

AQI Predictor

Final Year Project Proposal

Session 2016-2020

A project submitted in partial fulfilment of the
COMSATS University Degree
of
BS in Computer Science (CUI)



Department of Computer Science
COMSATS University Islamabad, Lahore Campus

30 July 2020

Project Registration

Project ID (for office use)						
Type (Nature of project)		<input checked="" type="checkbox"/> Development <input type="checkbox"/> Research <input type="checkbox"/> R&D				
Area of specialization		Artificial Intelligence and Machine Learning				
Project Group Members						
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Plagiarism Free Certificate

This is to certify that, I am Waqas Ahmad S/D/o Mukhtar Ahmad, group leader of FYP under registration no CIIT/FA16-BCS-047/LHR at Computer Science Department, COMSATS Institute of Information Technology, Lahore. I declare that my FYP proposal is checked by my supervisor and the similarity index is 7% that is less than 20%, an acceptable limit by HEC. Report is attached herewith as Appendix A.

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Name of Supervisor: Dr. Usama Ijaz Bajwa Co-Supervisor (if any): _____

Designation: Associate HOD/Assistant Professor Designation: _____

Signature: _____ Signature: _____

Approval of FYP Management Committee

Committee Member 1: Name: _____

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*Remarks: _____

Convener: Name: _____

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Project Abstract

The project, AQI Predictor, is basically an app to predict the quality of Air using pictures and a pre-trained model that works in conjunction with the app to further increase the accuracy of the predictions. Along with the app, a website will be created that will be synchronized with the app and the data that will be collected in order to show a map of the areas the AQI has been calculated for. This will help people in deciding which areas have what kind of air quality. The quality of air will be predicted by providing us a numerical value (Air Quality Index) which will further tell us more details such as if the air is harmful or good and how necessary precautions can be taken. These factors and results will help us and the authorities including the government and relevant governmental and other bodies decide certain measures to make the air quality better.

Introduction

Declining air quality index is a serious problem of the world, and many International Organizations have worked to mitigate the issues arisen by the Air Quality Index (AQI). Now in Pakistan, there is no application or software available which can judge the AQI of our environment and help us take specific measures. We have decided to build an app that can judge the AQI of the local area just by a picture. It is not only frugal but also user-friendly as compared to hardware-based solutions. Most of the hardware devices which measure AQI, they need prior knowledge of device to operate it and are expensive to purchase and operate.

The front end of our main system (the app) will be developed in Java using the Android SDK. It will have a simple interface that will give users the option to either capture a picture or use one from their gallery to process. The interface can, of course, be changed later on to add more features and sophistication. It will work in conjunction with the model and the database that will be linked to it at the backend. The app will then process the picture to calculate the AQI from the picture by handing the picture over to the model that's trained on the dataset we will have given it. The images will also be saved in our database, increasing the samples in our dataset for the model to be trained further for higher accuracy if required. The app will work on the principle of crowdsourcing. The users being the source for our constantly increasing dataset.

Coming onto the model, we will train the model using the concepts on Neural Networks. We will extract features from the dataset, and we will save it on our database. These features or set of features will be used to train the model. The model will train itself on this vast dataset and the predict specific values such as PM2.5, aerosol and any other relevant data which will help us in calculating the AQI through the app.

By getting the user's location, we can also tell the temperature as well as humidity level of that specific location by obtaining information from another source.

Secondly, we will make a website that will work in synchronization with all the data that the database at the backend. The site will be linked with our database. It will show all the data and results that will be calculated by the app, which can be useful for the average citizen or relevant government institutes/employees. The website will also embed a map

which will show the AQIs of different areas that have been predicted by the app. We will try to add as many features as we can.

This accomplishment will help the Government to tackle the areas and alleviate the problems of bad air quality by doing proper plantation or initiating a drive for plantation. Govt. can also hinder the working of factories which emit harmful chemicals in that area until air quality reaches a normal level.

Motivation and Scope

AQI (Air Quality Index) is a severe problem which is inevitably increasing, and with the increase of it, the effect of Global warming on the environment can be seen. Currently, on Government level, there is no policy being implemented to mitigate the problems occurring due to the worst quality of AQI. The Government of Pakistan at this level cannot get a fair idea that which areas need its special attention regarding the AQI or which areas are on severe threat of bad air quality. Our app will help to target specifically those areas where there is a need for proper plantation so that air quality can be made better, thereby taking appropriate steps.

This project can help factories, governments and specific environmental organizations and NGOs in checking the air quality of various locations and taking concrete measures to make it better. Right now, we are limiting our scope to our country, Pakistan, but the scope can be increased. This application will help Pakistan Meteorological Department and other supporting authorities to determine in which area of Pakistan pollution is more and if it exceeds the bearable limit. This app will help the general public to take precautions in such regions where the pollution level is worse or beyond the limits.

Related Work

In Pakistan there's no mobile or web application that can tell the AQI of a place by just using a photo. Here are some related works from around the globe:

Air Visual [1] is a mobile application just takes PM2.5 from 6 to 7 different resources and tells the user PM2.5 value and AQI level of a specific city.

Air Cognizer [2] is a similar mobile application developed for India. Therefore it is not available in Pakistan.

There are a few research papers available on the internet which are relevant to our project. These research papers Estimation of the PM2.5 Pollution Levels in Beijing Based on Nighttime Light Data from the Defense Meteorological Satellite Program-Operational Linescan System [3] and Particle Pollution Estimation Based on Image Analysis [4] will help us understand the project in more detail. However, there is no physical implementation or relevant help available on the internet.

Goals and Objectives

Many countries have been affected by the poor quality of air that is the result of many external factors such as poor waste management, burning of various materials that harm the

air and excessive smoke produced by vehicles and factories, etc. There are no cheap solutions as to measuring and preserving the air quality.

