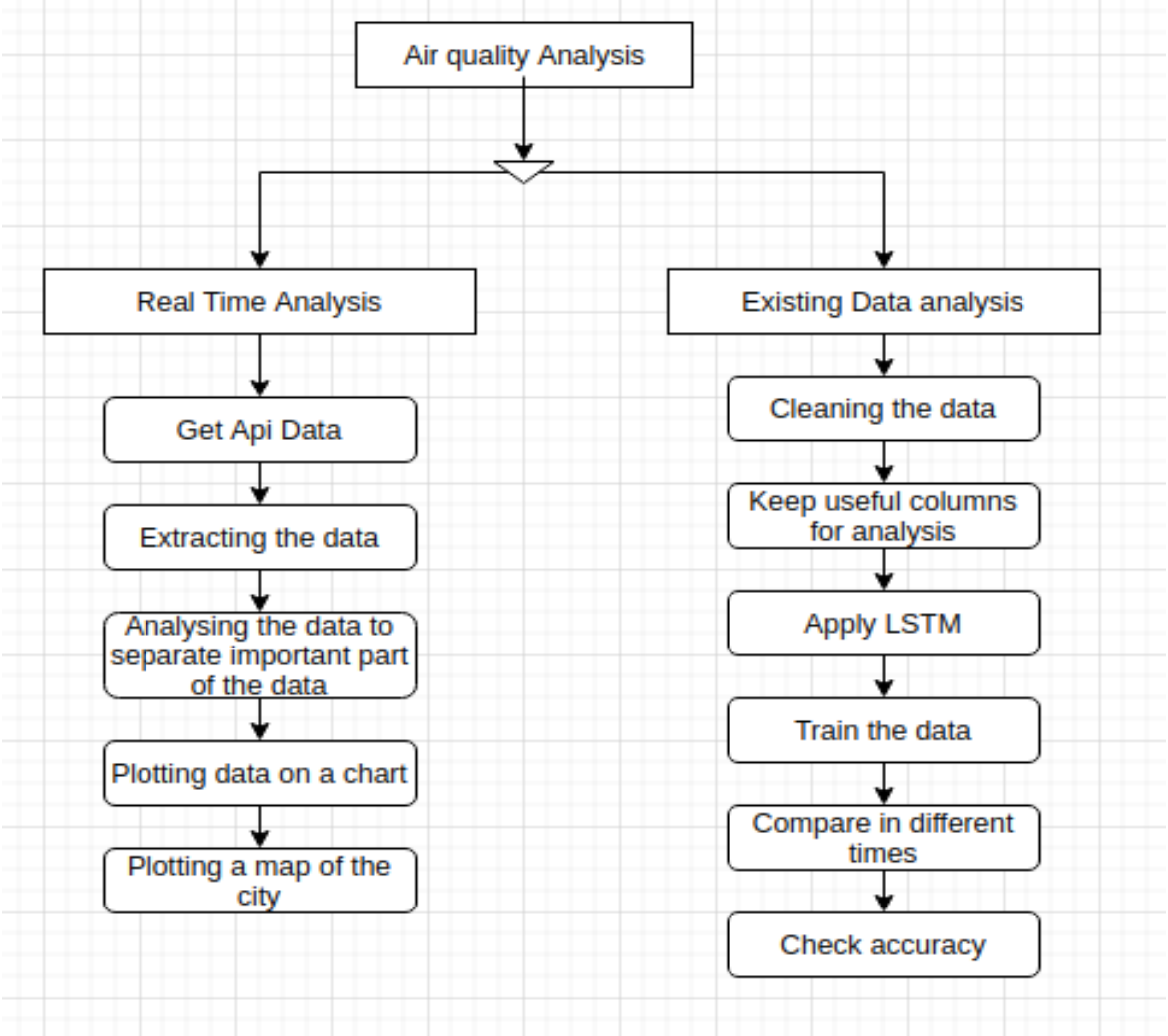


Figure 3.1: Air Quality Analysis and Prediction of Local Area's work process

3.2 Collection and Analysis of Requirement

Here we explain about how we gather requirements for out project and how we apply that requirements all through spot in our system.

- Need a heavy dataset of previous air quality.
- Need to ready the dataset to run on LSTM algorithm.
- View the quantity of every elements of the air individually.
- Admin need to have access to add or delete.
- Being user friendly is one of the most priority.
- User can see the air quality as Good, Average & Poor on the basis of pollution quantity.
- System will be able to sense the real-time data and give the prediction.
- Will be able to predict future air quality on the basis of previous dataset.

