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Pollution based Navigation System for Metropolitan Cities

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***Abstract*: Air pollution is to blame for several health issues within the urban areas. The urban air info free by the globe Health Organization in September 2017 according that city has exceeded the most PM10. Conveyance emissions and industrial activities were found to be related to indoor as well as outside pollution in city. The increasing traffic in urban sectors ends up in emission of harmful gases thereby increasing pollution levels which incorporates dioxide (NO_2), dioxide (SO_2), Carbon Monoxide (CO), Ozone (O_3), particulate.**

***Keywords*: Architecture, asthma, carbon monoxide, djikstra, ozone, pollution.**

1. Introduction

The world population in increasing every day and it is predicted to reach 7 billion by 2020. This will lead to a noteworthy rise in the number of vehicles on the road that in turn will lead to higher discharges of harmful particles into the atmosphere. The common particles emitted into the atmosphere are PM10, CO, Nitrogen Oxides and Ozone. Inhaling these particles will lead to respiratory problems such as asthma and other heart diseases. Soot, ozone, dust and sulfur oxides are a growing risk for billions of people around the world. The WHO reported that 93 percent of all children in the world breathe air with pollution levels that exceed their guidelines.

A. Pollution situation in metro cities

Indian cities are revolving under multiple problems, including environmental issues that they must struggle with. Most demanding of them all is the problem of air pollution. The citizens are forced to breathe poor air quality in heavily polluted cities which has a devastating impact on their health. In 2016, a World Health Organisation (WHO) study establish that fourteen of the twenty world's most polluted cities are in India.

1) Delhi

In Delhi, bad quality of air permanently damages the lungs of 2.2 million which is 50 percent of all children. Air quality index of Delhi is generally Moderate (101-200) level between January to September, and then it drastically deteriorates to Very Poor (301-400), Severe (401-500) or Hazardous (500+) levels in three months between October to December, due to various factors including stubble burning, fire crackers burning during Diwali and cold weather. In November 2017, in an event known as the great smog of Delhi, the air pollution spiked far beyond acceptable levels.

B. How pollution affect children

A baby which is exposed to a lot of air pollution even when it is inside the womb can lead to baby's lungs being destroyed. It can also lead to extremely low birth weight. and premature birth. Children are more vulnerable to breathing in polluted air than adults. Their airways are smaller and still developing. They breathe more rapidly than adults. Buggies and prams put them at the level of car exhausts and hand-held cigarettes.

Following are some risks that children are exposed to due to air pollution:

- Their lungs not working as they grow older
- Developing asthma during childhood or as an adult and if they have asthma already, air pollution can make it worse
- Wheezing
- Coughs
- Lung cancer when they're older
- Infections like pneumonia

C. Effects on adults

Headaches, coughs, fatigue, reduced lung capacity, lung cancer and even early deaths are the common effects of poor or bad air quality on adults.

D. Air pollution and similarity to smoking

Long-term exposure to air pollution, particularly ground-level ozone, is similar to smoking about a pack of cigarettes a day, a new study says, and it can cause emphysema similar to smoking. Studies stated that exposure to ground-level ozone could lead to a million more acute respiratory problems. Exposure to air pollution caused more than 107,000 premature deaths in the US in 2011 alone.

A sustainable lifestyle in an urban city-like environment is thus possible only through smart city style urban management for which we can use our system which uses pollution levels as an index to give possible routes to our destination.

2. Guidelines with implementation

The implementation of sensors is not an easy task. The sensor

allocation is based on the city's pollution level and composition. It is not an arbitrary allocation. A certain pollution index might be good enough for one city but might be too high for another. Also avoiding polluted areas is not always possible or feasible. Some routes are unavoidable in most cases or most cases but sensors can be placed for analysis. Apart sensor tech., we will need to make sure that the sensor is placed at a location that doesn't cause false positives. The sensor needs to be placed at a place that's at the best possible location, free from errors. For example, if a certain sensor starts detecting a small fire used by people for heat in winters, then it will give false positives. There is no pollution in such cases but because of the proximity of the heat source to the sensor, it detects high levels of greenhouse gases. This will cause a huge problem because it will render the system useless. To avoid this, locations need to be studied and it needs to be made sure that the area will not give false positives. A sensor can be placed on light poles (in the middle, not on the top), on traffic signals and similar areas which ensure that:

- The sensor doesn't generate false positives
- The sensor is actually in the zone of traveling
- Away from the reach of animals and troublemakers
- Has easy access to internet and electricity

The nexus of sensors depends on the internet connection therefore the concepts of IOT are a must. The communication can be ad-hoc or group leaders can communicate to the base. The communication part isn't much of an issue anymore because of the advancement of the technology. Easy internet access and sensor take has made the IOT integration much easier. Now let's talk about the sensors. The sensors currently in use are good enough to suit our purpose and some of them are- MQ-2 Gas Sensor, MQ-7 Gas Sensor, MQ-9 Gas Sensor, MiCS-2714 Gas Sensor (NO2), MiSC-2614 Gas Sensor (Ozone), Keyes DHT11 Temperature and Humidity Sensor, Shinyei PPD42 Particulate Matter Detector. These sensors are in general use today for detecting gases such as H2, LPG, CH4, CO, Alcohol, Smoke, Propane etc. A combination of these sensors is needed to review the pollution level. In general, the carbon, sulphur and nitrogen oxides are used to check pollution levels. Ozone is another polluting gas but it is not prevalent in INDIA.