Our main objective is to create an android app that will measure the AQI (Air Quality Index) just by taking a picture. A pre-trained model will be used alongside which will help the app in determining the air quality index by comparing it with the dataset the model will be trained on.

The app will function just by taking a picture and using it in the app for processing. The app will then use the model to process the picture, which will result in generating an AQI value.

This project will then help people to determine the AQI values of any location they want. The values with the location will then be uploaded to our server widen the dataset which the model is training on so even higher accuracy is achieved. This dataset will integrate seamlessly with the website as well as providing the site and its visitors with the live predicted values of wherever it's being used. This can later be used for many causes such as determining if the Air Quality of a specific area is harmful or not.

Software Development Life Cycle

We have chosen evolutionary model for our project. The reason for choosing this model is that we need to redefine our features and functions as we keep developing. The evolutionary model combines iterative and incremental model. We will divide our project into smaller, incremental developments. Then those small developments will be tested and checked if there are any issues. Then we will develop on top of these small developments which will, in the end, give us our complete projects with updated and latest features and functions as well as efficiency while addressing our issues along the way. We will keep updating (changing and adding new features) our project as we keep gaining more knowledge on how this project could be made better.

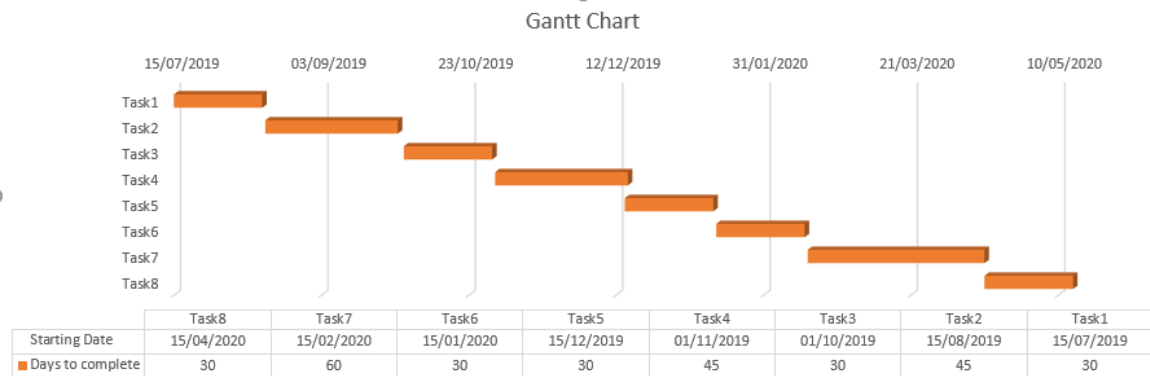
Individual Tasks

Although it's a group project of 3 members, but individual tasks are not so isolated, it's a team work, and we've planned to accomplish every task as team. But out of the cluster, our work flow plan includes:

- ✓ Research existing solutions
(everyone's participation required)
- ✓ Learning New Technologies
(everyone's participation required)
- ✓ Designing an Architecture of the System (E.g. Diagrams)
(everyone's participation required)
- ✓ Creating the front end
(everyone's participation required)
- ✓ Creating the back end (e.g. Training The model)
(everyone's participation required)
- ✓ Connecting Front end with back end
(everyone's participation required)
- ✓ Debugging
(everyone's participation required)

- ✓ Deployment
(everyone's participation required)

Gantt Chart



Sr No.	Task	Starting Date	Dates Complete to
1	Research existing solutions, Requirement gathering, Prioritizing the requirements	15-July-19	30
2	Documentation (Use cases, Sequence diagrams)	15-August-19	45
3	Gathering the data to train the model, Designing the Front-end	1-October-19	30
4	Development of interfaces	1-November-19	45
5	Training of the model	15-December-19	30
6	Integrating the front-end and back-end	15-January-20	30
7	Formal testing of application and the website	15-February-20	60
8	Deployment	15-April-20	30

Future Work

As of now, our project is going to be of an intermediate professional level which can predict AQI with reasonable accuracy that will be sufficient for our usage and will only use photos with natural light (day time) to predict results correctly. Our system will work accurately for Pakistan, which is the country we are making it in and for. In the future, it can be further enhanced by providing the model with a much larger dataset that includes various countries to train it further so it can work for those places too. It can also be enhanced in a way that the accuracy can be increased and can work at night time as well. This will increase the efficiency and effectiveness of this project in the

future. Furthermore, as our website grows in functionality and data that will be constantly collected, it will reach a much wider audience that can help us grow into a much larger and effective society — in turn, helping us open the doors for many more possibilities.

Tools and Technologies


The followings are web and technologies that we will use during our project

-  Android Studio
-  FireBase Database
-  Amazon EC2 Serve
-  jupyter notebook
-  Java
-  Python
-  HTML5
-  CSS
-  Bootstrap

1 References

- [1] AirVisual, “Air Quality || Air Visual,” 2019. [Online]. Available: <https://play.google.com/store/apps/details?id=com.airvisual&hl=en>.
- [2] AirCognizer, “Air Cognizer,” 2019. [Online]. Available: https://play.google.com/store/apps/details?id=com.bvpiee.com.airmirror&hl=en_US.
- [3] R. Li, X. Liu and X. Li, “Estimation of the PM_{2.5} Pollution Levels in Beijing Based on Nighttime Light Data from the Defense Meteorological Satellite Program-Operational Linescan System,” 12 May 2015. [Online]. Available: <https://www.mdpi.com/2073-4433/6/5/607/htm>.
- [4] C. Liu, F. Tsow, Y. Zou and N. Tao, “Particle Pollution Estimation Based on Image Analysis,” 1 February 2016. [Online]. Available: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0145955>.

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