3.3 Use Case Modeling

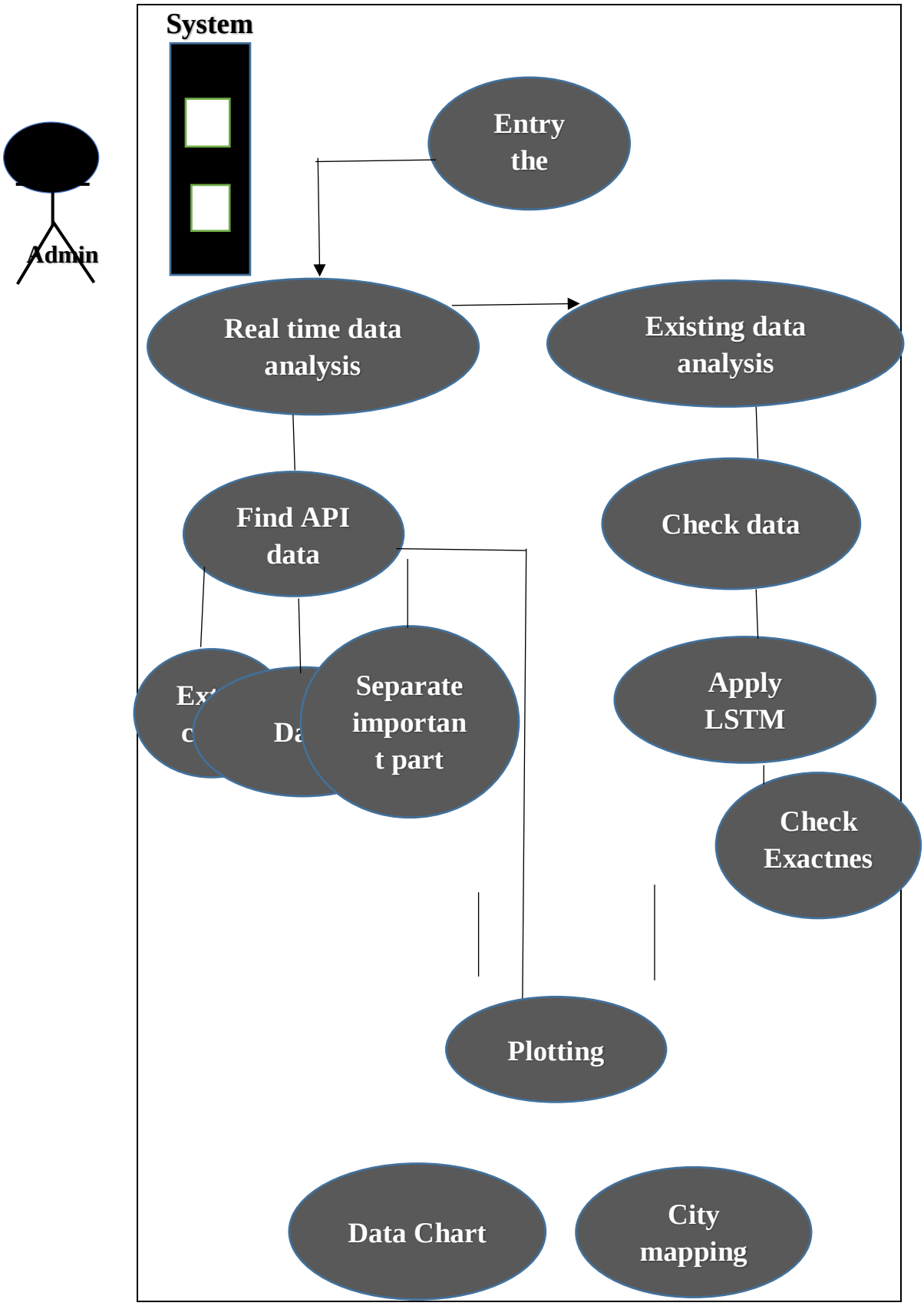


Figure 3.2: Use Case Model Diagram

CHAPTER 4
DESIGN SPECIFICATION

4.1 Front-end Design

The Front-end style is that the delineation of a PC code. This can be the methodology of connection approach between the clients and consequently the workers. Front-end style is thought as a customer side turn of events. Inside the most aspect of a PC code advancement the principal crucial half is to style the front-end. We tend to make a simple front-end style for the clients to co-work with the PC code basically. Here are some front-end style of our PC code given below.

4.2 Real-Time Data Fetching

Air contamination is one among the extraordinary enemies among recent memory. In 2015, contaminated air was in control of six.4 million passing round the world: two.8 million from family air contamination and four.2 million from encompassing (outside) air contamination. Info from that year shows that air contamination overall caused:

19% of each vessel dying

24% of ischemic coronary health problem passing's

21% of stroke passing's

23% of cellular breakdown within the lungs passing's

Also, outside air pollution has all the earmarks of being a major danger issue for neurodevelopmental messes in children and neurodegenerative sicknesses in grown-ups.