A. Implementation

After the placement of the sensors, we will start taking inputs. The inputs will be punched in every 10 minutes. The values will be punched to the group leader and the group leader will punch the data to the cloud. The rest of the computation will take place in the cloud and the mobile app itself.

B. Algorithm

The proposed algorithm consists of a series of steps:

1. After collecting data, the sensors will punch the data to the cloud.
2. The cloud is connected to the mobile.
3. The cloud will send the data packets on the area the mobile app is requesting.
4. The mobile app will use the indexing done by the cloud. Here that depends on how much pollution is maximum or minimum that you are willing to tolerate, for example if you have a baby on board then the least amount of pollution is advisable.
5. After this, the app uses the data and segregates the data based on the ppm levels. Depending on the amount of pollution the user is willing to tolerate, the app will set the threshold of the ppm level.
6. After this, there can be two approaches, i.e, calculating the minimum distance yourself using Djikstra's algorithm by developing and app or using the google API.

Here using the google API is the better option because in the google API approach, we can instruct the google API to avoid certain points on the graph that the cloud has suggested and google can find the best possible route. This way, the highly polluted levels are excluded as well as we get the benefits of the best navigation system there is available.

3. About the Application

Since our project talks about shortest path, we can plan for Djikstra's algorithm for finding the path. Since, our main aim is to find the path which depends on 2 factors, firstly pollution and second distance. But, we are considering pollution as the main factor. Kepping that in mind, we are using MQ sensor for the colection of data related to pollution, that is carbon monoxide, etc. This data will be stored on the cloud using Thingspeak. We include the thingspeak header file in the arduino code and you should have a Mathworks account fo rusing Thingspeak like an API. On the thingspeak website, you have to log in or sign up with a Mathworks account and create a new application and enter the details as asked. After this you will get the API key for the application which you have to add in the arduin code.

After this to get the visual representation of the pollution in form of graph, download the thingspeak application from the play store and add the details of the same. Since, it is connected to MATLAB, you can easily get the plots as you want for further analysis. Now, if the data value from MQ sensor is greater than the threshold it will be rejected and alternate path will be checked. Using the combination of Djikstra's and MQ sensor pollution data, we are able to find a path which has less pollution and maybe less distant from some of the other paths available.

There can be an alternative to this application, which is by using Google maps api (Distance matrix API in particular). It is a service that provides distance and time for a matrix of start and end points.

This PI returns the information based on the recommended or the best route between the star and the end points, consisting of duration as well as distance values.

API request form:

https://maps.googleapis.com/maps/api/distancematrix/outpu

tFormat?parameters where output Format may be either of the following values:

* json
* xml

Distance Matrix Response Elements

- Status: contains metadata on the request
- origin_addresses: starting addresses
- destination_addresses: ending addresses
- rows: output array

The first step is to get the API key from google cloud platform console. Then create a project on the google's platform. Go to menu and select APIs & Services > Credentials. On this page click on create credentials > API key which creates the key.

Now you have to include an API key with every distance matrix API request.

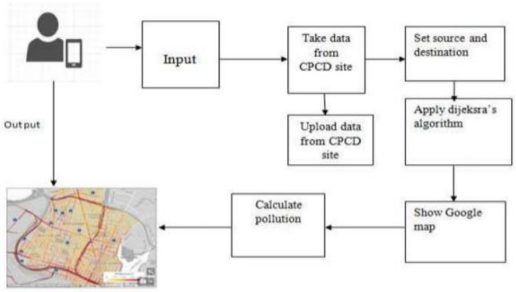

Fig. 1. System architecture

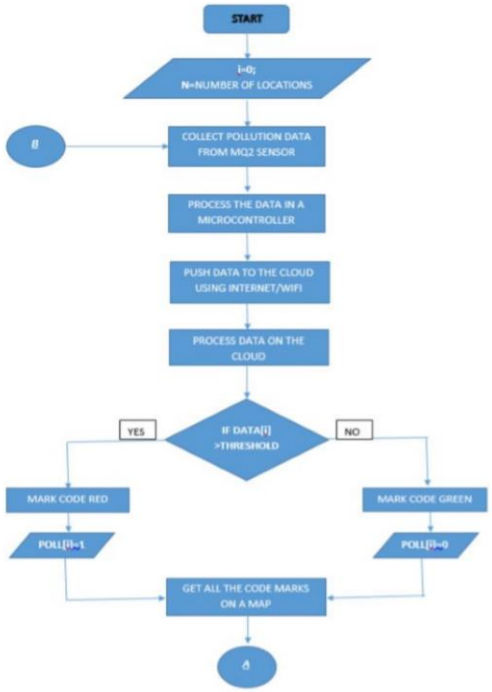

Fig. 2. Flow chart of proposed architecture

4. Conclusion

This paper presented an overview on pollution based navigation system for metropolitan cities.

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