With the monetary, ecologic and human price air contamination takes, estimating innovation is associate degree inexorably vital enterprise.

In this part the real-time data will be fetch from the API. Here is a sample of fetching data.

```
[ ] {'aqi': 228,
 'attributions': [{'name': 'World Meteorological Organization - surface synoptic observations (WMO-SYNOP)',
   'url': 'http://worldweather.wmo.int'},
  {'logo': 'US-StateDepartment.png',
   'name': 'Dhaka Air Quality Monitor - US Consulate',
   'url': 'http://bd.usembassy.gov'},
  {'name': 'World Air Quality Index Project', 'url': 'https://waqi.info/'}],
 'city': {'geo': [23.796373, 90.424614],
  'name': 'Dhaka US Consulate, Bangladesh',
  'url': 'https://aqicn.org/city/bangladesh/dhaka/us-consulate'},
 'debug': {'sync': '2020-12-28T18:03:07+09:00'},
 'dominentpol': 'pm25',
 'forecast': {'daily': {'o3': [{'avg': 45,
     'day': '2020-12-26',
     'max': 93,
     'min': 29},
    {'avg': 39, 'day': '2020-12-27', 'max': 82, 'min': 26},
    {'avg': 43, 'day': '2020-12-28', 'max': 90, 'min': 31},
    {'avg': 42, 'day': '2020-12-29', 'max': 84, 'min': 31},
    {'avg': 40, 'day': '2020-12-30', 'max': 71, 'min': 26},
    {'avg': 37, 'day': '2020-12-31', 'max': 76, 'min': 23},
    {'avg': 36, 'day': '2021-01-01', 'max': 36, 'min': 24}],
   'pm10': [{'avg': 62, 'day': '2020-12-26', 'max': 72, 'min': 53},
    {'avg': 54, 'day': '2020-12-27', 'max': 57, 'min': 45},
    {'avg': 54, 'day': '2020-12-28', 'max': 57, 'min': 45},
    {'avg': 56, 'day': '2020-12-29', 'max': 57, 'min': 48},
    {'avg': 52, 'day': '2020-12-30', 'max': 57, 'min': 45},
    {'avg': 56, 'day': '2020-12-31', 'max': 57, 'min': 48},
    {'avg': 58, 'day': '2021-01-01', 'max': 62, 'min': 54},
    {'avg': 61, 'day': '2021-01-02', 'max': 72, 'min': 48},
    {'avg': 58, 'day': '2021-01-03', 'max': 65, 'min': 48}],
   'pm25': [{'avg': 161, 'day': '2020-12-26', 'max': 171, 'min': 144},
```


Figure 4.1: Real-time data fetching 1


```
   'pm25': [{'avg': 161, 'day': '2020-12-26', 'max': 171, 'min': 144},
    {'avg': 153, 'day': '2020-12-27', 'max': 158, 'min': 137},
    {'avg': 153, 'day': '2020-12-28', 'max': 158, 'min': 137},
    {'avg': 153, 'day': '2020-12-29', 'max': 158, 'min': 137},
    {'avg': 149, 'day': '2020-12-30', 'max': 158, 'min': 137},
    {'avg': 155, 'day': '2020-12-31', 'max': 158, 'min': 139},
    {'avg': 152, 'day': '2021-01-01', 'max': 158, 'min': 137},
    {'avg': 157, 'day': '2021-01-02', 'max': 158, 'min': 137},
    {'avg': 154, 'day': '2021-01-03', 'max': 158, 'min': 138}],
   'uvi': [{'avg': 1, 'day': '2020-12-26', 'max': 4, 'min': 0},
    {'avg': 1, 'day': '2020-12-27', 'max': 4, 'min': 0},
    {'avg': 1, 'day': '2020-12-28', 'max': 4, 'min': 0},
    {'avg': 1, 'day': '2020-12-29', 'max': 5, 'min': 0},
    {'avg': 1, 'day': '2020-12-30', 'max': 5, 'min': 0},
    {'avg': 1, 'day': '2020-12-31', 'max': 5, 'min': 0},
    {'avg': 2, 'day': '2021-01-01', 'max': 5, 'min': 0}]}},
 'iaqi': {'dew': {'v': 14},
  'h': {'v': 53},
  'p': {'v': 1012},
  'pm25': {'v': 228},
  't': {'v': 24},
  'w': {'v': 3.6}},
 'idx': 8781,
 'time': {'iso': '2020-12-28T14:00:00+06:00',
  's': '2020-12-28 14:00:00',
  'tz': '+06:00',
  'v': 1609164000}}
```


Figure 4.2: Real-time data fetching 2

4.3 Necessary Elements Taken Of the Air

After fetching the real-time data from API it will separate the elements of the air which we need to predict the pollution level of the air. The data is collected from reliable online air quality measuring sites to get the precise and authentic data from the server. It contains a lot of data that can be used in various research and analysis. We are taking the particular ones that are important for our purpose of this project. It's basically our way of helping to understand the surrounding air quality so that we can take better safety measures for our own health and environment. The given pie chart is representing the amount of the elements of the air.

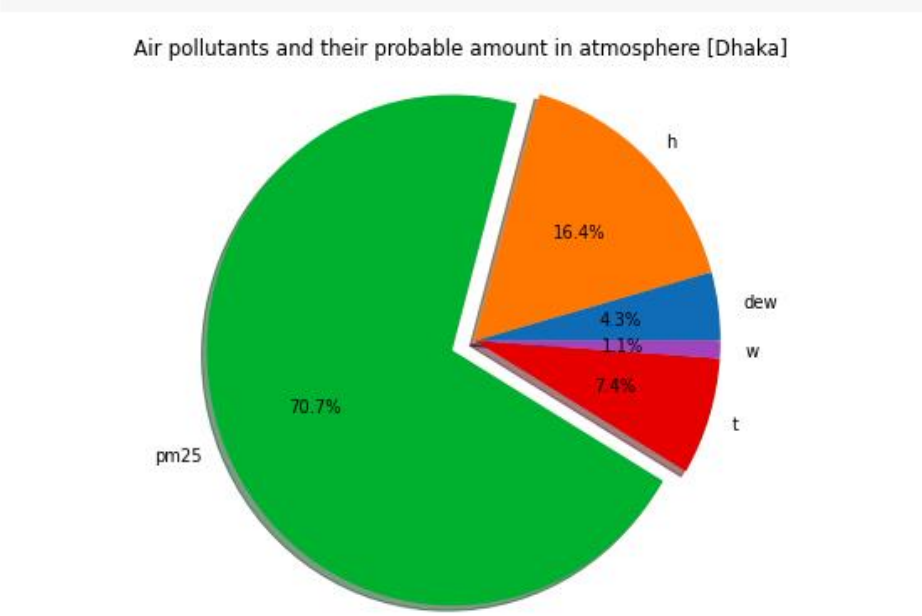


Figure 4.3: Pie chart of the elements of air

4.4 Locating City on World Map

In this part, the system will show you your current location. This part was one of the challenging task of this project. One sample is given below.

Plotting a map of the city

```
[ ]  import cartopy.crs as ccrs

     geo = data['city']['geo']

     fig = plt.figure(figsize=(10,8))
     ax = plt.axes(projection=ccrs.PlateCarree())
     ax.stock_img()

     plt.scatter(geo[1],geo[0],color='blue')
     plt.text(geo[1] + 3,geo[0]-2,f'{city} AQI \n    {aqi}',color='red')

     plt.show()
```

Figure 4.4: Location Mapping

4.5 Dataset

We have also collected a dataset to apply our algorithm on it to grasp the deeper understanding of the data and analyze it thoroughly. That's our first step to get into it. Then we have eliminated the unnecessary columns that are not important for our analysis. We have tried to train the model as much as we can to get the precise and optimized data. We have applied LSTM and RNN partially to train the dataset and finding the pattern of the data to get the understanding of it clearly. Also to get the prediction of it in any given time in future. Those are all in our consideration to get the pattern in the data. Here we use a huge dataset to run the algorithm. Here is a sample of our dataset.

```
[ ]  import pandas as pd


     csv_path = 'dhaka-air-quality.csv'

     df = pd.read_csv(csv_path)
     df = df.head(50)
     print(df)
```

	date	pm25	pm10	o3	no2	so2	co
0	2020/4/1	122		23	4	6	
1	2020/4/2	97		27	3	7	
2	2020/4/3	67		28	3	7	
3	2020/4/4	91					
4	2020/4/6	99		24	3	8	
5	2020/4/7	107		25	4	4	
6	2020/4/8	93		29	3	4	
7	2020/4/9	86		31	8	11	
8	2020/4/10	111		31	16	10	
9	2020/4/11	145		26	8	8	
10	2020/4/12	116		28	12	16	
11	2020/4/13	121		31	11	9	
12	2020/4/14	136		12	12	10	
13	2020/4/15	151					
14	2020/3/1	112		24	23	4	
15	2020/3/2	146		5	42	6	
16	2020/3/3	167		24	23	7	
17	2020/3/4	153		22	14	4	
18	2020/3/5	134		20	13	4	
19	2020/3/6	129		20	13	3	

Figure 4.5: Sample Dataset

4.6 Training Data

We have applied LSTM and RNN somewhat to train the dataset and finding the example of the information to get the comprehension of it clearly. Here we giving some document to understand the training and testing dataset process clearly.

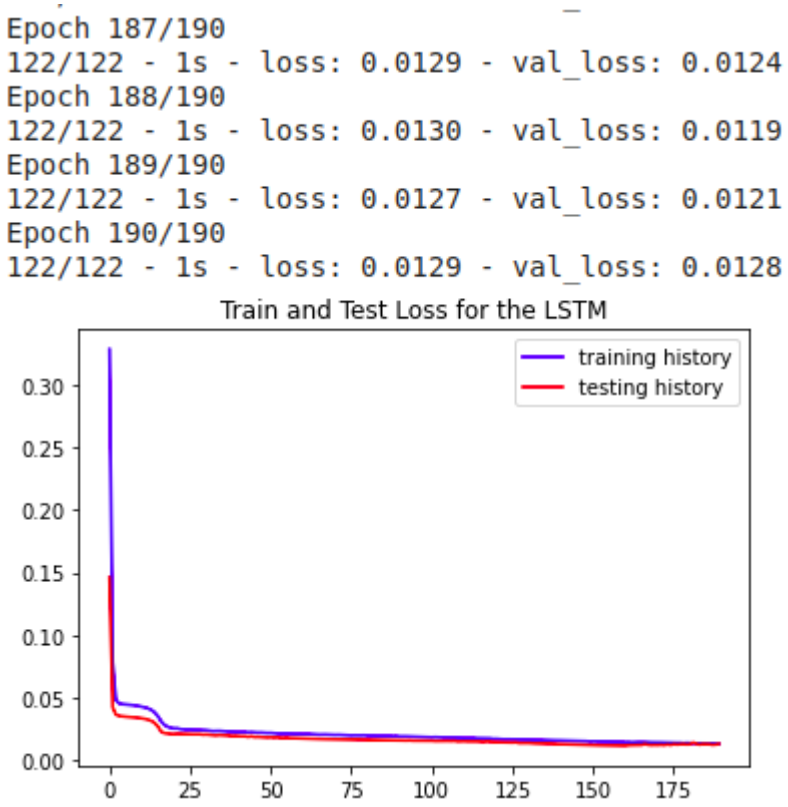


Figure 4.6: Training Data 1

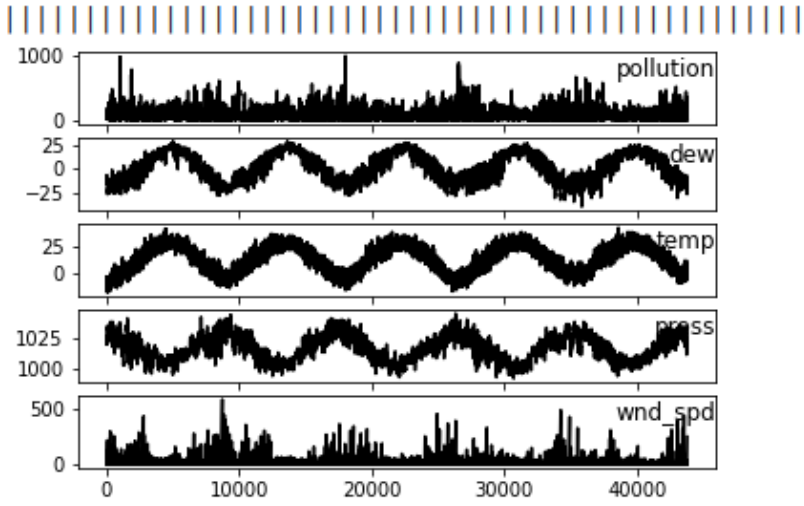


Figure 4.7: Training Data 2

4.7 Comparison between Different Times Air Quality

Recently we are facing serious air issues in Dhaka. Mask is essential for our daily life. When we started the project, the world was in a different time. We were trying to collect the data from local authorities. And then all of a sudden a global pandemic happened and that affected everything heavily. Lockdown was implemented in every part of the world and surprisingly the air quality of the world became better and better within weeks. That was astonishing. So it gave us the understanding that air quality is not the fault of global warming or something like that. It's us. We humans are causing all these air quality issues. We burn, cut trees. Clearing forest to make urban cities. This one sided development mind is costing us heavily in the long run.

Anyway, after a month after lockdown, air quality drastically improved all over the world. Seemed like the world was at peace after a long long time. However, after the lockdown was revoked, within days, pm values became higher and higher, at some point it's unbreathable in some parts of the world. That's unbelievable!

We have collected data. Then cleaned the data for our project. We have tried our way to help yourself to be aware of our environment and air quality which is a greatly underappreciated topic.

Our algorithm will find the pattern of air quality in time and try to forecast air with quality in a given time. With more training we have tried to increase the quality of our project with less errors.

Like decisive climate, there area unit models to anticipate levels of air pollution and air quality. There area unit several conjecture models that need additional elaboration than climate gauge models. These models area unit numerical recreations of however mobile pollutions scatter noticeable all around.

Air pollution happens once the encircling air contains gases, residue, vapor or smells in sufficiently high amounts to be unsafe to the soundness of individuals and creatures or enough to create damage plants and materials.

Here we are attaching some documents to understand the different times air quality analysis and prediction and effects of air pollution.

Figure 4.8: Effects of Air Pollution 1

Figure 4.9: Effects of Air Pollution 2

Difference between before lockdown and after lockdown of air quality is given below.

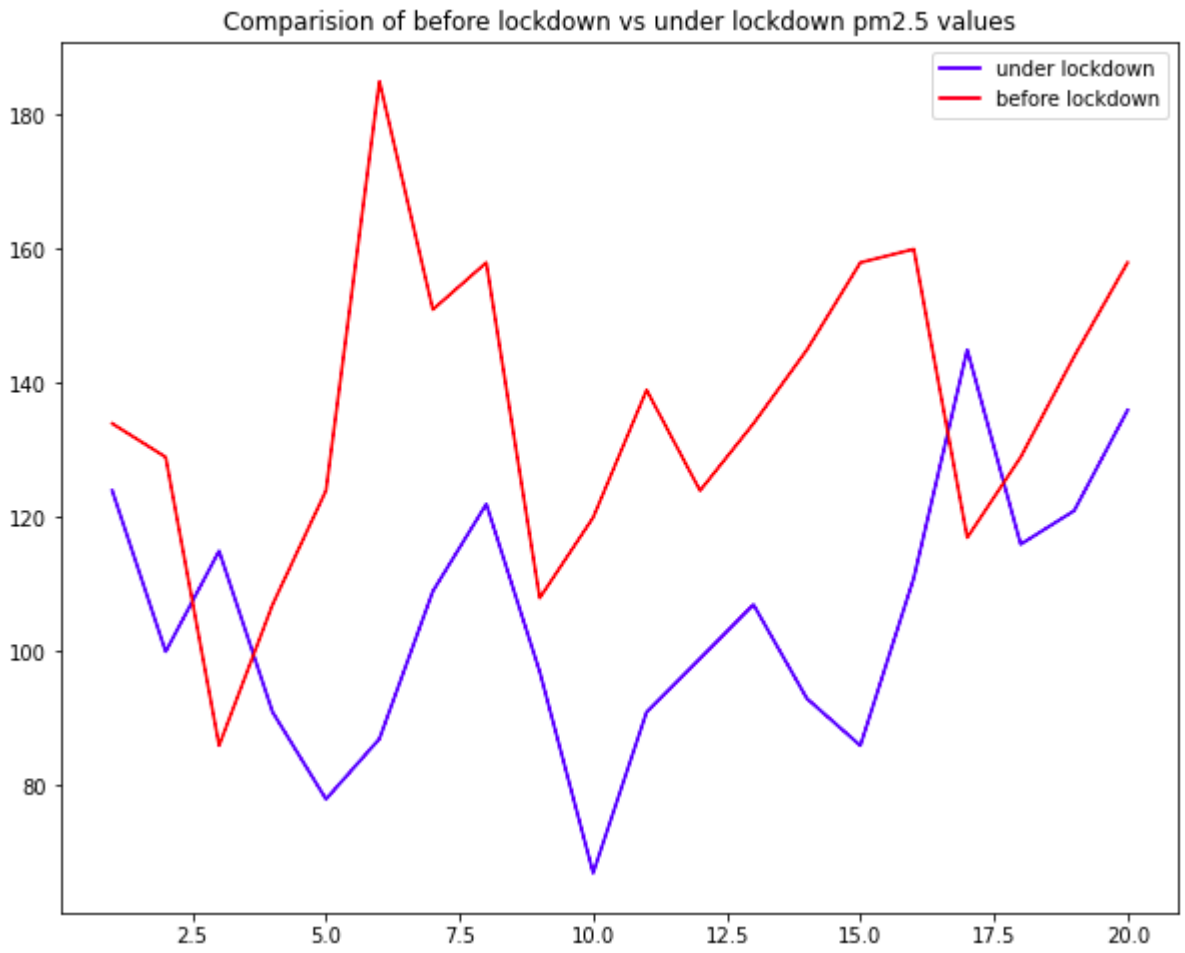


Figure 4.10: Different Times Air Quality

4.8 Implementation Requirements

- We implement our system by using LSTM algorithm.
- We use Python 3.6 for implement the application.
- Google colab is used here.
- We also use Cartopy to build our project.
- Using RNN to train the dataset.

CHAPTER 5
CONCLUSION AND FUTURE SCOPE

5.1 Conclusion and Discussion

With the advancement of machine learning techniques, real-time air quality monitor and evaluation is desirable for future smart cities. Air is a very important asset for us now a days. Everyone have a right to have a safe air. Industries of our urban areas, motor engines has been polluting our fresh air. We should more careful to keep fresh our Air.

All through this project, a few models which can predict Pm2.5 levels and characterize them into various pollution groups were tested and their performance was effectively assessed. The exploratory data analysis and AI strategies executed for the prediction models uncovered intriguing relationships among air and pollution information. We acquired a few eminent results from the prescient models that merit being examined.

5.2 Future Scope of Developments

- We have a motive to attach our system with the google map.
- Convert to mobile application.
- Accuracy will be improved.
- For air quality real-time data ingestion.
- GIS for air quality.

APPENDIX

Project Reflection:

This project “Air quality analysis and prediction of local area” will be very helpful for the people to be aware about the quality of air of current location. After knowing about the pollution of the current air people will be able to take the necessary steps to protect themselves from becoming sick. People also will be able to see the difference between past and present air quality. The system will be able to predict the future air quality based on the previous air quality dataset, which will make the people more benefited. Our main motive is to make peoples understand well about the air quality and its gruesomeness and how to get relief from it. Moreover, we humans are the main responsible for the air pollution. If we become careful for the air, the air will be more careful for us.

REFERENCES

[1] Humaib Nasir, Kirti Goyal, Dolonchapa Prabhakar, "Review of Air Quality Monitoring: Case Study of India", Indian Journal of Science and Technology, Vol 9(44), pp 1-7, November 2016

[2] Sheng Chen,Guangyuan Kan.,Ke Liang,Jiren Li, "Air Quality Analysis and Forecast for Environment and Public Health Protection: A Case Study in Beijing, China", Transylvanian Review, Vol XXIV , November 2016

[3] Gowtham. Sarella , Mrs. Dr. Anjali. K. Khambete, "AMbient Air Quality Analysis using Air Quality Index – A Case Study of Vapi", IJIRST –International Journal for Innovative Research in Science & Technology, Volume 1 ,Issue 10 , March 2015

[4] Waleed M. Sweileh, Samah W. Al-Jabi, Sa'ed H. Zyoud ,Ansam F. Sawalha, "Outdoor air pollution and respiratory health: a bibliometric analysis of publications in peer-reviewed journals (1900 – 2017)",Multidisciplinary Respiratory Medicine volume 13, Article number: 15 (2018)

[5] Ying Yan, Yuangang Li , Maohua Sun, Zhenhua Wu, "Primary Pollutants and Air Quality Analysis for Urban Air in China: Evidence from Shanghai", 2019

[6] Air quality data, available at <https://aqicn.org/city/dhaka/>, last accessed 09.01.2021 at 9:30pm

[7] Air quality data, available at <https://www.iqair.com/us/bangladesh/dhaka>, last accessed 08.01.2021 at 1:30pm

[8] Air quality data, available at <https://bd.usembassy.gov/embassy/air-quality-data/>, last accessed 09.01.2021 at 10:00pm

[9] Dhaka real time air quality data, available at <https://air-quality.com/place/bangladesh/dhaka/19c424f2?lang=en&standard=aqi_us>, last accessed 09.01.2021 at 9:30pm

[10] LSTM understanding, available at <https://colah.github.io/posts/2015-08-Understanding-LSTMs/>, last accessed 15.12.2020 at 9:00pm

[11] LSTM understanding, available at <https://en.m.wikipedia.org/wiki/Long_short-term_memory>, last accessed 06.01.2021 at 7:30pm

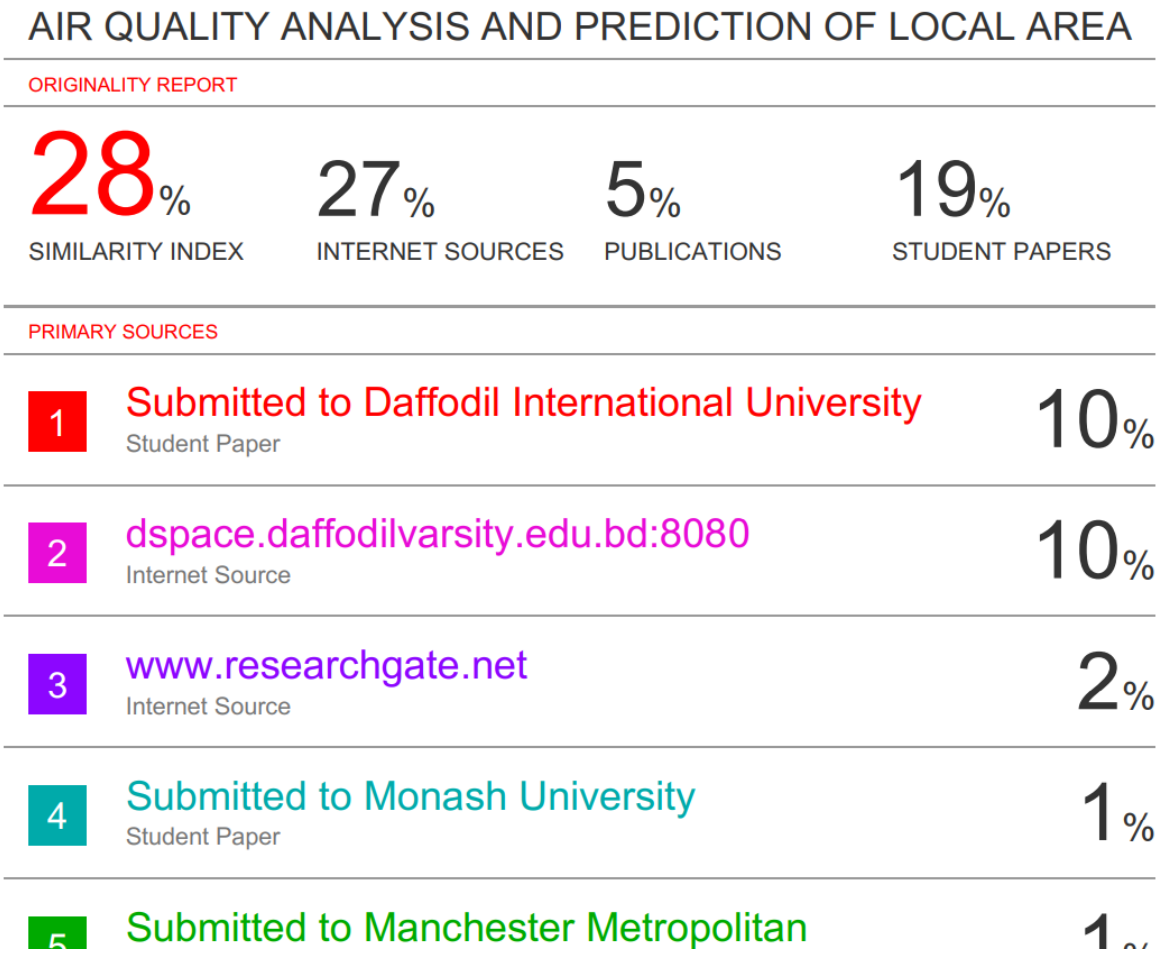
[12] LSTM understanding, available at <https://machinelearningmastery.com/gentle-introduction-long-short-term-memory-networks-experts/>, last accessed 05.12.2020 at 9:30pm

[13] Python data testing understanding, available at <https://towardsdatascience.com/train-test-split-and-cross-validation-in-python-80b61beca4b6?gi=67f4df90f819>, last accessed 05.12.2020 at 8:30pm

[14] LSTM deeper understanding, available at <https://machinelearningmastery.com/stacked-long-short-term-memory-networks/>, last accessed 05.12.2020 at 11:30pm

[15] Building and testing machine learning project, available at <https://developer.ibm.com/technologies/data-science/tutorials/build-and-test-your-first-machine-learning-model-using-python-and-scikit-learn/>, last accessed 05.12.2020 at 9:30pm

PLAGIARISM PERCENTAGE



AIR QUALITY ANALYSIS AND PREDICTION OF LOCAL AREA

ORIGINALITY REPORT

28%	27%	5%	19%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Daffodil International University Student Paper	10%
2	dspace.daffodilvarsity.edu.bd:8080 Internet Source	10%
3	www.researchgate.net Internet Source	2%
4	Submitted to Monash University Student Paper	1%
5	Submitted to Manchester Metropolitan	1%